Consumer Food Safety Risk Attitudes and Perceptions Over Time: The Case of BSE Crisis

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Abstract — **Recent research has shown that by decoupling the risk response behaviour of consumers into the separate components of risk perception and risk attitude, a more robust conceptualization and prediction of consumers' reactions to food safety issues is possible. Furthermore, it has been argued that the influence of risk attitudes and risk perceptions on consumer risk behaviour for contaminated food products can be used to formulate effective agricultural policies and strategies in case of a food crisis. The question arises whether or not the influence and magnitude of these risk variables changes over time and, hence, whether policies and strategies must be adapted. The BSE (mad cow disease) crises in the USA, Germany and The Netherlands in 2001 and 2004 provided us with a natural experiment to examine the relationship between risk attitudes and perceptions and behaviour over time. The results show that in some countries consumers risk behaviour changed, whereas in others not. These results are useful to policy makers and decision makers in food industry in developing more efficient supply chain management and public policies.**

Keywords— **consumer risk behaviour, food safety, risk attitude, risk perception, time**

I. INTRODUCTION

Recent food safety events have led to multiple market crises and produced varied consumer reactions worldwide. Consumers' behaviour has eroded by several food safety events which had a devastated impact on the demand of various food products such as beef and poultry, among others ([1]; [2]). Hence, the need to understand the drivers of consumer risk response to food-related crises that involve life-threatening design flaws is emerging. Knowing the drivers of consumer risk behaviour and how they change during a crisis may allow agricultural policy makers and the industry to make more informed decisions on how to develop supply management strategies to manage the crisis. Pennings, *et al.* (2002) [3] argued that by decoupling the risk response behaviour of consumers into the separate components of risk perception and risk attitude, a more robust conceptualization and prediction of consumers' reactions is possible. They examined the consumer reactions to the BSE crisis (mad cow disease) in United States (US), Germany and The Netherlands in 2001. Their results show that the relative influence of risk perception and risk attitude on consumers' reactions is different across these countries and that it depends, amongst others, on the accuracy of knowing the probability of being exposed to the risk. They suggest that while effective communication is effective for some countries, other countries require more extreme measures with respect to the beef supply (e.g., product elimination). However, risk attitudes and risk perceptions may change over time, because, for example, new information is released about the crisis and/or consumers become more familiar with the health risks associated to product-harm in a later phase than in the incipient phase of a product-related crisis ([4]; [5]). Furthermore, the influence of risk attitude and risk perceptions on behaviour may change over time during a crisis, which has consequences on the development of public policies and industry strategies. Here, we examine how risk attitudes and risk perceptions and their relative influence on behaviour changes over time and how that influences marketing strategies.

In this paper we use the same decision context as Pennings *et al.* (2002): the Bovine Spongiform Encephalopathy (BSE) crises in the U.S., Germany

and the Netherlands. In 2001, the BSE crisis was spread out in most EU countries including the Germany and The Netherlands, but it wasn't fanned out in US until the end of 2003. The BSE crisis caused consumer panic and disrupted substantially the meat markets worldwide (e.g.,[6]; [7]). The strong concern of consumers with the BSE is that contaminated food beef can cause Creutzfeldt-Jacob Disease (CJD) in humans. Although the chance of contracting CJD is very small, consumers' reactions to the information related to the BSE crisis have significant consequences in the beef production industry and international trade of agricultural and food products (e.g., [8]). Many governmental agencies (e.g., Economic Research Service USDA; Canadian Animal Health Coalition) have been heavily focused on the economic impact assessment of BSE crises on beef's and other meat prices and the effectiveness of a series of measures to safeguard health and restore confidence in beef (e.g., [9]), it has not been reported, however, how consumers reactions to the BSE crisis might have changed after the incipient phase of these demand shocks. Estimating consumer reactions at different phases of a market crisis may be of particular importance to the (food) industry and analysts, and stakeholders who weight the relative benefits and costs of being involved in the beef and cattle industry.

