CONSUMER REACTIONS TO H5N1 AVIAN INFLUENZA: THE TURKISH CASE

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Thesis Abstract

Elif Akben, "Consumer Reactions to H5N1 Avian Influenza:

The Turkish Case"

The purpose of this thesis is to analyze consumer reactions to the 2005-2006 H5N1 Avian Influenza (commonly known as "bird flu") outbreak experienced in Turkey. Specifically, we aim at identifying the factors which have an impact on whether consumers are concerned about the safety of poultry products they eat. We also analyze the factors which affect the decision to reduce poultry consumption both during and after the crisis. The data comes from a unique household survey (sample size: 961) constructed for this study. Our estimates reveal that the negative impact of the pandemic on the poultry sector could have been alleviated by first informing consumers about it. Second, campaigns can target consumers with higher income levels and those living in urban areas to help poultry demand to return to pre-outbreak levels. We also derive that the impact of government agencies on consumers is significant, but mostly in the post-pandemic period. Policies designed using these results can assist to decrease the negative impacts of future food scares, especially in emerging and transition economies.

Tez Özeti

Elif Akben, "H5N1 Kuş Gribine Tüketici Tepkileri:

Türkiye Örneği"

Bu tezin amacı Türkiye'de tüketicilerin 2005-2006 H5N1 Kuş Gribi salgınına tepkilerini ölçmektir. Hedef, tüketicilerin yedikleri beyaz et ürünlerinin güvenliği hakkında endişeli olup olmamalarını etkileyen faktörleri incelemektir. Benzer şekilde, kriz öncesinde ve sonrasında tüketicilerin beyaz et tüketimini azaltma kararına etki eden faktörler de incelenmektedir. Kullanılan veri bu çalışma için özel olarak hazırlanan bir hanehalkı anketinden alınmıştır (örneklem sayısı: 961). Model sonuçlarına göre, salgının beyaz et sektörü üzerindeki olumsuz etkilerini azaltmak tüketicileri bilgilendirerek mümkün olabilirdi. İkinci olarak, yüksek gelir grubuna ve kentte yaşayan tüketicilere hitap eden kampanyalar talebin kriz öncesi seviyesine dönmesinde etkili olabilir. Son olarak devletin tüketiciler üzerindeki etkisi anlamlıdır, fakat bu etki daha çok kriz sonrası için geçerlidir. Bu bilgiler ışığında hazırlanan politikalar, özellikle gelişmekte olan ülkelerde ileride karşılaşılabilecek benzer bir krizin olumsuz etkilerini azaltmakta faydalı olabilir.

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CHAPTER 1

INTRODUCTION

Recently, there has been a growing concern about food safety as a consequence of food scares, such as the outbreak of Bovine Spongiform Encephalopathy (BSE), also known as “mad-cow” disease, or the contamination of hamburgers and apple juice with the E. coli O157:H7 bacterium. The most recent example of these scares is the case of Avian Influenza (AI).

Avian influenza, popularly known as “bird flu”, is a highly contagious viral disease of birds, caused by type A strains of the influenza virus. There are almost hundreds of subtypes of avian influenza A viruses, but only four are known to have caused human infections: H5N1, H7N3, H7N7, and H9N2 (World Bank, 2007). In general, human infection with these viruses has resulted in mild symptoms and very little severe illness, with one notable exception: the highly pathogenic H5N1 virus, which has caused by far the greatest number of fatalities in humans.

Recent research indicates that the 1918 “Spanish Flu” virus; the cause of one of history’s most deadly epidemics, shares a number of similarities with the H5N1 virus (Taubenberger et al., 2005). Nevertheless, putting the 1918 incident aside, the first cases of human infection with the H5N1 virus were reported in the Hong Kong Special Administrative Region in China in 1997. The eighteen reported cases here resulted in six fatalities. The costs of the 1997 outbreak in Hong Kong are estimated as high as hundreds of millions of US dollars including knock-on effects (McLeod et

al., 2006). Following these incidents, human cases ceased after the rapid destruction of the entire chicken population in Hong Kong. But later on, in the February of 2003, two further human cases were confirmed in a family in Hong Kong. By mid-2003, the H5N1 virus had begun to circulate widely in poultry in South-East Asia. It quickly spread to eight countries to cause an outbreak unprecedented in its geographical extent. In December 2003, the first human cases associated with this outbreak were reported in Vietnam. Until mid-2005, avian influenza remained confined to South-East Asia, but then, the virus expanded its geographical range throughout several regions of Central Asia, Europe, Africa, and the Middle East.

