Investigating consumer food waste decisions: a cross-country comparison between Thailand and the United Kingdom

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ABSTRACT

Food waste is increasingly recognized by policymakers worldwide to be an environmental, economic and food security priority where consumer decisions play a key role. Literature shows that there is uncertainty about consumer decisions to waste food which likely reflect trade-offs and economic incentives. Using the experimental vignette methodology, in an online stated survey, we investigated consumers' food waste decisions in developed and developing countries. Specifically, we examined and compared consumers' decisions to discard food in United Kingdom and Thailand during different eating scenarios which vary the presence/absence of other people during eating, place of eating, cost of the meal, amount of leftover food, and future meal plan. The results show that consumers both in the United Kingdom and Thailand are more likely to save food when eating at home, when the cost of a meal is high, and a full meal is left. Furthermore, while British consumers are more likely to save food when they have no meal plan for the following day, Thai consumers are more likely save food when eating alone. These findings have important implications and provide useful recommendations to policymakers and other stakeholders that aim to adopt FW reduction strategies.

Key words: Consumers food waste decisions; Eating scenario; Experimental Vignette methodology; Comparison; United Kingdom; Thailand.

1. INTRODUCTION

Food waste (FW) is increasingly recognized as an environmental, economic and food security issue which has recently received considerable attention particularly from policymakers and researchers worldwide (Koester 2017; Nikolaus, Nickols-Richardson, and Ellison 2018; Hamilton and Richards 2019; Ellison and Lusk 2018; Ellison, Muth, and Golan 2019; Aschemann-Witzel et al. 2017; Bellemare et al. 2017). Indeed, recent estimations indicate that around 30% of the total amount of food produced around the world is lost or wasted along the food supply chain by various supply chain stakeholders and consumers (FAO 2011; Gustavsson et al. 2011).

FW causes a large number of challenges in our society such as inefficient allocation of energy, land, chemicals and water resources (Hall et al. 2009; Loebnitz, Schuitema, and Grunert 2015), surpluses of food products (Reutter et al. 2017) which also indicates unequal food security status and hampers global food security (Buzby et al. 2011; Parfitt, Barthel, and Macnaughton 2010; Coleman-Jensen, Gregory, and Singh 2014; FAO 2011), contributes to environmental degradation (Buzby, Wells, and Hyman 2014; Nellemann 2009), causes larger greenhouse gas emissions (Isabelle 2014) and running costs of waste handling and food waste management in cities where food waste is a negative externality between close neighbors (Xiao and Siu 2018). It is largely accepted by a number of governments and their agencies that there is a necessity to introduce FW reduction strategies (Nikolaus, Nickols-Richardson, and Ellison 2018; Ellison and Lusk 2018) at the suitable points along the food supply chain (see Bellemare, Çakir, Peterson, Novak, & Rudi, 2017) also because since the global population is expected to increase, there is a need to reduce FW in hopes to decrease food prices and increase the amount of food available to consumers (Buzby, Wells, and Hyman 2014). Indeed, one of the key Sustainable Development

Goals (SDGs) stated by the United Nations aims to "*halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses*" by 2030 (United Nations 2015). Furthermore, FW is one of the priority areas included in the Circular Economy strategy of the EU (European Commission 2003).

FW is generated at the different stages of the food supply chain such as at agricultural production, post-harvest handling and storage, processing, distribution and consumption (Gustavsson et al. 2011). However, despite its importance, there remains uncertainty over the primary contributors of FW shared between supply chain stakeholders and consumers. Research indicates that in developed countries the majority of food waste occurred at the consumption stage (Aschemann-Witzel et al. 2015) while in developing countries food waste mainly occurs at the production stage (FAO 2011). In this respect, one of the key drivers of FW generation at the consumption stage is the level of living standards, where higher living standards are likely to generate more FW (Dung et al. 2014). Recent estimates indicate that per capita FW in developed and developing countries are respectively 107 kg/year and 56 kg/year (Dung et al. 2014). However, populations in developing countries are rapidly growing. People in these countries are adopting higher living standards and food consumption trends typical of Western countries (e.g. fast food chains, etc.) which are likely to raise FW also at consumption stage (Pinstrup-Andersen and Watson II 2011; Young 2012; Dung et al. 2014).