Our objective is to examine whether or not the influence and the magnitude of the separate components of risk response behaviour of consumers (i.e., risk attitude; risk perception; and their interaction) change over time (during different crisis phases). We utilize the data from Pennings, *et al.*, (2002) and collected new field data in 2004 in the US, Germany and the Netherlands. The remainder of the paper is structured as follows. First, we present our consumer behaviour model. Next, we discuss the research design and the results, and conclude with managerial implications and suggestions for further research.

II. CONSUMER RISK REACTIONS TO BSE CRISIS

The risk attitude and risk perception are two different concepts. The *risk attitude* reflects decision-makers' general predisposition to the risk content in a consistent way and the *risk perception* reflects consumers' interpretations of their chance of being exposed to the content of the risk (e.g.,[10]; [11]; [12]). Following Pennings *et al.*, (2002) and Lusk and Coble (2005)[12], we model consumers' reactions during a crisis as a function of risk attitudes, risk perception, and the interaction between them. Suppose that an individual consumer's von Neumann-Morgenstern utility at the phase t_1 of a product-related crisis depends upon wealth $U(W)$. Consumers' decision on whether to purchase a product is assumed to be based upon the gain in the utility anticipated from consuming the infected food product. At the phase t_1 individual consumers are confronted with specific information regarding the food safety event. Hence, the gain in utility associated with the consumption of the product is uncertain because safety-related issues are not known with certainty.

In Pratt (1964) [13] and Arrow's (1971) [14] work, risk management, reflected in the risk premium π, is a function of the risk attitude (risk aversion r), the base wealth (W) of the individual consumer and the risk perception (with a mean $\bar{\varepsilon}$ and σ^2 variance of source of additional wealth). The Pratt and Arrow's risk premium (π) determines the situation where an individual consumer is indifferent between holding the perceived risky asset or holding its mean value minus the risk premium. In formulae:

$$EU_{t_1}(W+\varepsilon) = U(W+\bar{\varepsilon}-\pi) \quad (1)$$

where EU is the expected utility of individual at the crisis phase t_1. Using Taylor series expansion around W, it can be shown that the risk premium π is equal to:

$$\pi_{t_1} = 1/2\sigma^2 r(W) \quad (2)$$

where $r(W) = -U''(W)/U'(W)$ is the Pratt-Arrow measure of absolute risk aversion. The Equation (2) illustrates that the risk premium of an individual consumer depends on risk attitude $r(W)$, risk perception σ^2, and the product between them. This framework implies that not only the risk attitude and risk perception, but also their interaction drives the behaviour of consumers.

Recent conceptualizations in consumer behaviour support that consumers may select different decision making strategies in different situations as the constraints of the situations and/or the knowledge

about a specific situation may change over time (e.g., [15]; [16]). This implies that when consumers' experience and knowledge may change over time, consumers become adaptive decision-makers and their decision making strategy may change. Hence, consumers' decision may vary from one choice environment to another. These implies that if consumers have a specific risk response to a product/service crisis due to their knowledge and experience of using such a product at the crisis phase, say, t_1, their behaviour may alter in the light of new information released and/or experiences at a later phase t_2. That is, the magnitude and influence of consumers' risk attitude, risk perception and the product between them may change during different crisis phases.

In this paper, we study consumer risk responses to BSE crisis in a dynamic behavioural context: from the crisis phase t_1 to t_2 by conducting empirical studies for different segments of the population (in different counties). From a policy perceptive, the insights that result from decoupling risk attitudes and risk perceptions in a dynamic - natural - decision context can yield important managerial implications for policy makers and industry decision makers at the different phases of a market crisis. That is, we consider the following three possible outcomes that may occur at the different phases (t_1, t_2) of the BSE crisis:

Outcome #1: Suppose that the risk perception drives consumer risk response at the crisis phase t_1. This would suggest that effectively communicating the 'true' probabilities of being exposed to risk (when available) will be a useful way to shape the consumers risk response to the BSE crisis at that phase. If at a later phase of the crisis, t_2, the influence of risk perception on consumer behaviour will decrease substantially, policy makers and managers should focus on other ways (e.g., gradual beef recalls) to decrease the uncertainty of the risk content inherent in the particular situation.

