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**THE SPARTA MODEL: AN ECONOMETRIC ANALYSIS OF
CONSUMER BEHAVIOUR UNDER RISK**

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The SPARTA Model: An Econometric Analysis of Consumer Behaviour under Risk ¹

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Abstract

This paper explores the role of trust in food safety information in determining consumer choice in relation to socio-demographic effects and other determinants. The complexity of factors influencing the way a consumer processes food safety information makes it difficult to develop adequate risk communication strategies. This is, however, a priority for current European policy and this paper tries to answer some key questions: (1) can the consumer be segmented into socio-demographic groups in relation to their trust in food safety information? (2) are country and cultural differences relevant in the way food safety information is processed? (3) how do risk perception and trust in food safety information influence food choice in relation to other determinants? (4) How does a food scare alter the weight of these determinants? (5) How do information sources differ in terms of how they impact on consumers' risk perception and behaviours? To provide some answers to the above questions, we propose a modelling framework which extends the Theory of Planned Behaviour to account for risk perception and trust and allows for country-specific effects. The model is tested on the impact of salmonella information on chicken consumption choices across five European countries, France, Germany, Italy, Netherlands and the United Kingdom, based on a nationally representative survey for a total of 2725 face-to-face interviews. Results show that although no relationship emerges between socio-demographics variables and the trust placed by consumer in food safety information, although country differences are relevant. The findings also suggest that the policy priority should be on building and maintaining trust in food and health authorities, and research institutions.

Keywords: *food safety information, trust, risk perception, Theory of Planned Behaviour, chicken*

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Introduction

There is considerable empirical evidence that different consumers respond to food risk communication in different ways. This implies that policymakers and food firms cannot rely on a single public information strategy for emerging food risks. Furthermore, the impact of food safety information varies significantly according to the sources who provide it.

Over the last decades the European market has been hit by multiple food scares which has led to the creation of the European Food Safety Authority (EFSA), with responsibility for establishing a rapid alert system and managing communication in the event of a food crisis. A growing body of research investigating the factors that determine consumer response has been developed to provide some scientific basis to the EFSA tasks. However, issues surrounding households' information processing and subsequent food choice in a situation of increased perceived risk – hence increased levels of involvement - are likely to be culturally specific and hence too varied to be applied at an EU level.

Background

The model introduced in this paper is based on the Theory of Planned Behaviour (TPB) (Ajzen 1985; 1991), a successful analysis tool for a range of behaviours, often associated with risky or health-related actions such as smoking, risky driving, physical activities and exercise, or contraception (see Conner et al., 2003 for an extensive list of applications). The TPB framework has also been applied to food choices, e.g. Cook et al (2002) investigate consumer attitudes to GM foods, while Dennison and Shepherd (1995) explore adolescent food choice. In another study which looks closely at the impact of information on consumer choice, McEachern and Schröder (2004) investigate the effects of value-based meat labelling on purchasing intentions. The implications of applying the TPB model to different countries are discussed in Kalafatis et al. (1999), who analyze the intentions of purchasing environmentally friendly products in the UK and Greece and find that their determinants have a different weight in the two countries.

The TPB framework, devised from the Theory of Reasoned Action (TRA), (Ajzen and Fishbein, 1980), defines human action as a combination of three dimensions, behavioural beliefs, normative beliefs, and control beliefs. Behavioural beliefs (i.e. beliefs about the outcome of the action), produce either a positive or a negative attitude towards behaviour; normative beliefs refer to subjective norms or perceived social forces (expectations of family members, colleagues and friends, doctors, religious organisations etc.); and control beliefs lead to perceived behavioural control (availability, price etc.). All these produce intentions to behave (Ajzen, 2002), a pre-determinant of behaviour.