In terms of consumer behaviour, the decision to save or waste food could be framed as an economic decision depending on consumers' incentives, preferences, attitudes, habits and resource constraints (Ellison and Lusk 2018). FW decisions can be considered as the outcome of

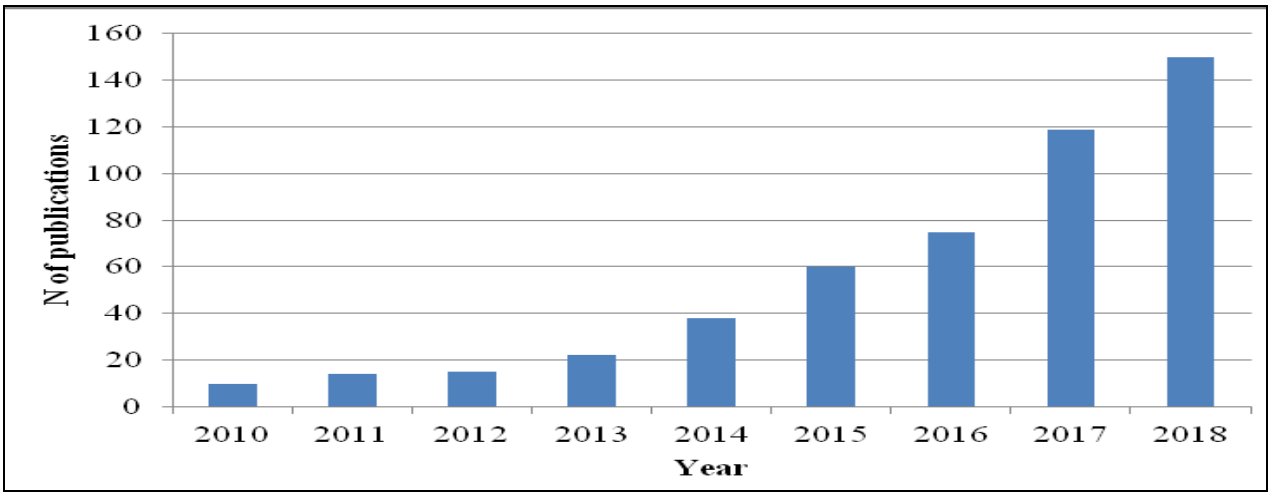
a trade-off between various factors such as for example, direct costs of FW (e.g. discarded food inputs) and costs of extra resources or efforts to avoid or reduce food waste (e.g. time spent to go to the supermarket or cooking time). Yet, economic analyses providing theoretical or empirical evidence about the impacts of food waste, mitigation measures or the associated costs and benefits, are scarce and mainly focused on developed countries. Recent studies (for example Diaz-Ruiz, Costa-Font, & Gil, 2018; Hebrok & Boks, 2017; Lorenz, Hartmann, Hirsch, Kanz, & Langen, 2017) have shown that there is a need for more socioeconomic research to provide suggestions and recommendations to policymakers and other stakeholders about FW reduction strategies (Jensen and Teuber 2018). While the precise measurement of FW quantity is important, investigating how consumer-specific economics factors influence FW decisions is should be a priority. Although research about consumer FW behavior is growing, most economic studies have been descriptive by investigating attitudes, motivations for wasting food with a focus on Western countries (Parizeau, von Massow, and Martin 2015; Neff, Spiker, and Truant 2015; Aschemann-Witzel et al. 2017). Therefore, there are few studies aimed at understanding how consumers make food waste decisions (Lusk and McCluskey 2018; Ellison and Lusk 2018), particularly in the context of developing countries (Soma and Lee 2011). In order to successfully reduce consumer FW, it is necessary to have a better understanding of the factors influencing consumer about perceptions and behaviors towards FW as well as the tradeoffs between these factors (Aschemann-Witzel et al. 2015). To our knowledge, there is only one study from Ellison & Lusk (2018) that treated consumer FW as an economic decision at the household level in the United States, while there are no studies that compare consumer FW decisions between developed and developing countries when focusing on “eating situations”.

To address this gap, we investigate and compare consumers' FW decisions related to leftovers from a fully prepared meal by conducting an online survey using the experimental vignette methodology (EVM) in the United Kingdom and Thailand. Our first contribution will be to determine how the decisions about waste food were affected by factors such the presence/absence of other people during eating, place of eating, cost of the meal, amount of leftover food, and future meal plan. Secondly, we compare consumer FW decisions between a developed and developing country (United Kingdom and Thailand).

2. CONSUMER FOOD WASTE: LITERATURE REVIEW

During the last decade the research on consumer FW has been accumulating at an increasing strong rate (Figure 1). For example, between 2016 and 2018, the number publications doubled (i.e. from 75 to 150)[1].

Figure 1 - Time trend of number of publications on the topic of 'consumer' + 'food waste'



Source: search for 'consumer'+ 'food waste' in Scopus (January 25, 2019).

[1] Own calculations based on a Scopus search for the terms 'consumer'+ 'food waste'.

In the current literature on consumer FW behaviour some main issues can be identified. First, research on FW is largely descriptive in nature (Ellison and Lusk 2018). A large part of the research on consumer FW is aimed at understanding consumers' behaviour, knowledge, awareness, psycho-social factors, attitudes and motivations (Stancu, Haugaard, and Lähteenmäki 2016; Porpino, Parente, and Wansink 2015; Graham-Rowe, Jessop, and Sparks 2014; Mondéjar-Jiménez et al. 2016; Russell et al. 2017). Second, the majority of the research has been conducted in Western countries (Pratesi, Secondi, and Principato 2015; Ellison, Muth, and Golan 2019; Russell et al. 2017; Bellemare et al. 2017; Nikolaus, Nickols-Richardson, and Ellison 2018) with only a few studies about developing countries (Stefan et al. 2013; Longo-Silva et al. 2013; Porpino, Parente, and Wansink 2015; Soma and Lee 2011). Lastly, recent research has focused on the effectiveness of different food policies initiatives to reduce food waste (Hamilton and Richards 2019; Schanes, Dobernig, and Gözet 2018).