Outcome # 2: Suppose that risk attitude is the main driver of consumer reactions to BSE crisis at the crisis phase t_1. In such a case, the interest of policy-makers and managers should be centered to the identification of ways to eliminate the risk (e.g., a total recall of the product: testing and slaughtering all suspected cows) because even if the probabilities of being exposed to risk are small, effectively communicating these probabilities will have not any substantial influence on consumer behaviour. However, if at t_2 the risk attitude does not influence consumers' risk behaviour, the policies and industry strategies have to be adapted to the new conditions and these tough measures should be abandoned.

Outcome # 3: Suppose that the interaction of risk attitude and risk perception drives consumer decision to reduce their beef consumption at the crisis phase t_1. The solution in this case may rely on a combination of the solutions mentioned above: both tough policy measures and marketing strategies (e.g., product elimination) and effective dissemination of health information are required. If the relative importance of this factor on consumer decision diminishes at a later phase of the crisis, the emphasis of the marketing strategies has to be placed on influencing the consumer risk attitudes or risk perception, depending on which factor's relative importance is higher.

III. RESEARCH DESIGN

To address our research objective, we used a between-subject research design to examine the risk reactions of consumers to the BSE crisis in Germany, The Netherlands and US at two different crisis phases: 2001 and 2004. The first data was collected during the first two months of 2001. The BSE was spread out in the Netherlands and Germany and several cases of infected cattle have been reported. The consumption of meat in Germany decreased about 35% just after the BSE outbreak in the end of November in 2000 (GfK, 2001). At that time the USDA took several measures to protect US imports from contaminated countries and animal feeds. The second data was collected in the first two months of 2004 just after the BSE was also fanned out in US: December 23, 2003. Although the American popular media and press emphasized on the fact that BSE crisis hasn't set panic on American consumers (e.g., WSJ, 21/1/2004 p.12-D), US beef exports globally reached 461 million pounds in 2004, or 17% of the 2003 level of 2.523 billion pounds, creating a serious problem for the US beef industry and food supply chain that realized losses of about $ 4.0 billion [17].

Table 1: Cross country differences in knowledge about CJD and beef consumption

	United States		*Germany*		*Netherlands*	
	2001	2004	2001	2004	2001	2004
What do you think contracting CJD from eating beef will do to you? [a]						
• I would die; there is not treatment	24.1%	26.5%	58.7%	48.5%	58.1%	35.1%
• I might die, but there is a glance and chance of surviving	31.5%	25.4%	19.5%	29.7%	17.8%	24.8%
• I would get very ill, and the illness would be chronically	19.4%	20.2%	9.7%	15.2%	15.3%	22.9%
• I would get ill, and will recover after some time	19.4%	22.0%	4.0%	4.3%	4.5%	13.2%
• I would feel ill, but would recover fast	5.6%	5.9%	8.1%	2.3%	4.3%	3.2%
What do you think is your chance of getting CJD of eating beef? (1=small; 9=large) [b]	2.92	2.39	3.42	3.22	2.77	2.56
Are you concerned with eating beef? (1=not concerned; 9= very concerned) [b]	3.74	3.55	6.27	4.93	3.80	2.44
Do you trust the information that your government provides? (1=do not trust; 9=fully trust) [b]	5.93	4.65	3.42	3.83	5.00	5.90
Do you eat less beef because of BSE contamination? [a]	17.8%	8.9%	58.1%	29.0%	22.9%	17.1%
By what proportion have you reduced beef consumption? [a]	54.6%	43.5%	77.7%	66.5%	56.4%	38.3%
Have you switched to other meat products and fish products? [a]	17.8%	16.7%	49.0%	31.9%	19.7%	9.6%

[a] The differences in knowledge; reduction of beef consumption; proportion of reduction; and switching to other substitutes, among countries were significant. The chi-square tests on the independence among countries resulted in p-values less than 0.03 in 2001 and 2004.

[b] The hypotheses that the means of these variables in each year (2001 and 2004) were equal was rejected at the 5% level using ANOVA.