Integrating risk perception and trust into the TPB framework and considering the influence of different individual (or household) characteristics leads to the development of the SPARTA approach. The acronym SPARTA comes from the initials of the global variables used to explain behavioural intentions:

- Subjective Norm (*S*)
- Perceived Behavioural Control (*P*)
- Attitudes (*A*)
- Risk perception (*R*)
- Trust (*T*)
- *Alia*¹, other variables, e.g. socio-demographics and cultural (country-specific) characteristics (*A_L*)

The interaction between these components can be expressed pictorially in figure 1. These variables were built by aggregating the questionnaire items according to the expectancy-value formulation by Fishbein and Ajzen (1976).

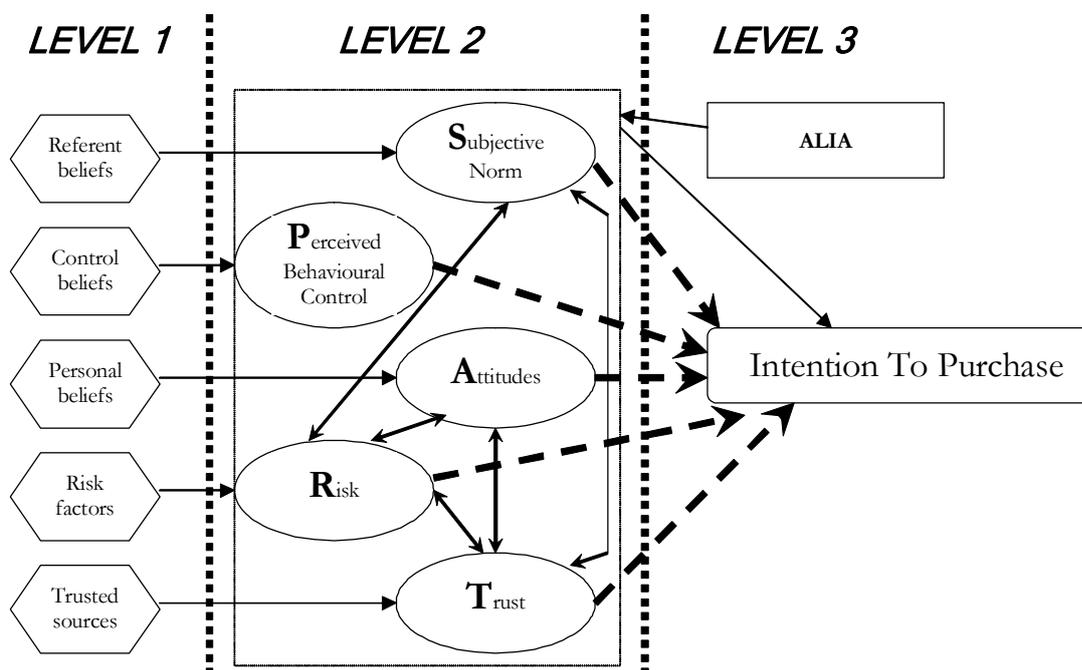


Figure 1. The SPARTA modelling approach

Chicken was chosen as the product to be investigated in the survey as it is a widely consumed food across Europe that is subject to a number of potential hazards but had not (at the time of the survey) been the subject of recent food scares. Hence chicken is expected to be representative of standard food safety issues and consumption behaviour.

The aim of this paper is to explore the complex interactions between the determinants of the SPARTA model, within a cross-cultural EU case study to investigate chicken consumption choices in two scenarios: (a) a 'standard' purchasing situation; and (b) purchasing following a hypothetical salmonella scare. The work should contribute to the policy debate on how to target consumers with accurate food safety information through examining whether:

- Social networks are equally important sources of information across EU countries

1. The term '*Alia*' is taken from the Latin meaning 'other things' – here referring to all other determinants e.g. socio-demographic variables.

- the level of trust that citizens have in institutions, the media, scientific bodies and other sources of food safety information differ across countries
- Consumers can be segmented and targeted according to demographic characteristics.