In summary, the consumer FW literature to date has provided a broad understanding of consumers' knowledge, attitudes, motivations, and behaviours. However, there is a knowledge gap when it comes to understanding individual consumers' waste decisions as an economic decision and factors that determine these decisions.

In this study we aim to fill this gap by exploring the waste decisions regarding leftovers from a fully-prepared meal in a context where waste is clearly defined and where we can experimentally manipulate the variables of interest. We examine and quantify consumers' trade-offs between the factors that determine FW in the United Kingdom and Thailand.

3. MATERIALS & METHODS

3.1 The Experimental Vignette Methodology (EVM)

In order to investigate consumer FW behaviour, we applied the experimental vignette methodology (EVM). Similarly to conjoint analysis, EVM is a particular type of stated-preference experiment where participants are asked to evaluate (i.e. rate or choose) multiple hypothetical descriptions of objects such as product profiles, vignette[2] or scenarios that vary different attributes that are presumed to be important determinants of participants' decision making (Alexander and Becker 1978; Hainmueller, Hangartner, and Yamamoto 2015). EVM identifies the relative importance of each attribute in participants' decision making in predetermined contexts created researchers (Hainmueller, Hangartner, and Yamamoto 2015). EVM has its origins in the field of social psychology (Alexander and Becker 1978), but its application has been extended to economics (Kristensen and Johansson 2008; Epstein, Mason, and Manca 2008; Kapteyn, Smith, and van Soest 2007), marketing and management (Wason, Polonsky, and Hyman 2002), as well as food consumer studies (Hartmann et al. 2018; Ellison and Lusk 2018), and other sectors. We applied EVM because one of its key advantages is that vignettes – although hypothetical in nature - provide short concrete descriptions of a product profile, person or scenario that are considered to be the most important determinants of decision-making in a standardized way (Alexander and Becker 1978). Thus, the use of vignette facilitates the respondent's action, because it avoids that they have provide such information themselves. This is of particular importance in FW where it is difficult for respondents to estimate the amount of FW (Bellemare et al. 2017) and also because it is difficult to identify the criteria that consumers use when deciding whether or not food should be thrown out (Ellison and Lusk 2018).

[2] A vignette is defined as ''*a short, carefully constructed description of a person, object, or situation, representing a systematic combination of characteristics*''(Atzmüller & Steiner, 2010:128).

In this study we utilize a within-subject vignette design where respondents are presented with multiple vignette scenarios and asked to rank each scenario according to their likelihood to save/waste their leftovers from their meal.

3.2 Experimental design

The data used in this study are drawn from an online stated experimental vignette study conducted during Fall 2018 involving 417 consumers in the United Kingdom and Thailand using the online platform Qualtrics LLC (Provo, US). Consumers where randomly recruited by Qualtrics using sampling quotas in terms of age and gender equal for both countries for comparison. Consumers were informed about the opportunity to participate in a survey on consumers' food waste behaviour. Only consumers who were at least 18 years old and have British or Thai citizenship were included in the study.

Five attributes were used to describe the different eating scenarios, such as "presence", "place", "cost", "amount" and "plan" (Table 1). First, we included "presence" (meaning that if the consumer has a meal alone or with other people) since this may change the likelihood of a consumer wasting food. This is because the decision of waste/save food may have also a social component that may impact upon consumer's decision to save/waste food (Aschemann-Witzel et al. 2015; Stöckli, Dorn, and Liechti 2018). Two-levels of presence were specified: eating "Alone" or "With others". Second, we included the "place" where the consumer eats because the location of the meal might have an effect the likelihood of consumer decision to waste food as indicated by Ellison & Lusk (2018). Thus, two-levels of place either "Home" or "Restaurant" were reported. Third, we included the "cost" of the meal because it might have an effect on the

likelihood of the consumer's decision to waste food as indicated by Ellison & Lusk (2018). Thus, two-levels of "cost" were specified either "100 Bath/£6[3]" or "500 Bath/£30[4]". Fourth, we included the "amount" of leftover food after a meal because it could have an effect on the likelihood of consumer decision to waste food (Stancu, Haugaard, and Lähteenmäki 2016; Ellison and Lusk 2018). Thus, two-levels of "amount" were specified either a "Half meal" or "Full meal". Lastly, we included the "plan" (meaning that if consumers have already meal plan for the following meal) because it could affect the likelihood of consumer decision to waste food (Ellison and Lusk 2018; Stancu, Haugaard, and Lähteenmäki 2016). Two-levels of "plan" either "No plan" or "Plan" were included.