The World Organization for Animal Health (OIE) reported that by the end of 2006, outbreaks of H5N1 infection had spread to domestic or wild birds in fifty-six countries (World Organization..., 2007). Over 200 million poultry died or were culled; with the largest declines occurring in Vietnam and Thailand, where they were equal to a loss of 15-20 percent of the stock of poultry (Brahmbhatt, 2006). Economic losses in the Southeast Asia poultry sector alone are estimated to be around 10 billion US dollars, and culling has cost the African poultry industry another 60 million US dollars (World Bank, 2007). By the end of 2006, 261 human cases including 157 deaths were reported to the World Health Organization (WHO) from 10 countries, including Turkey, which is the focus of this study.

The first case of the H5N1 virus in Turkey was reported on October 5, 2005. The outbreak was observed in a backyard flock kept in a sparsely populated area in Manyas district, Balıkesir province. This first outbreak was quickly contained with no signs of transmission to humans. However, later in January 2006, a widespread outbreak occurred starting in northeastern Turkey. As of mid-March 2006, the presence of the H5N1 virus was confirmed in 58 of Turkey's 81 provinces. As for

the first human case, it occurred in four children from a family in Doğu Beyazıt on January 5, 2006. In sum, twenty-one human cases of avian influenza with four deaths were reported by the WHO. Later on, experts confirmed that all the patients had a history of close contact with sick birds and therefore, and there was no indication of human-to-human transmission (WHO, 2006).

On August 2006, Turkey was cleared from the highly pathogenic avian influenza based on the OIE Animal Terrestrial Code classifications. However, this was not a complete end to the story, since at the beginning of 2007 further cases of AI were once more detected in poultry. Due to its geographical location for serving as a bridge between Asia and Europe, Turkey is on the migratory routes of wild birds which means that the AI outbreak is likely to repeat itself.

Overview of the Poultry Sector in Turkey

The poultry (chicken and turkey) sector is one of the leading sectors in Turkey's agricultural production. Around 12,650 broiler and 2,800 egg producer companies exist in this sector. Approximately two million people from the farm and meat production lines to marketing, transport, and distribution earn their lives within the poultry sector. Annual turnover of the sector was around 3-3.5 billion US dollars in 2004 (Akman, 2005).

The development of Turkish poultry has been marked by significant changes over the last thirty years. In the early 1970s, the sector consisted of small family managed companies with limited production capacity. In 1980s, the number of integrated establishments began to increase and in 1990s facilities at world standards have been established. The production, consumption and trade data about poultry

meat are presented on Table 1. As can be seen from the table, the production of poultry meat has increased continuously since 1990 with an annual average production increase of 14.4 percent. Production only declined in 1994 and 2001 in response to two major economic crises in the country. Turkey currently ranks 14th in the world in poultry production (Yalçın, 2007).

Table 1. Poultry Meat Production, Consumption and Trade in Turkey (1990-2005)

Years	Total poultry meat production (Tones)	Change in production (percent)	Per capita consumption (Kg/year)	Poultry meat exports (Tones)	Poultry meat imports (Tones)
1990	216,759		3.83	575	203
1991	238,764	10.15	4.15	278	589
1992	288,285	20.74	4.92	2,115	2,727
1993	368,668	27.88	6.15	1,014	77
1994	311,347	-15.55	4.91	12,228	1
1995	417,539	34.11	6.65	4,913	38
1996	553,540	32.57	8.62	9,520	65
1997	616,589	11.39	9.53	11,012	291
1998	622,150	0.90	9.43	12,481	31
1999	656,078	5.45	9.83	9,886	12
2000	752,382	14.68	11.09	10,439	1,446
2001	673,371	-10.50	9.59	24,417	211
2002	705,206	4.73	9.98	19,642	38
2003	853,345	21.01	11.88	25,055	62
2004	1,045,555	22.52	14.33	29,161	20
2005	1,063,795	1.76	14.11	44,774	252

Source: Besd-Bir (2006).