Applied studies based on the TPB have used a variety of methods for estimating the relationship between behavioural intention and its determinants. Most articles (e.g. Conner et al., 2003; Kalafatis et al., 1999) rely on structural equation modelling (Povey et al., 2000; Shaw and Shiu, 2002; Tonglet, 2001) or tobit regression when the data are censored (Lynne et al, 1995). Cook et al. (2002) base their estimate of a TPB model on an ordered discrete choice model. In this paper, given that behavioural intentions are measured with a 7-point Likert scale, standard multiple regression is not applicable; as the dependent variable is discrete, nominal, ordered and non-continuous, the ordered probit model is appropriate (Liao, 1994). This model belongs to the class of discrete choice probability models widely used in the analysis of attitudes, behaviours and choices and the likelihood of their occurrence. The ordered probit model is estimated by the BFGS (Broyden-Fletcher-Goldfarb-Shannon) maximum likelihood algorithm in the LimDep package. Other statistical methods employed within the overall SPARTA modelling strategy include simultaneous principal components analysis (see e.g. Duntemann, 1989) for obtaining the latent determinants of Trust and a cluster analysis to examine different groups of consumers¹.

The questionnaire was based on the SPARTA model specification and was designed following a set of four focus groups in each of five countries. The questions were built following the TACT (target, action, context, time) guidelines discussed in Ajzen (2002).

A nationally representative survey based on probabilistic area sampling was conducted in five countries (UK, Italy, Germany, the Netherlands and France) in May 2004 on a total of 2725 respondents via face-to-face, in-home interviews. A range of between 451 (Dutch) to 622 (French) consumers (depending on country size) were interviewed in each country. The sampling unit was the household and the respondent the person responsible for the actual purchase of food. The questionnaire took approximately 30 minutes to complete with 'prompts' on certain questions from the interviewer when required by the respondent. Data were subject to a 10% validation.

Results

It is important to note that the results presented below, although consistent, are a synthesis of results from a wider European Project and have been presented as such to help draw relevant policy conclusions².

1. Previous work using a simultaneous equations model was used to examine the issue of endogeneity (feedbacks) among the dependent variables. A consistent and asymptotically efficient estimate for the coefficients in this model is provided by three-stage least squares (3SLS). The model satisfies the order and rank conditions that ensure proper identification. A detailed account of these and indeed all results relating to the SPARTA model is available from the authors on request.

2. A detailed account of all project results is available from the authors on request.

Trust – a principal components and cluster analysis approach

The level of confidence in the information provided by different sources was measured by the following question: “Suppose that each of the following has provided information about potential risks associated with salmonella in food. Please indicate to what extent you would trust that information” and the answer was measured on a 7-point Likert scale from “completely distrust” to “completely trust”, where 4 is the neutrality point and explicit non-responses were allowed. Measuring hypothetical information means that few assumptions can be made relating to the content of that information, as a result it is assumed that there is direct association between the source and the content of the information that a consumer would receive. For example, consumer and environmental groups concentrate on negative information, the National Food Standards Agency and University scientists could be assumed to be objective while food producers, having a vested interest, concentrate on positive messages about the safety of food. These assumptions are corroborated by the results of the cluster analysis and the behavioural relationship with trust.

To aid potential policy relevance, a principal components analysis was used and suggests that there are five latent trust components, i.e. sources which tend to attract a similar level of trust (or distrust) across respondents. The rotated component matrix for these five components, all with eigen values larger than 1, is seen in Table 1. Interestingly, all mass media sources group together in the first component, while in the second one are found all food chain actors and product labels. The third component emphasises those sources that are expected to provide more technical and independent information. Governments and consumer organisations are also relevant to this component, although with a lesser weight compared to other authorities and scientists. The fourth component includes consumer organisations as well as animal welfare and environmental groups, and organic shops to a lesser extent. These groups may be thought of as ‘alternative’ sources of information. The fifth component is mixed and includes processors, governments, political groups and television advertisements.