Table 1 - Attribute levels used in the study

ATTRIBUTE	LEVEL
Presence	Alone With others
Place	Home Restaurant
Cost	100 Bath/£6 500 Bath/£30
Amount	Half meal Full meal
Plan	No plan Plan

The selected attributes and their levels were then used to generate a 2^5 factorial design in balanced incomplete blocks that resulted in the creation of thirty-two scenarios (i.e. vignettes), which were then divided into four blocks of eight scenarios each in order to prevent respondents'

[3] The lower cost has been calculated as lower price for an average meal in both Thailand and UK. Bath is the currency for Thailand and £ is the currency for UK.
[4] The higher cost has been calculated as higher price for an average meal in both Thailand and UK. Bath is the currency for Thailand and £ is the currency for UK.

fatigue. The randomization of the scenarios (i.e. vignettes) was conducted within each block of the eight scenarios. The experimental design was creating using Minitab v. 17.0 (Minitab Inc.)

The basic vignette shown to respondents is provided below where participants are asked to rank each vignette from where 1 = the most likely to save the leftovers and 8 = the most likely to throw away the remaining dinner; variables that were experimentally varied across vignettes are in brackets:

> *"Imagine you have just finished eating dinner [alone/with others] [at home/out at a restaurant]. The meal costs about [100 ฿ (£6)/ 500 ฿ (£30)] per person. You're full, but there is still food left on the table enough for a [half/whole meal] lunch tomorrow. You [don't/already] have meals planned for lunch and dinner tomorrow"*

Upon completion of the task, the respondents were then asked to fill out a questionnaire in order to collect a number of the consumers' characteristics.

The questionnaire were designed in English. For UK consumers it was administrated in English. For Thai consumers the questionnaire was translated into Thai and back translated in English to ensure its quality and consistency. A pre-test involving 50 consumers was performed during the autumn of 2018 to test the survey.

4. ECONOMETRIC ANALYSIS

Prior to conducting a more sophisticated econometric analysis, we performed an analysis of descriptive statistics for the ranking data to provide a first overview of the results (Alvo and Yu 2014). Thus, we used mean rank to measure popularity of each eating scenario situation which

provides the information about central tendency of the ranking scores. The mean of the ranking score, *m*, of the i^{th} vignette situation (i = 1, 2..) is defined as follows:

$$m_i = \sum_{j=1}^{8} n_j v_j(i)/n$$

where v_j = all possible ranking scores from 1 to 8 of the i^{th} vignette situation n_j = frequency of rank j given by respondents for that i^{th} vignette situation n = number of observations ranking the i^{th} vignette situation.

Further, we performed the econometric analysis of ranking data by using the Rank Ordered Mixed Logit (ROML) to estimate the model (Boyd and Mellman 1980; Cardell and Dunbar 1980). This approach assumes that ranking options are formally equivalent to being able to choose the most preferred option from a set of options, then the second-best, third-best and so on, until the least preferred option is identified. Therefore, the ranking data are treated as being equivalent to a set of discrete choices in which the most preferred option is chosen from a set of options before being excluded from the possible choices, with the next one being identified as being the best from the remaining set and so on. Thus, ranking eight scenarios from the most likely to save food to the least likely to save food becomes equivalent to making seven discrete choices over decreasing sets of scenarios.

The ROML is a generalization of the Rank Order Logit (ROL) (Beggs, Cardell, and Hausman 1981; Chapman and Staelin 1982; Plackett 1975) in that it allows for each respondent to have

their own preferences (in this case marginal utilities), where it is assumed that the overall distribution of preferences has a known distributional form (e.g. it is normal). The ROML can be estimated in a classical way using Maximum Likelihood (ML) estimation providing the likelihood function can be accurately simulated and has a unique maximum. However, while the classical approach is straightforward for the ROL, it can be difficult and time consuming for the ROML should there be a large set of options to be ordered. The recovery of individual preferences (or marginal utilities) from the ROML can also be difficult using classical methods.

An alternative approach to the estimation of the ROML is the Bayesian approach which multiplies the "full data likelihood" by prior distributions for the parameters that govern the distribution of the latent marginal utilities, then using Monte Carlo Markov Chain methods to simulate the distributions of all parameters within the ROML including the individual marginal utilities. In this paper we used this approach.

Formally, we assume that the *jth* person *(j=1....,J)* obtains utility U_{ij} for the *ith* option *(i=1.....,8):*

$$U_{ij} = \beta_j^{'} x_{ij} + \varepsilon_{ij}$$

where ε_{ij} is the unobserved random error (independent across *i* and *j*) which is assumed to be extreme value (Gumbel) distributed. x_{ij} is a vector of observed attributes. β_j is unobserved latent marginal utility such that it has: (i) a mean vector β with precision matrix (inverse covariance matrix) Ω which is assumed to be diagonal; or, (ii) a mean vector that is a linear function of covariates *zj* β with precision matrix (inverse covariance matrix) Ω which is assumed to be

diagonal, and (iii) the prior distributions are then specified for β and Ω. For the results presented here it is assumed that β has a prior distribution that normally distributed with mean 0 and an identity precision matrix. The diagonal elements of Ω have half-normal priors.