Currently, the majority of poultry meat is supplied by modern enterprises and the industry is dominated by vertically integrated firms (Yalçın, 2007). Their organizational structure is illustrated in Figure 1. Most of the integrated firms have their own breeder units, hatcheries, feed mills and slaughterhouses. They provide their contract farms with day old chick, feeds, veterinary products and even financial

credits if farmers wish. These inputs are transported to the contracted farm with the company owned vehicles. The firms have their veterinarians as well. The integrated broiler meat firms are organized under the name of “Besd-Bir” (Beyaz Et Sanayicileri ve Damızlıkçılar Birliği - The Poultry Meat Producers and Breeders Association). The association has forty-one member firms which accounted for about 90 percent of the total commercial poultry production in Turkey (Yalçın, 2007).

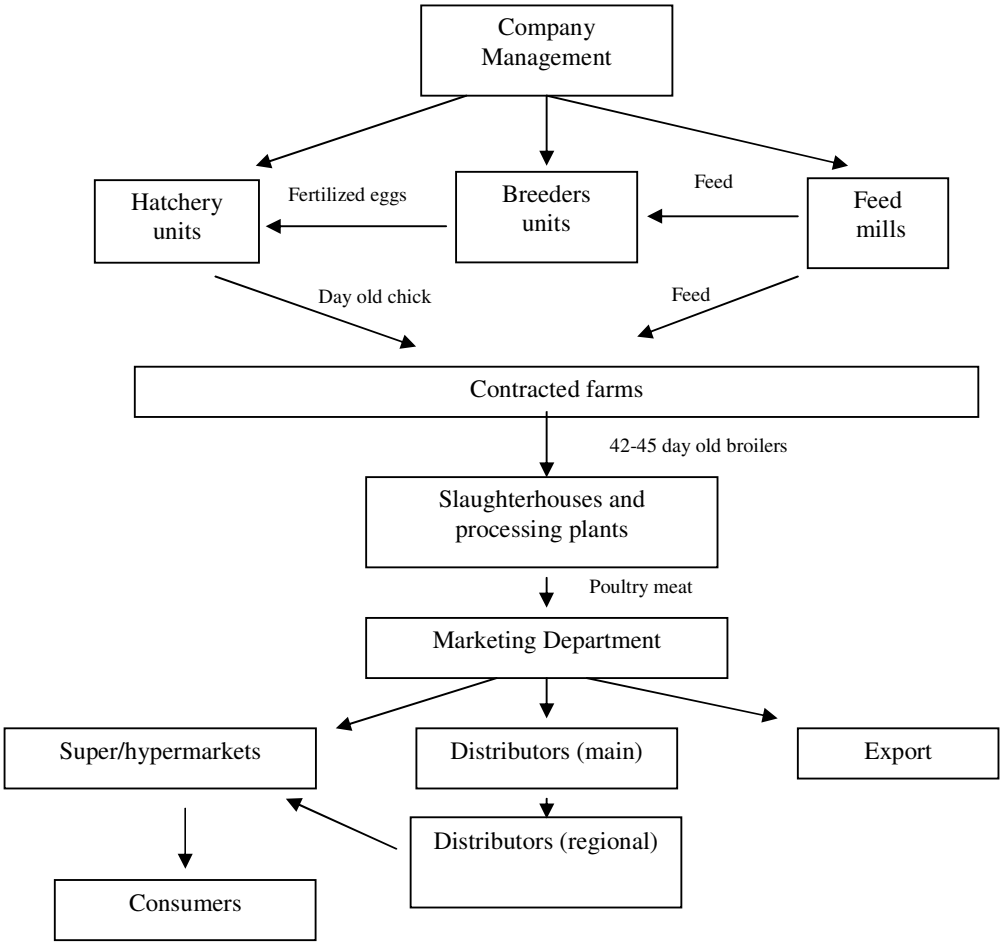

Fig. 1. Organizational structure of the integrated broiler firms in Turkey

Source: Yalçın, 2007.