Table 1. Principal components loadings for trust in food safety information

<i>Information source</i>	<i>T1</i>	<i>T2</i>	<i>T3</i>	<i>T4</i>	<i>T5</i>
Shopkeepers	0.12	0.81	0.11	-0.05	0.15
Supermarkets	0.17	0.74	0.17	-0.06	0.31
Organic shop	0.11	0.68	0.10	0.40	-0.05
Specialty store	0.20	0.74	0.08	0.25	0.03
Farmers / breeders	0.10	0.73	0.11	0.11	0.07
Processors	0.11	0.47	0.18	-0.04	0.59
Doctors / health authority	0.18	0.23	0.76	-0.01	0.04
University scientists	0.18	0.13	0.72	0.10	0.07
National Food Authority	0.14	0.16	0.79	0.12	0.21
Government	0.21	0.06	0.50	0.10	0.64
Political groups	0.28	0.09	0.19	0.28	0.74
Environmental organisations	0.21	0.13	0.18	0.83	0.15
Animal welfare organisations	0.18	0.12	0.10	0.84	0.16
Consumer organisations	0.30	0.11	0.52	0.51	-0.09

European Food Safety Authority					
Television documentary	0.67	0.12	0.22	0.13	0.10
Television news / current affairs	0.73	0.15	0.30	0.03	0.10
Television adverts	0.40	0.23	-0.02	0.06	0.60
Newspapers	0.75	0.15	0.16	0.13	0.13
Internet	0.63	0.04	0.13	0.17	0.25
Radio	0.79	0.16	0.18	0.15	0.07
Magazines	0.71	0.23	0.05	0.15	0.25
Product label	0.35	0.43	0.18	-0.03	0.12
<i>Component label</i>	<i>Media</i>	<i>Food chain</i>	<i>Expert</i>	<i>Organisations</i>	<i>Other</i>

A K-means cluster analysis (CA) on the principal component scores was deployed to identify homogeneous groups of consumers with respect to the level of trust in these sources. The number of clusters was previously identified by applying hierarchical (Ward) and non-parametric (density) methods and testing different partitions on the basis of the Pseudo- t^2 and Pseudo F statistics and the Cubic Clustering Criterion.

Table 2 reports the three identified clusters, together with some descriptive statistics for the socio-demographic variables and the distribution across the three clusters for each country. Since the principal component scores are standardised, a positive value implies a degree of trust above the sample average. The first group, “trusters”, includes those more inclined to trust virtually everybody, as shown by an average value of 5.64 for the aggregated trust index. Members of this group have a level of trust above the average for all groups of sources with the exception of mass-media, which is exactly at the sample mean level. Trust in this cluster is especially high for information provided by food chain actors. The second cluster is labelled “distrusters”, even though the average level of trust is at the neutrality level (4.04). On average, members of this group show a much lower level of trust towards information provided by experts and scores are below the average for all sources. The last cluster is mixed – “mixed trusters”. Respondents in this group tend to trust the food chain actors less but they do trust mass media and specifically experts at a level above the sample average.

Table 2. Cluster of sampled units according to their level of trust in food safety information (aggregate)

	<i>Trusters</i>	<i>Distrusters</i>	<i>Mixed trusters</i>	<i>Total</i>
Trust in information sources				
Mass Media	0.00	-0.36	0.30	0.00
Food Chain	0.60	-0.06	-0.83	0.00
Experts	0.33	-1.26	0.58	0.00
Alternative sources	0.32	-0.22	-0.28	0.00
Fiducia info soggetti interessati	0.36	-0.14	-0.41	0.00
<i>Average trust</i>	<i>5.46</i>	<i>4.04</i>	<i>4.64</i>	<i>4.85</i>
Socio-demographics				
Average age	42.71	44.43	41.88	42.90
Median income (€)	30k-50k	30k-50k	30k-50k	30k-50k
Median food expenditure (€)	75-120	75-120	75-120	75-120