Since ROML assumes that the total utility consumers derive from a scenario can be segregated into the marginal utilities given by the attributes of a scenario, the specification of the utility (*U*) function in our study can be defined as follows:

$$U_{ij} = \beta_{1j}\, PRESENCE_{ij} + \beta_{2j}\, PLACE_{ij} + \beta_{3j}\, COST_{ij} + \beta_{4j}\, AMOUNT_{ij} + \beta_{5j}\, PLAN_{ij} + \varepsilon_{nj}$$

where *j* person *(j=1....,J)* obtains utility U_{ij} for the *ith* option *(i=1.....,8).* PRESENCE is a dummy variable representing the presence/absence of other people during meal situations taking the value of 0 if the presence is "Alone" and 1 if it "With others". PLACE is a dummy variable representing location of the meal taking the value of 0 if the presence is "Home" and 1 if it "Restaurant". COST is a dummy variable representing the cost of the meal taking the value of 0 if the cost of the meal is lower (i.e. "100 Bath/£6") and 1 if the cost is higher (i.e. "500 Bath/£30"). AMOUNT is a dummy variable representing the amount of food left after the meal taking the value of 0 if the amount is "Half meal" and 1 if it is "Whole meal". Finally, PLAN is a dummy variable representing if consumers have/have not already meal plan for the following day taking the value of 0 if the presence is "No plan" and 1 if it "Plan". Finally, ε_{nj} is an unobserved random term that is distributed following an extreme value type I (Gumbel) distribution, i.i.d. over alternatives.

The model is estimated using Hamiltonian Markov Chain Monte Carlo (MCMC) (Neal 2011) as implemented by the STAN software. The code was provided by Jim Savage (Savage 2018).

5. RESULTS

5.1 Sample description: socio-demographics

Table 2 reports the summary statistics for the socio-demographics characteristics investigated (i.e. gender, age, household size, education, presence of people under 18 years old, area of growing up, area of living, employment and income) across the two countries. To check for significant differences across the groups, for the numerical variables (i.e. age, household size, education and income) we used the non-parametric Kruskall-Wallis test, while for the categorical variables (i.e. gender, presence of people under 18 years old, area if growing up, area of living and employment) we used the chi-square test. The results show that the hypotheses of equality of means between socio-demographics characteristics across treatments failed to be rejected at the 5% significance level for gender and age in according to our specific sample selection.

Thailand has larger families, higher education level, larger presence of people under 18 years old, growth up and living more in urban area, larger number of students and independent workers and are richer. On the other hand participants from UK have smaller families, lower education level, smaller presence of people under 18 years old, growth up and living more in sub-urban areas, larger number of public workers, retired and unemployed and are poorer.

Table 2 - Socio-demographic characteristics of the sample

SOCIO-DEMOGRAPHICS	UNITED KINGDOM (N=208)	THAILAND (N=209)
Gender Female	50.48%	50.72%

Male *Pearson chi2(1) = 0.0023* *Pr = 0.961*	49.52%	49.28%
Age 18-29 30-41 42-53 54-65 >66 *Chi-squared = 2.962 with 1 d.f.* *Probability = 0.0853*	 19.71% 27.40% 25.00% 21.63% 6.25%	 25.84% 21.05% 36.36% 15.79% 0.96%
Household size (n° member) 1-3 4-6 7-9 >10 *Chi-squared = 70.236 with 1 d.f.* *Probability = 0.0001*	 72.12% 26.92% 0.48% 0.48%	 32.06% 58.85% 8.61% 0.48%
Education Primary school Secondary school College Bachelor's degree+ *Chi-squared = 27.906 with 1d.f.* *Probability = 0.0001*	 1.44% 33.17% 34.13% 31.25%	 0.48% 22.97% 14.83% 61.72%
Presence of people under 18 in HH Presence Absence *Pearson chi2(1) =10.2508* *Pr = 0.001*	 37.50% 62.50%	 53.11% 46.89%
Area of growing up Rural area Sub-urban Urban area *Pearson chi2(2) =13.6779* *Pr = 0.001*	 25.96% 42.31% 31.73%	 28.71% 25.84% 45.45%
Area of living Rural area Sub-urban Urban area *Pearson chi2(2) = 39.9836* *Pr = 0.0000*	 22.60% 50.00% 27.40%	 11.48% 30.62% 57.89%
Employment Student Independent worker Private sector worker Public sector worker Retired Unemployed seeking work Not in paid employ not seeking work *Pearson chi2(6) = 63.2482* *Pr = 0.000*	 5.29% 6.25% 33.65% 23.56% 11.06% 8.17% 12.02%	 10.05% 28.71% 37.32% 13.40% 1.91% 2.39% 6.22%
Income* Less than £15,000 or 100,000 Bhat £15,000 - £24,999 or 100,000 – 199,999 ฿	 19.23% 19.23%	 8.61% 14.83%