The poultry sector has a strategic importance for the Turkish economy. Compared to red meat and fish, poultry meat is an inexpensive source of protein for consumers (see Figure 2). Fish consumption has historically been low for Turkish consumers. While red meat (cattle, sheep and beef) consumption has decreased throughout the last fifteen years, this has been balanced by the increase in chicken and turkey meat consumption (see Figure 3). Annual consumption per person, which was about 7 kg in 1990, reached to the levels of 14 kg per person in 2005. But despite the increase, the consumption in the country is still very low compared to the EU countries consumption (the ratio is around 1:2). World per person consumption numbers were 12.2 kg/year both in 2003 and 2004, with USA having 54 kg/year, and EU 23 kg/year in 2004 (Executive Guide…, 2003/4).

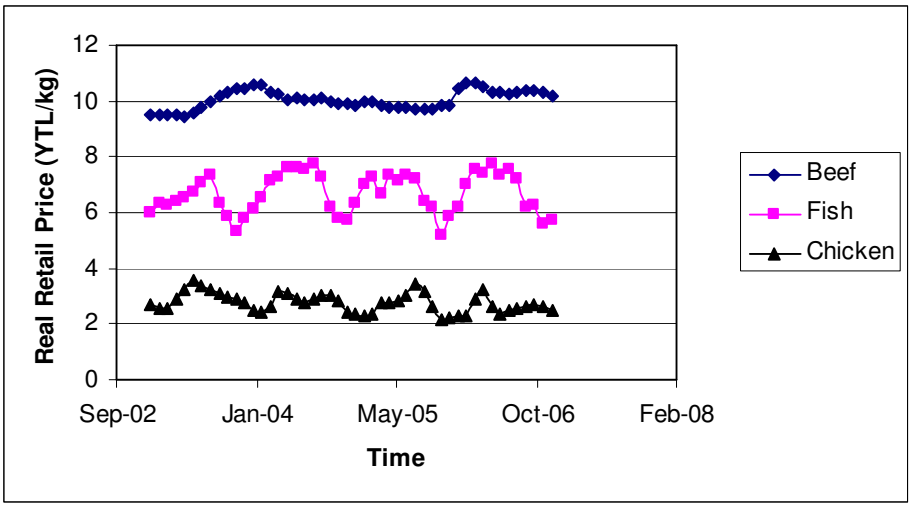

Fig. 2. Real retail prices for beef, fish, and poultry in Turkey (YTL/kg)

Source: Turkstat (2006) and author's own calculations.

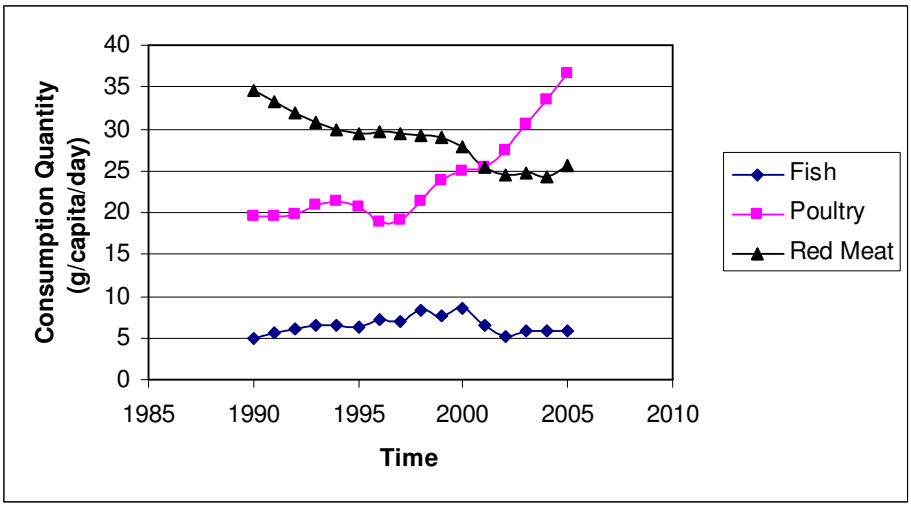

Fig. 3. Daily fish, poultry and red meat consumption in Turkey (g/capita/day)

Source: FAOstat (2006).