The research design used in the 2004 field studies was identical to that one used in 2001 by Pennings *et al.,* (2002). The scales used in the field studies were consistent with the definitions of our two key-variables. Specifically, each scale used in the final surveys consisted of a 9-point semantic differential scale and included 3 items.[1] All measures, used in the field studies conducted in 2001 and 2004, had a reliable construct validity exceeding $a = 0.7$ [18]. The reduction in beef consumption since the BSE crisis was measured with a dichotomous variable (no-yes) and the consumer's knowledge was measured through a multiple choice question in which their knowledge about BSE and its consequences was tested. Consumers were contacted while they were shopping. A total of 298 Germans, 233 Dutch and 228 American consumers were interviewed in 2001; and 301 Germans, 326 Dutch, and 595 American consumers in 2004.[2]

IV. RESULTS

In this section we present the results regarding consumers' risk attitudes and risk perceptions with respect to beef consumption in each of the three countries and in both years. The findings show (see table 1) that Germans have reacted most strongly to the BSE crisis in both years than American and Dutch consumers. The reactions of Germans reactions have become milder in 2004 than in 2001 (e.g., the 58,7 % of German consumers in 2001 thought that if they contracted CJD from eating beef would die, whereas in 2004 the 48.5% of them thought that contracting CJD would lead to death). Although the reactions of German consumers have become milder in 2004 (e.g., concern with eating beef decreased from 6.27 in 2001 to 4.93 in 2004), they still remain stronger than the reactions of Americans and the Dutch. The milder reactions of Germans might due to the slight increase of their trust to the information that the German government provides (i.e., 3.42 in 2001 vs. 3.83 in 2004). Dutch consumer reactions follow similar patterns. Their reaction to BSE crisis has become milder over the crisis phases and their trust toward the information provided by the Dutch government has increased (5.00 in 2001 vs. 5.90 in 2004). In contrast, American consumers' trust toward the information provided by the US government has decreased (5.93 in 2001 vs. 4.65 in 2004). This decrease might be caused by the fact that the spread of the BSE crisis in US after December 2003 erode American consumers' confidence about governmental food safety policies.

These findings can be better interpreted by examining the risk attitude and risk perceptions of the consumers in the three countries in 2001 vs. 2004 by investigating the average sum score of the risk attitude and perception scales. The 9-point semantic scales for each variable were defined as follows. For the risk attitude scale, low values indicate low risk aversion (1 = relatively low risk aversion) and high values indicate high risk aversion (9= relatively high risk aversion). For the risk perception semantic scale: low values indicate that consumers perceive more risk (1 = relatively high risk perception) and high values indicate that consumers perceive less risk (9 = relatively low risk perception).[3] These two definitions imply that as the average sum-score of the risk attitude of consumers in each country increases, consumers become more risk-averse; and as the average sum-score of risk perception of consumers in each country increases, consumers perceive less risk. German consumers appear to be significantly more risk-averse in both years (risk attitude score of 4.40 in 2001 and 4.51 in 2004) than Dutch (5.04 in 2001 and 4.63 in 2004) and American (5.02 in 2001 and 5.05 in 2004) consumers. They also seem to perceive significantly more risk (risk perception score of 4.85 in 2001 and 6.0 in 2004) than US and Dutch consumers (scores of

[1] For the risk attitude scale we measured the following three items: (1) For me eating beef is worth the risk ("strongly disagree" to "strongly agree"); (2) I am "not willing to accept" to 'willing to accept" the risk of eating beef, and 3) I do not accept the risks of eating beef ("strongly disagree" to "strongly agree"). The measures of risk perception consisted of the following three items: (1) When eating beef, I am exposed to "much risk" to "not much risk", 2) I think eating beef is risky ("strongly disagree" to "strongly agree", and 3) For me, eating beef is … "risky" to "not risky".

[2] The average age of consumers ranged from 42 years in The Netherlands to 45 years in Germany in 2001; and 38 years in US to 47 in Germany in 2004. The percentage of women in the three samples ranged from 51% in Germany to 60% in the US in 2004, and 51% in Germany to 62% in The Netherlands in 2004. Finally, the percentage of consumers interviewed that have children still living at home ranged from 16% in US to 60% in The Netherlands in 2001 and 30% in US to 46 in The Netherlands in 2004.

[3] All the corresponding items to each construct (risk attitude and risk perception) were recoded to the direction that the given definitions imply.