£25,000 - £34,999 or 200,000 – 299,999 ฿	21.63%	10.05%
£35,000 - £44,999 or 300,000 – 399,999 ฿	12.98%	11.00%
£45,000 - £54,999 or 400,000 – 499,999 ฿	8.17%	8.61%
£55,000 - £64,999 or 500,000 – 599,999 ฿	3.37%	8.61%
£65,000 - £74,999 or 600,000 – 699,999 ฿	6.73%	4.78%
£75,000 - £84,999 or 700,000 – 799,999 ฿	1.34%	7.66%
£85,000 - £94,999 or 800,000 – 899,999 ฿	0.96%	8.13%
More than £95,000 or 900,000 ฿	0.48%	12.44%
Chi-squared = with 43.903 d.f.1		
Probability = 0.0001		
I don't know	1.44%	1.91%
Prefer not to say	4.33%	3.35%
Pearson chi2(1) = 0.3500		
Pr = 0.554		

*£ is the currency for UK. ฿ is the currency for Thailand.

5.2 Summary statistics of the vignettes

In this section we provide a first overview of the ranking data by showing descriptive statistics (i.e. mean ranking) of the vignette data. Within each block, each participant was presented with eight vignettes (i.e. thirty-two vignettes in total for the four blocks) in a randomized order, and they were asked to rank them from 1 (= the most likely to save the leftovers) to 8 (= the most likely to throw away the leftovers). Table 3 presents the mean ranking for each of the thirty-two vignettes for British participants. We notice that British participants were most likely to save the leftovers when eating with other people, from a meal cooked at home, when the meal cost £30 per person, when there were enough leftovers for a whole meal, and there was no future meal plan (mean ranking: 2.68). On the other hand, participants were most likely to throw out leftovers when eating alone from a restaurant, when the meal cost £6 per person, when there were enough leftovers for whole a meal, and there was a future meal plan in place (mean ranking: 6.03).

Table 3 - Summary Statistics of the vignettes in United Kingdom

VIGNETTE	MEAN RANKING[A] (STD. DEV.)	PRESENCE	PLACE	COST (฿)	AMOUNT	PLAN

20	2.68 (1.92)	With others	Home	30	Whole meal	No plan
28	3.216 (2.335)	Alone	Home	30	Whole meal	No plan
10	3.278 (1.947)	Alone	Home	30	Half meal	No plan
16	3.444 (2.062)	Alone	Home	30	Whole	Plan
27	3.588 (1.846)	With others	Home	6	Whole	No plan
2	3.600 (2.222)	With others	Home	30	Half meal	No plan
8	3.660 (1.944)	With others	Home	30	Whole	Plan
22	3.925 (2.235)	With others	Home	30	Half meal	Plan
4	3.960 (2.347)	Alone	Restaurant	30	Whole meal	No plan
30	4.000 (2.498)	Alone	Home	30	Half meal	Plan
12	4.019 (2.327)	With others	Restaurant	30	Whole meal	No plan
1	4.220 (2.393)	Alone	Home	6	Half meal	No plan
19	4.283 (2.460)	Alone	Home	6	Whole meal	No plan
26	4.333 (2.066)	With others	Restaurant	30	Half meal	No plan
18	4.377 (2.021)	Alone	Restaurant	30	Half meal	No plan
32	4.392 (2.011)	With others	Restaurant	30	Whole meal	Plan
21	4.491 (2.207)	Alone	Home	6	Half meal	Plan
15	4.593 (2.088)	With others	Home	6	Whole meal	Plan
24	4.755 (2.156)	Alone	Restaurant	30	Whole meal	Plan
7	4.800 (2.330)	Alone	Home	6	Whole meal	Plan
14	4.815 (2.216)	With others	Restaurant	30	Half meal	Plan
6	4.900 (1.972)	Alone	Restaurant	30	Half meal	Plan
9	5.019 (2.219)	With others	Home	6	Half meal	No plan
29	5.059 (2.167)	With others	Home	6	Half meal	Plan
11	5.130 (2.224)	Alone	Restaurant	6	Whole meal	No plan
25	5.392 (2.219)	Alone	Restaurant	6	Half meal	No plan
3	5.400 (1.969)	With others	Restaurant	6	Whole meal	No plan

5	5.460 (2.401)	With others	Restaurant	6	Half meal	Plan
23	5.623 (1.973)	With others	Restaurant	6	Whole meal	Plan
13	5.704 (2.246)	Alone	Restaurant	6	Half meal	Plan
17	5.868 (1.881)	With others	Restaurant	6	Half meal	No plan
31	6.020 (1.871)	Alone	Restaurant	6	Whole meal	Plan

[A] Indicates that vignettes were ranked such that 1-Most likely to save; 8-Most likely to throw out.