The Economic Impact of the Avian Influenza Outbreak on Turkish Poultry Sector

The biggest economic crisis for the Turkish poultry sector has been the 2005 AI outbreak. Right after the first avian influenza outbreak in Manyas, a 3 km protection zone was established around the district, and all backyard poultry (over 10,000 heads) within that protection zone were culled. The Ministry of Agriculture and Rural Affairs compensated for the financial losses of the affected farmers (EU, 2006). In addition, the flock of a size of almost 16,000 birds in the two commercial enterprises within the same protection zone was slaughtered. Besides the protection zone, a ten km radius surveillance zone was also established, which contained roughly 45,000 backyard poultry, and ten active poultry farms with a stock of over 130,000 animals. Measures taken in the surveillance zone included a ban on the

movement of live poultry, regulation of the transport of eggs, and prohibition of open market trade of poultry meat.

Despite these measures, the economic impact was still severe. Within two weeks of the outbreak, the consumption of poultry in Turkey, which was roughly 1.2 kilogram per capita per month before the crisis, dropped by 50 percent (EU, 2006). Retail poultry prices fell almost by 20 percent while the market capitalization of the traded Turkish poultry firms dropped by over 30 percent within the first week following the crisis (Sarnıç, 2006; Turkstat, 2006). This is partly due to the fact that Balıkesir and the nearby regions of Bursa, İzmir, Manisa, and Sakarya account for over 40 percent of Turkey's broiler enterprises and poultry production. Demand for eggs, where the production is also concentrated in the provinces stated above, fell from 12 eggs per capita per month by also 20 percent while the retail prices of eggs dropped by 22 percent (EU, 2006; Turkstat, 2006). Prior to the outbreak, the turnover of the poultry and egg sector was estimated to be around US$3 billion annually, but as a result of the outbreak, the poultry and egg sectors incurred losses of roughly 0.9 million US dollars per day within the October-December 2005 period (Besd-Bir, 2006; EU, 2006). In November 2006, real retail and wholesale poultry prices reached their lowest levels since the beginning of 2003, but this was not the case with the prices received by farmers.[1] Only in March 2006, the sector started to observe signs of recovery (see Figure 4).

[1] Retail prices used in the analysis have been deflated by the CPI, wholesale prices by the PPI, farmer prices by the Agricultural PI.

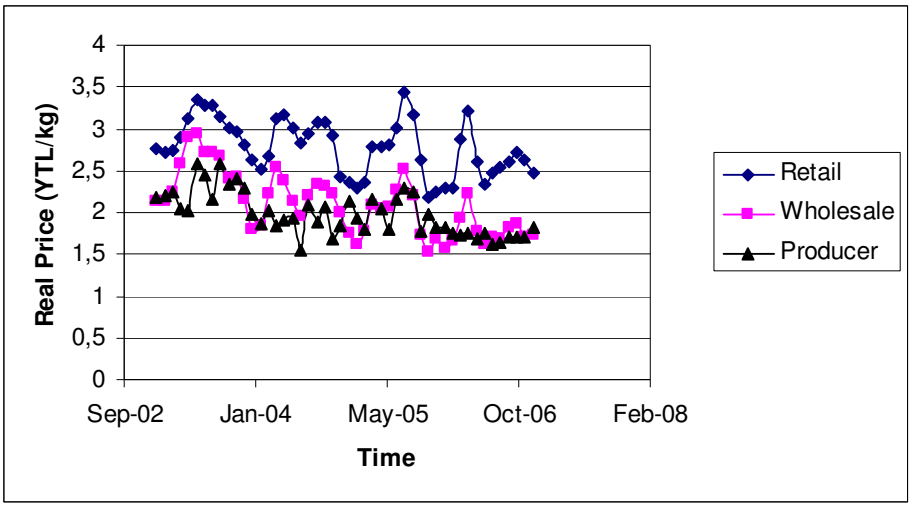

Fig. 4. Real poultry prices in Turkey (YTL/kg)

Source: Turkstat (2006) and author's own calculations.