Table 2: Explaining consumer beef reduction with risk attitude, risk perception and their interaction in 2001 & in 2004

Did you reduce your beef consumption because of the BSE crisis? (0= I reduced it ; 1= I did not reduce it)										
	Nagelkerke's R^2		Corrected Classified Choices		Risk Attitude (RA) γ_1		Risk Perception (RP) γ_2		RA x RP γ_3	
	2001	**2004**	**2001**	**2004**	**2001**	**2004**	**2001**	**2004**	**2001**	**2004**
United States	51.7 %	45,1 %	84.9%	86,8 %	**-0.920*** (0.020)	-0.332 (0.125)	**1.291*** (0.000)	**0.732*** (0,000)	**1.460*** (0.002)	**0.445*** (0.005)
Germany	66.3 %	53.8 %	86.6%	83.7 %	**-0.549*** (0.021)	**-0.659*** (0.010)	**0.688*** (0.000)	**0.332*** (0.005)	0.294 (0.315)	0.155 (0.565)
The Netherlands	42.6 %	29,5 %	83.6%	92,%	-0.010 (0.996)	-0.514 (0,451)	**0.658*** (0.000)	**0.876*** (0.000)	-0.152 (0.542)	0.162 (0,565)

Note: An asterisk indicates that each parameter is significant at the 5% level in each examined year. The Nagelkerke's R^2 measures the proportion of variance of the dependent variable (reduction of beef consumption) about its mean that is explained by the independent variables ($\gamma_1, \gamma_2,$ and γ_3). The RA ranges from 1 (relatively low risk aversion) to 9 (relatively high risk aversion); the RP ranges from 1 (relatively high risk perception) to 9 (relatively low risk perception). Prior to the calculations, the interaction of RA x RP was calculated using the inverted range of RA responses so that the most pronounced risk-averse response assumed a value of (-4). The values of the recoded RA and RP were standardized before the calculation of their interaction (RA x RP) in order to avoid response biases. We performed a Chow test for the equality of parameters for each country in both years. The null hypothesis was rejected at 5% level for US (F = 25.6), 10% level for Germany (F = 3.9) and 25% for the Netherlands (F = 2.5).

6.28 and 6.54 in 2001 and 6.1 and 6.7 in 2004, respectively) but less risk than in 2001 (score of 4.85 in 2001 vs. 6.0 in 2004). Dutch consumers' risk perception became a bit milder during the crisis and American consumers risk perception slightly increased.[4] These results show some consistency in risk behaviour of different segments of the population over time and confirm Hofstede's (1980[19]; 1983;[20]) findings that Americans and Dutch are in the same segment with respect to their uncertainty avoidance whereas Germans are in another segment.

The question emerges how these combined variations in consumers risk behaviour across different countries influence consumer decision about whether or not to reduce beef consumption in the different phases of the product-related crisis wherein consumers are confronted with different information flows regarding the development of the crisis. Significant variations across countries were found in 2001 and 2004 by performing logistic regressions in which the decision of consumers in the three countries to reduce beef consumption is a function of their risk attitude, risk perception, and the product between them. Table 2 shows that the determinants of consumer risk behaviour (risk attitude; risk perception and their interaction) influence significantly (although in varied ways) the risk behaviour of consumers in the 3 countries in both years. However, the influence of the determinants as reflected by the absolute values of the regression coefficients, differ between both years. The behaviour of German consumers in 2001 and 2004 is driven by both risk attitude (γ_1 = - 0.549; $p < 0.02$ in 2001 and γ_1 = - 0.659; $p < 0.01$ in 2004) and risk perceptions (γ_2 = 0.688; p <0.00 in 2001 and γ_2 = 0.332; $p < 0.00$). Dutch consumers' decision to decrease their risk consumption is consistently driven only by their risk perception in both crisis phases (γ_2 = 0.658; p <0.00 in 2001 and γ_2 = 0.876; $p < 0.00$ in 2004). The risk attitude (γ_1 = - 0.920; $p < 0.02$), risk perception (γ_2 = 1.291, $p < 0.00$) and the interaction of risk attitude and risk perception drive (γ_3 = 1.155; p < 0.00) the American decision in 2001. However, in 2004 American consumers behaviour is driven only by their risk perception (γ_2 = 0.732, p< 0.00) and the interaction of risk attitude and risk perception (γ_3 = 0.445; $p < 0.00$). We performed a Chow test (see: Wooldridge, 2006, pp. 251-252; [21]) for testing the equality of parameters for each country in both years. The null hypothesis was rejected at 5% level for US (F = 25.6), 10% level for Germany (F = 3.9) and 25% for the Netherlands (F = 2.5). Therefore, these results demonstrate that, American and German consumers risk behaviour has changed over years, whereas Dutch consumers' behaviour has slightly changed.