Table 4 presents the mean ranking for each of the thirty-two vignettes for Thai participants. We note that Thai participants were most likely to save the leftovers when eating with others, from a meal cooked at home when the meal cost 500฿, provided there are enough leftovers for a whole meal, and there were future meal plans (mean ranking: 3.098). In contrast, respondents were most likely to throw out leftovers when eating with other people, from a restaurant meal, when the meal cost 100฿ per person, with half a meal leftover, and there was a future meal plan in place for the following day (mean ranking: 6.020).

Table 4 - Summary Statistics of the vignettes in Thailand

VIGNETTE	MEAN RANKING[A] (STD. DEV.)	PRESENCE	PLACE	COST (฿)	AMOUNT	PLAN
8	3.098 (1.982)	With others	Home	500	Whole meal	Plan
28	3.273 (2.329)	Alone	Home	500	Whole meal	No plan
16	3.500 (2.183)	Alone	Home	500	Whole meal	Plan
20	3.667 (2.330)	With others	Home	500	Whole meal	No plan
24	3.686 (2.005)	Alone	Restaurant	500	Whole meal	Plan
10	3.712 (2.163)	Alone	Home	500	Half meal	No plan
4	3.725 (2.384)	Alone	Restaurant	500	Whole meal	No plan
30	4.164 (2.537)	Alone	Home	500	Half meal	Plan
18	4.196 (2.117)	Alone	Restaurant	500	Half meal	No plan

19	4.196 (2.341)	Alone	Home	100	Whole meal	No plan
27	4.200 (2.337)	With others	Home	100	Whole meal	No plan
6	4.216 (2.444)	Alone	Restaurant	500	Half meal	Plan
22	4.294 (2.129)	With others	Home	500	Half meal	Plan
2	4.373 (1.928)	With others	Home	500	Half meal	No plan
32	4.509 (2.098)	With others	restaurant	500	Whole meal	Plan
21	4.510 (2.194)	Alone	Home	100	Half meal	Plan
11	4.558 (1.994)	Alone	Restaurant	100	Whole meal	No plan
29	4.564 (2.551)	With others	Home	100	Half meal	Plan
7	4.627 (2.200)	Alone	Home	100	Whole meal	Plan
12	4.673 (2.415)	With others	Restaurant	500	Whole meal	No plan
14	4.750 (2.308)	With others	Restaurant	500	Half meal	Plan
9	4.846 (2.296)	With others	Home	100	Half meal	No plan
1	4.922 (2.226)	Alone	Home	100	Half meal	No plan
26	4.964 (2.000)	With others	Restaurant	500	Half meal	No plan
31	4.964 (1.866)	Alone	Restaurant	100	Whole meal	Plan
13	4.981 (2.397)	Alone	Restaurant	100	Half meal	Plan
15	4.981 (2.210)	With others	Home	100	Whole meal	Plan
3	5.020 (2.035)	With others	Restaurant	100	Whole meal	No plan
25	5.364 (2.031)	Alone	Restaurant	100	Half meal	No plan
23	5.706 (2.166)	With others	Restaurant	100	Whole meal	Plan
17	5.745 (2.171)	With others	Restaurant	100	Half meal	No plan
5	6.020 (2.015)	With others	Restaurant	100	Half meal	Plan

[A] Indicates that vignettes were ranked such that 1-Most likely to save; 8-Most likely to throw out.

5.3 Estimation results from the Rank Ordered Mixed Logit (ROML) model

The parameter estimates for UK and Thailand of the main effects using the ROML model are exhibited in table 5. There present the mean, standard error of the mean and the standard deviation of the marginal utilities across respondents. The "t-value" is simply the mean divided by the associated standard error. Strictly speaking this is a pseudo t-value because t-values and associated p-values are not calculated using Bayesian inference. Nonetheless, a t-value above 2 indicates that there is a very small mass in the posterior to the left of zero for the mean utility. Conversely, a t-value below -2 indicates that there is only a small mass in the right tail of the posterior for the mean marginal utility. Broadly speaking, this mirrors what is done in classical analysis.

The results show that in both countries participants have higher probability to save the leftover meal when they are having meal at home, the meal cost is high, and they have a full leftover meal. Looking at the magnitudes, place and cost are attributes that affect the likelihood to save/waste food the most. In addition, while UK participants have higher probability to save the leftover meal when have not plan for the following day, Thai participants have higher probability to save the leftover meal when they eat alone.

Table 5 - Parameter estimates for Rank Ordered Mixed Logit (ROML) model with vignette variables' main effects for the UK and Thailand

ATTRIBUTE	UNITED KINGDOM (N = 208)				THAILAND (N = 209)			
	Mean	SeM	Stdv	t-value	Mean	SeM	Stdv	t-value
Presence	-0.01	0.07	0.16	-0.20	-0.31	0.09	0.49	-3.50
Place	-0.78	0.13	1.15	-6.01	-0.46	0.09	0.57	-4.95
Cost	0.81	0.11	0.85	7.34	0.75	0.14	1.41	5.43

Amount	0.23	0.07	0.06	3.58	0.33	0.08	0.27	4.29
Plan	-0.31	0.07	0.20	-4.37	-0.09	0.08	0.32	-1.14