Poultry producers estimated the worst scenario with shrinkage of the market resulting in a 50 percent decrease in demand and size. This amounted to a loss of 1-1.5 billion US dollars in 2006 while causing a job destruction of the size of 75,000 workers (Harmanyeri, 2006).

The international trade in poultry was also affected by the AI outbreak (see Figure 5). Whereas in 2004 Turkey exported 29,000 tons of poultry meat, by the end of October 2005, right before the outbreak, this number increased to 44,600 tons (Besd-Bir). However, with the outbreak, 18 of the 20 countries that had been importing from Turkey stopped their imports. The European Union, which was at the point of negotiating to start poultry meat imports from Turkey also postponed its decision (Özcan, 2006). Historically, Turkey's imports of poultry products have been practically zero (Akman, 2005).

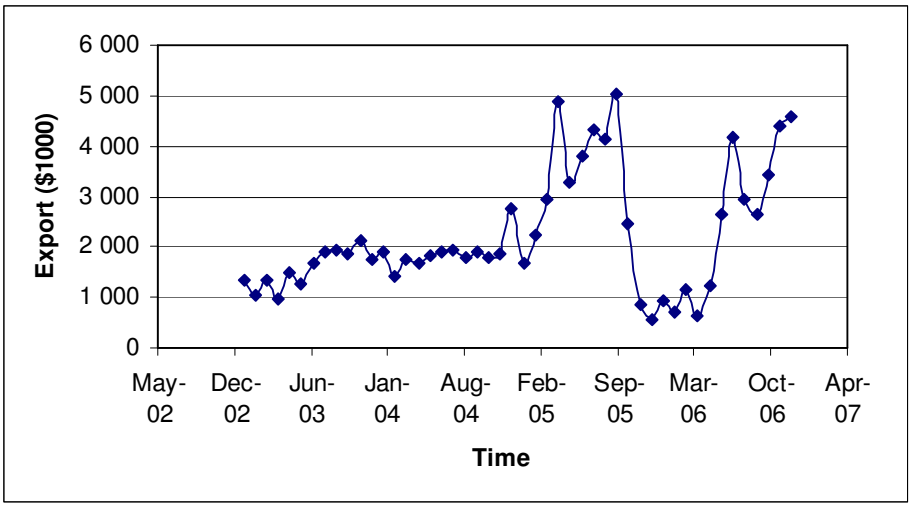

Fig. 5. Turkish meat exports[2] ($1000)

Source: Turkstat (2006)

Finally, the tourism sector was hurt by the crisis, too. Following the outbreak, the number of tourists entering Turkey in February 2006 dropped by 10 percent compared to February 2005 numbers (Sarnıç, 2006).

Objectives of the Study

The aim of this project is to provide a better understanding of consumers' reactions to the AI crisis (and to a similar food scare) using data from a household survey. We aim at identifying the factors which have an impact on whether consumers are concerned about the safety of the poultry products they eat. Similarly, we also analyze the factors which affect the decision to reduce poultry consumption during the crisis and once it is over.

[2] According to FAOstat, 90-95 percent of total meat exports are poultry meat

This study is significant in the sense that it will help policy makers and the poultry industry to restore public confidence by providing a better understanding of consumer reactions. Consumers, who are aware of the causes, related potential health hazards and ways of protecting themselves from the impacts of the food scares, they also reflect this awareness on their consumption patterns. Demand for poultry products is sensitive to consumer behavior. By understanding consumer behavior, it will be possible to develop strategies to communicate food risk issues more effectively with corresponding consumer segments.

Whereas almost all empirical studies in the literature concentrate on developed countries (mostly USA, UK and Japan), we expect that the results of this study shed light on the consequences of food scares not only in Turkey but also in other transition and emerging economies and provide a basis for policy recommendations.