To gain further insight into the dynamics of the influence of risk attitude and risk perception on consumption, we performed additional analyses that account directly for the effect of time. That is, we pooled our data from 2001 and 2004 per country and accounted for the impact of *Time* (T) and the interaction of it with each of our explanatory variables that hypothesized to influence consumer decision to reduce beef consumption due to BSE over time (Table 3). By performing such an analysis one can gain insights on whether consumers' risk behaviour in each country has changed between the two phases of the crisis and whether the magnitude of these changes are gauged with statistical significance, and, hence, influence the consumers' decision to reduce their beef consumption over time. The results show that time has indeed a significant effect on American and German consumer decisions (δ_4 =4.226, p< 0.001*; and* δ_4 = 2.448, $p < 0.014$) but not on Dutch consumers' behaviour. They also demonstrate significant changes in the American consumers risk perceptions (δ_6 = - 0.559, $p < 0.029$) and the interaction of risk attitude and risk perception (δ_7 = -1.015, $p < 0.039$) and German consumers' risk behaviour (δ_6 = -0.374; $p <$ 0.046). These changes in the magnitude of explanatory variable regressors indicate the extent to which the time effect influences the risk behaviour over time. For instance, the statistically significant change in the magnitude of American consumers risk perception ($\delta_4 - \delta_6$ = 1 .291 - 0.559 = 0.732) shows that risk perception still influences consumer risk perception over time; however, its influence has decreased.

Further, we performed a joint test to see whether the subgroup of our explanatory variables interacting with the time effect explains the variation in the decision to reduce beef consumption. Thus, the subset

[4] The hypotheses that the means of the average sum scores in 2001 vs. 2004 were equal were rejected at the 5% level. For US and Germany and 10% level for the Netherlands.

Table 3: Explaining consumer beef reduction with risk attitude, risk perception and their interaction over time

Did you reduce your beef consumption because of the BSE crisis? (0= I reduced it ; 1= I did not reduce it)

			Risk Attitude (RA)	Risk Perception (RP)	RA x RP	Time (T)	RA x T	RP x T	(RA x RP)T
	Nagelkerke's R^2	Corrected Classified Choices	δ_1	δ_2	δ_3	δ_4	δ_5	δ_6	δ_7
United States	69.6%	86.3%	**-0.920***	**1.291***	**1.460***	**4.226***	0.588	**-0.559***	**-1.015***
			(0.020)	(0.000)	(0.002)	(0.001)	(0.192)	(0.029)	(0.039)
Germany	61.6%	85.6%	**-0.549***	**0.688***	0.294	**2.448***	-0.119	**-0.374***	-0.139
			(0.021)	(0.000)	(0.315)	(0.014)	(0.731)	(0.046)	(0.709)
The Netherlands	71.6%	88.6%	-0.010	**0.658***	-0.152	0.952	-0.504	0.218	0.314
			(0.996)	(0.000)	(0.542)	(0.412)	(0.510)	(0.226)	(0.342)

Note: An asterisk indicates that each parameter is significant at the 5% level over time. The Nagelkerke's R^2 measures the proportion of variance of the dependent variable (reduction of beef consumption) about its mean that is explained by the independent variables (γ_1, γ_2, and γ_3). The RA ranges from 1 (relatively low risk aversion) to 9 (relatively high risk aversion); the RP ranges from 1 (relatively high risk perception) to 9 (relatively low risk perception). Prior to the calculations, the interaction of RA x RP was calculated using the inverted range of RA responses so that the most pronounced risk-averse response assumed a value of (-4). The values of the recoded RA and RP were standardized before the calculation of their interaction (RA x RP) in order to avoid response biases. The dummy variable (time= T) is defined as 0 = 2001 and 1= 2004. The null hypothesis that the subset of regression coefficients of the group of variables interacting with the dummy variables is jointly equal to zero was rejected at 5% significance level for US and 10% significance level for Germany.