6. DISCUSSION & CONCLUSIONS

There is an increasing interest among policy makers about how to decrease food waste due to its environmental, economic and food security consequences. In this paper we investigated and compared consumers' FW decisions related to leftovers from a fully prepared meal by conducting an online survey using the experimental vignette methodology (EVM) in the United Kingdom and Thailand. We found some interesting results. First, we found that on average consumers are likely to save food when eating at home. This finding is corroborated by Ellison and Lusk (2018) which found that US consumers more likely save food when produced at home rather than at the restaurant. Second, we found that, on average, consumers are likely to save food when the cost of the meal is high. This finding is corroborated in two US studies conducted by Ellison and Lusk (2018) and Hamilton and Richards (2019). Third, we found that on average consumers are likely to save food when the amount of food left over is larger (i.e. whole meal) rather than lower (i.e. half meal). This seems sensible since both the higher economic value of the meal and the amount of food left for a full meal may incentivize consumers to save leftovers. Fourth, we found that while already having a future meal plan reduced British consumers' likelihood to save food, it did not substantively change Thai participants' behaviour. Lastly, while the presence of other people during meals reduced Thai consumers' likelihood to save food, it did not substantively influence British participants.

In summary, this study showed that the decision to save/waste during eating situations is, in part, an economic decision, with both costs and benefits. The likelihood to save/waste food depends on

several contextual factors. We also found that there are differences between consumer FW decisions when comparing UK and Thailand. Thus, for policy makers, in order to effectively reduce FW it is important to understand consumers' FW decision processes and the impact of contextual factors which should be targeted differently across countries. For example, in Thailand educational campaigns or effective communication at restaurants that inform consumers eating with others how to re-use leftover food once they bring food at home could potentially nudge consumers to save the leftovers. Another possibility is for the restaurant to provide discounts to consumers who take leftovers home or lowering prices to consumers who consume their entire meal could potentially nudge consumers reduce leftovers.

Future research should focus on considering further contextual factors effecting consumer decisions to save/waste food during eating situations. They might also increase realism by conducting experiments in field contexts (e.g. restaurants) and by have a greater focus on low income countries.

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Appendix A - The 32 scenarios from 2^5 factorial design in balanced incomplete blocks.

SCENARIO	BLOCK	ATTRIBUTES				
		PEOPLE	LOCATION	COST (£/฿)	AMOUNT	PLAN
1	1	Alone	Home	£6 (100 ฿)	Half meal	No plan
2	1	With others	Home	£30 (500 ฿)	Half meal	No plan
3	1	With others	Restaurant	£6 (100 ฿)	Whole meal	No plan
4	1	Alone	Restaurant	£30 (500 ฿)	Whole meal	No plan
5	1	With others	Restaurant	£6 (100 ฿)	Half meal	Plan
6	1	Alone	Restaurant	£30 (500 ฿)	Half meal	Plan
7	1	Alone	Home	£6 (100 ฿)	Whole meal	Plan
8	1	With others	Home	£30 (500 ฿)	Whole meal	Plan
9	2	With others	Home	£6 (100 ฿)	Half meal	No plan
10	2	Alone	Home	£30 (500 ฿)	Half meal	No plan
11	2	Alone	Restaurant	£6 (100 ฿)	Whole meal	No plan
12	2	With others	Restaurant	£30 (500 ฿)	Whole meal	No plan
13	2	Alone	Restaurant	£6 (100 ฿)	Half meal	Plan
14	2	With others	Restaurant	£30 (500 ฿)	Half meal	Plan
15	2	With others	Home	£6 (100 ฿)	Whole meal	Plan
16	2	Alone	Home	£30 (500 ฿)	Whole meal	Plan
17	3	With others	Restaurant	£6 (100 ฿)	Half meal	No plan
18	3	Alone	Restaurant	£30 (500 ฿)	Half meal	No plan
19	3	Alone	Home	£6 (100 ฿)	Whole meal	No plan
20	3	With others	Home	£30 (500 ฿)	Whole meal	No plan
21	3	Alone	Home	£6 (100 ฿)	Half meal	Plan
22	3	With others	Home	£30 (500 ฿)	Half meal	Plan
23	3	With others	Restaurant	£6 (100 ฿)	Whole meal	Plan
24	3	Alone	Restaurant	£30 (500 ฿)	Whole meal	Plan
25	4	Alone	Restaurant	£6 (100 ฿)	Half meal	No plan

26	4	With others	Restaurant	£30 (500 ฿)	Half meal	No plan
27	4	With others	Home	£6 (100 ฿)	Whole meal	No plan
28	4	Alone	Home	£30 (500 ฿)	Whole meal	No plan
29	4	With others	Home	£6 (100 ฿)	Half meal	Plan
30	4	Alone	Home	£30 (500 ฿)	Half meal	Plan
31	4	Alone	Restaurant	£6 (100 ฿)	Whole meal	Plan
32	4	With others	Restaurant	£30 (500 ฿)	Whole meal	Plan