Households with children below 16	38%	38%	37%	38%
Median education level	Higher sec.	Higher sec.	Higher sec.	Higher sec.
Median town size	<10,000 inhab	<10,000 inhab	<10,000 inhab	<10,000 inhab
Distribution by country (%)				
UK	47.8	33.3	18.8	100.0
Italy	42.1	29.9	28.0	100.0
Germany	43.2	20.6	36.2	100.0
Netherlands	44.1	15.3	40.6	100.0
France	45.9	29.2	24.9	100.0
<i>Total</i>	<i>44.4</i>	<i>25.6</i>	<i>30.0</i>	<i>100.0</i>

Using these trust clusters, one result is particularly striking: the three clusters are practically identical in terms of demographic characteristics. In other words, no links emerge between the level of trust in food safety information and socio-demographic variables. Instead, some difference emerges when looking at the cluster distribution across the five countries. The UK has the highest percentage of trusters and distrusters and the lowest of mixed trusters. The distrusters group is also relevant in Italy and France, and Italy has also the lowest portion of trusters. Germany and the Netherlands have high percentages of mixed trusters.

Prior to estimating the SPARTA relationships using the ordered probit model, two important stages took place, however, for the sake of brevity are not reported here: (1) global variables (*S, P, A, R, T*) are related to their specific determinants (beliefs, risk factors and trust in sources of information); (2) the level of interaction between the global variables is quantified.

The ordered probit model – an examination of intentions to purchase

The final phase of analysis consists of estimating the ordered probit equations relating purchasing intentions to the SPARTA model determinants. The model was estimated separately for the three clusters of respondents, previously identified, allowing for a country-specific intercept.

The behaviour of interest is purchasing fresh or frozen chicken in the week following the interview. Since the survey does not allow a check on actual behaviour, the intention to do so was measured on a 7-point Likert scale, from extremely unlikely (1) to extremely likely (7). Global variables such as attitudes, subjective norm and perceived behavioural control were elicited (a) directly through a seven-point Likert Scale anchored at the end-points with corresponding statements and, (b) indirectly through a set of specific questions to identify their sub-determinants (following previous research e.g. East, 1997; Cook et al, 2002). Questions measuring perceived risk were adaptations of previously used questions (e.g. Slovic, 1992), again posed as 7-point Likert scales. A second behavioural intention was included in the questionnaire to check for the impact of a food scare. The respondents were asked to state their purchasing intentions (again on a 7-point Likert scale) assuming that they had just discovered, by reading an article in the newspaper, that high rates of salmonella in chicken had been found in their area, leading to the hospitalisation of several people.

Both behaviours of interest were investigated, the standard likelihood of purchase and the likelihood of purchase conditional on news about a salmonella incident. Results are shown in Table 3.

Table 3. Determinants of purchasing intentions by aggregate trust segments

<i>Determinants</i>		Standard situation			Salmonella scare			
		<i>Non-trusters</i>	<i>Mixed trusters</i>	<i>Trusters</i>	<i>Non-trusters</i>	<i>Mixed trusters</i>	<i>Trusters</i>	
C	UK	-0.97	*** -0.39	-0.78	* -1.08	*** -0.32	-0.37	
	Italy	-1.22	*** -0.97	** -1.16	*** -1.49	*** -1.03	** -0.67	*
	Germany	-1.40	*** -0.86	* -1.15	*** -1.16	*** -0.61	-0.30	
	Netherlands	-1.36	*** -0.71	-0.89	** -1.20	*** -0.36	-0.61	*
	France	-1.46	*** -0.97	** -1.47	*** -1.14	*** -0.85	** -0.66	*
S	Subjective norm	0.02	0.03	0.02	0.09	*** -0.01	0.02	
P	Perceived behavioural control	0.11	*** 0.07	0.07	* 0.11	*** -0.02	-0.03	
A	Attitude	0.36	*** 0.32	*** 0.40	*** 0.13	*** 0.20	*** 0.20	***
R	Risk perception	-0.01	0.06	0.00	-0.03	-0.09	** -0.12	***
	Chi-square	142.45	*** 45.30	*** 94.71	*** 67.42	*** 54.49	*** 51.39	***
	Correct predictions.	0.32	0.27	0.33	0.43	0.44	0.36	
	Correct predictions. (three categories)	0.60	0.59	0.72	0.61	0.66	0.62	

*** Significant at the 1% level

** Significant at the 5% level

* Significant at the 10% level

In a standard situation, and holding other determinants constant, attitude is the main determinant for all groups and has a stronger effect on trusters. Perceived behavioural control has a lower impact, while subjective norm is not significant in any of the clusters.