of these variables' regression coefficients is jointly assumed to be zero (see; Pindyck and Lubinfeld, 1996, pp.128-129; [22]). The null hypothesis that the time effect haven't had influenced the risk attitudes and risk perceptions of consumers was rejected at 5% level of significance for US and 10% level for Germany. This result implies that the effect of time influences the impact that risk attitudes and risk perceptions have on the components of consumer risk behaviour which is subsequently played out in changing consumer risk behaviour with respect to the BSE safety events over time.

V. CONCLUSIVE REMARKS

This analysis suggests different policy implications for different countries. In addition our results show that in some countries the relative importance of risk attitude and risk perceptions does not change over time and hence that in these countries agricultural policy makers and industry managers do not need to adapt their strategies. However, for other countries the relative importance of the risk variables does change, calling for different policies and strategies during the period of a crisis. For example in the US, the adoption of tough measures (e.g., testing and slaughtering all cows) is required in the first phase because risk attitudes drive consumption in that phase of the crisis. However, the implication of this policy only may not be effective in a later stage of the crisis because in the second phase of the BSE crisis both risk attitudes, risk perceptions as well as their interaction drive American consumers' behaviour. Hence in that phase of the crisis the solution has to rely on a combination of both tough policy measures and effective dissemination of health information (thereby influencing all the components of consumer risk behaviour). The importance of the change in the magnitude of American consumers perceptions over time (decreasing importance of risk perception on consumer behaviour) should be considered and adapt the use and development of communication strategies to the extent that is required. The same holds for countries such as Germany, where both risk attitude and risk perceptions drive behaviour over time. That is, not only the need of product elimination from the supply chain is suggested but also the establishment of effective information systems that will disseminate accurate information by the government, the industry and media is required but to a less extent than in the past. In contrast to US and Germany, the behaviour of consumer in The Netherlands is mainly driven by their risk perception in both phases of the BSE crisis, suggesting that communicating the true probabilities of contracting CJD is a sufficient policy tool during the various crisis phases.

The findings of the current study may provide guidelines and fruitful thought for further research on modeling consumer risk behaviour regarding food safety events over time. Our results indicate that consumer decision during the phases of a product-related crisis is a function of consumer risk attitude, risk perception and the interaction among them for different consumer segments. Future research on consumer over time may extend this framework, by modeling explicitly the extent and determinants of consumers' response behaviour from a specific decision environment to another subject to moderate or more severe information loads received by consumers at different phases of a crisis. Hence, policy makers and mangers may gain valuable insights on how consumer knowledge and decision making interacts and whether specific factors (i.e., lack and/or format of accurate information) may lead to consumer's adaptivity success or failure.

Two limitations of our research should be mentioned here. First, we tested the proposed conceptual model and we made relevant inferences by using a between-subjects research design. Although, the empirical investigation of consumer reactions to food -related crises that involves life-threatening design flaws over time by using a within-the-subjects design, seems difficult to be implemented – the events are unexpected and, hence, makes it difficult to gauge the same consumers in super market aisles during the phases of product-related crisis – is challenging. Such a research design may provide more precise information on how consumers' behaviour evolves and unfolds during the crisis phases. Second, we

conceptualized that consumers belong to specific market segments at country level. We indicated briefly the cross-cultural differences in trust and knowledge of consumers, but our theoretical and empirical analysis did not account for the influence of these factors on consumer risk behaviour. The heterogeneity in consumers' shopping and consumption habits (e.g., switch to substitute other meat products, the extent of involvement, etc) and/or psychological traits (e.g., trust and confidence to governmental agencies, etc) may also influence consumer reactions over time. Taking the heterogeneity of consumer into account is a challenging research task since one has to allow the magnitude and influence of the determinants of risk behaviour (i.e., risk attitude; risk perception and their product) to vary across different segments of consumers. Work is in progress to examine the impact of consumers' characteristics on the components of their risk behaviour food-related crisis over time.

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