Outline of the Following Chapters

Chapter 2 presents an overview of the previous literature on the economic effects of food safety scares in the world and in Turkey. Chapter 3 provides a description of the dataset and variables used in this thesis. The estimated models and related findings are presented in Chapter 4. Chapter 5 provides a brief summary of results and their implications for policy makers and researchers, and concludes with the limitations of the study and suggestions for further research.

CHAPTER 2

LITERATURE REVIEW

There is a wide range of studies attempting to assess the economic impact of food safety scares. These studies in the literature—mostly written on BSE, can be broadly categorized in the following groups: The first group of these studies analyzes the effects of food safety scares on consumer demand and related issues; and the second group investigates their impact on prices. The general theme across previous work is that food safety scares have a negative impact on quantities consumed and on prices. Our study complements this literature by adding the Turkish perspective on the Avian Influenza case.

Studies on Consumer Behavior

Part of the consumer studies focus on testing the stability of consumer preferences, following food safety scares and the effects of the safety shock on demand function. Jin and Koo (2003) and Peterson and Chen (2003) in their non-parametric demand analyses for Japanese consumers find that following the discovery of BSE, consumers' tastes for meat systematically moved away from beef to its substitutes. There are also studies which use demand systems analysis to investigate structural changes in consumer preferences. For example, Mangen and Burrell (2001) investigated the structural change in Dutch consumers' preferences

for meat and fish, following the UK government's announcement of BSE. The authors use a switching AIDS model and the hypothesis of constancy of the parameters. The constancy for meat and fish was rejected against a more general time varying parameter model. Verbeke and Ward (2001) investigated fresh meat consumption in Belgium between 1995-1998 also using an AIDS model. In specifying the demand system, the authors incorporate a media index, and show that television publicity has a negative impact on beef expenditure in favor of pork. Another study by Burton and Young (1996) investigates the impact of BSE on the demand for beef and other meats in the United Kingdom. Indices of media coverage of BSE are incorporated in a dynamic AIDS model of meat demand. The publicity (which BSE has received is found significant) affects the allocation of consumer expenditure among different meats. Finally, the recent study by Piggott and March (2004) investigated whether food safety information impacts U.S. meat demand. They used a theoretical model of consumer response to publicized food safety information on meat demand developed with an empirical application to U.S. meat consumption. The authors found evidence for the existence of pre-committed levels of consumption, seasonal factors, time trends, and contemporaneous own and cross commodity food safety concerns. Also, the average demand response to food safety concerns is small, especially in comparison to price effects, and to previous estimates of health related issues.

Another group of studies attempt to estimate consumers' willingness to pay (WTP) for safer products using a contingent valuation method. These studies in general show that consumers are willing to pay substantial premiums for beef safety and beef quality assurance (Dickinson and Bailey, 2002). For instance, Latouche et al. (1998) conducted a survey in France in 1997, eliciting consumer consumption

patterns and reasons for possible changes as well as consumer attitudes about quality labels and sanitary norms. Consumers were asked how much of a premium they would be willing to pay for beef that would not transmit the human variant of BSE. The meat products were medium quality, low-priced minced steak with little risk of transmission, and high-quality, higher-priced beef with no risk of transmission. The mean willingness to pay (WTP) premiums for the two meat products (including zero bids) were 22 percent of the original price and 13.7 percent of the original price, respectively. Further, the authors found that employed and highly educated respondents as well as respondents who preferred labeled or organic products indicated higher WTP, while respondents who were involved in agricultural activities were less willing to pay a premium. In a more recent study, McCluskey et al. (2004) analyze factors that affect Japanese consumers' willingness to pay price premiums for BSE-tested beef and estimate the mean willingness to pay for BSE-tested beef using data obtained from a consumer survey in Japan. Their estimated willingness to pay (50 percent) is higher than that of Latouche et al. and they also find that safety and environmental attitudes, reduction in beef consumption following the BSE outbreak, and being female have all statistically significant effects on WTP. This is not surprising, because in general, Japanese consumers are accustomed to paying high premiums for quality.