More indications can be found by comparing the standard situation models with those assuming a salmonella food scare. If one considers the group of non-trusters, while most of the determinants (including intercepts) change only marginally, attitudes lose a major part of their weight, while the subjective norm becomes significant and almost as relevant as attitudes. This could suggest that in the case of a food scare, non-trusters, who rely on referent beliefs, are less likely to reduce consumption, emphasising the relevance of social networks, specifically for this group. For mixed trusters and trusters, the loss of relevance of attitudes is slightly less prominent, but risk perception has an increased impact. In fact, trusters and mixed trusters are on average less affected by the scare as compared to their non-trusting counterparts, especially if they have positive attitudes. The impact is more relevant for those who declare higher perceived risks even in the standard situation.

The fit of the models is acceptable and becomes relatively good if behaviours are classified into three categories (unlikely to buy, neutral, likely to buy) reaching values between 59% and 72% of correct predictions.

Discussion and conclusions

The complexity of factors influencing the way a consumer processes food safety information makes it difficult to develop adequate risk communication strategies. Given the frequency of food scares, this is, however, a priority for current European policy and for the actors in the European food chain. This paper tries to answer some key questions: (1) can the consumer be segmented into socio-demographic groups in relation to their trust in food safety information? (2) are country and cultural differences relevant in the way food safety information is processed? (3) do risk perception and trust in food safety information influence food choice in relation to other determinants? (4) does a food scare alter the weight of these determinants? (5) do information sources differ in terms of how they impact on consumers' risk perception and behaviours?

The empirical work discussed in this paper, based on a survey of 2,725 face-to-face interviews across 5 European countries, and on the theoretical framework of the Theory of Planned Behaviour (the SPARTA model), provides some answers. While the survey and the questionnaire focus on a single product – chicken – in order to guarantee consistency in consumer responses, we expect that the implications of the results can be extended to other food products and that the SPARTA model is also relevant to non-food products.

The first conclusion to be drawn is that no relationship emerges between socio-demographics variables and the trust placed by a consumer in food safety information. This finding appears to be robust as it manifests from both the segmentation analysis (consumers that differ in terms of sources they trust do not show relevant differences in terms of demographics) and the behavioural modelling (only a few socio-demographic variables are statistically significant and they are not consistent across countries). There are major implications for this outcome, as it would suggest that the impact of food safety information depends on the source and its reliability, rather than the individual socio-demographic characteristics of the consumer processing it. That is to say it is not possible for policy makers to target specific socio-economic groups within the community e.g. single mothers or people from disadvantaged backgrounds. It indirectly suggests the need to understand the psychological characteristics of different segments of consumers and to target them with different communication messages.

Results also show that risk perception is unlikely to affect consumer choices when there is no related food scare, but when there is a scare the intention to purchase is affected by differing levels of risk perception. Again, this depends on the trust characteristics of the consumer. Those who have less trust in food safety information, independently of the source, tend to be less sensitive to risk perception and rely more on their social network. Those who are most inclined to trust information from any source are the most sensitive to changing risk perception levels, but those who have a mixed trust attitude also react significantly to changing risk perceptions. These two groups have in common a relatively high level of trust toward experts (e.g. food standard, safety and health authorities, scientists) which gives these sources a key role in communicating risk and suggests that efforts to maintain and build further trust in these

sources is a fruitful way of avoiding at least some of the undesirable adverse consequences of a food scare¹. Interestingly, trust in expert information does not reduce risk perception for people who are classified as non-trusters.

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