Finally, there are studies which make use of survey data to analyze consumer behavior regarding food safety issues. Part of these studies examines the determinants of consumers' concern about food safety (Rimal et al., 2001; Knight et al., 2004) while others investigate the determinants of consumption change both during food safety scares (Herrman et al., 1997, Rimal et al., 2001; Schupp et al., 2003; Corsi, 2005) and after the crisis is over (Schupp et al., 2003; Corsi, 2005;

Verbeke et al., 2000). The explanatory variables in these studies include common socio-economic and demographic characteristics, as well as attitudinal or psychological factors. The variables and methods used in some of these studies are summarized in Table 2.

To briefly summarize the results of these studies; Knight et al. (2004) revealed that women and blacks were more likely to have high levels of concern about food safety than were men and whites. Also, the level of concern increased with age. The explanation proposed by the authors is that the respondent's perceived vulnerability to that risk may explain differences across risks.

Schupp et al. (2003) on the other hand, analyzed the impact of Packer recalls and Mad Cow Disease on beef consumption and found that these incidents reduced beef consumption by 26 and 22 percent of respondents, respectively. These consumers reduced beef consumption by an average of one third for approximately fifteen weeks. Important factors included frequency of beef consumption, consumer rating of safety of local beef supplies, city and single adult in households.

In a more recent study, Corsi (2005) could not find any significant socio-economic determinant of consumption change as a result of the BSE outbreak since the overall significance of the model is very low. The conclusion proposed by the author is that the panic hit the overall population regardless of income and other socio-economic characteristics, mainly depending on their personal psychological impact. The author could not find any particular socio-economic determinant of the decision to maintain the reductions taken during the crisis. Again, reactions to the BSE, the long-term ones in this case, seem to be rather random.

Herrman et al. (1997) derived that reported reduction in the use of apples and apple products, as a result of the Alar crisis was more frequent for women, for

younger and non-white respondents. Reductions also were more common among those who indicated they paid more attention to news about government actions on food and product safety. Reductions were not, however, significantly related to reported frequency of television news watching.

Verbeke et al. (2000) also analyzed the BSE outbreak and their results reveal that likelihood of cutting fresh meat consumption increases with greater attention given to television messages, as well as with the presence of young children in the household and with increasing age of the consumer. Interaction between attention to television and age reveals that younger people's decisions are more susceptive to media coverage. Heavy meat consumers are least likely to cut fresh meat consumption.

Finally, Rimal et al. (2001) analyze the relationship between concern about seven different food safety issues and the corresponding changes in consumption. Their results revealed that there was a significant gap between concern about food safety issues and the corresponding changes in food consumption habits. The gap was wider among respondents with lower levels of education. Respondents in good health condition were more likely to be concerned. White and non-white respondents were equally concerned about food safety issues. Lastly, knowledge and practice of food safety awareness such as sanitary food handling at home makes consumers less concerned about food safety.

Table 2. Variables Used in Selected Studies (Sign and Statistical Significance)

	Knight and Warland(2004)			Schupp et al.(2003)					Rimal et al. (2001)				
Dependent variable		*Concern*			*Reduce*		*Maintain*			*Concern (index)*		*Reduce (index)*	
Independent variables	age	+	*	New Orleans	-		-		enforce	+	***	+	***
	female	+	***	New York City	-	**	+		attd	-	***	-	***
	white	-	***	Denver	-	**	+	**	knowledge about the issue	-	*	-	
	children present	-		San Fransisco	-	**	+		label	+	***	+	***
	education	+		female	+		+	**	conf1	+		+	**
	income	+		single adult head	+	**	-		conf2	+	*	-	
				children present	-		-		conf3	-		-	
				white	-	**	+		health	+	**	+	
				income	+		+	**	white	-		-	***
				education	-		+		education	-	**	-	
				age	-		-		emst	-		-	
				homemaker	-		+	**	female	-		-	
				own risk assessment	-		-		age	-		-	
				safety rating of local suppliers	+	**	+						
				frequency of beef consumption	-	**	-	**					
Food safety issue	Pesticides			BSE					BSE				
Country	USA			USA					Italy				
Year of crisis	-			1996					2001				
Estimation	Binary Logit			Binary Logit					Binary Probit				
Sample size	840			721					402				

Table 2. Continued

	Herrman et al. (1997)			Verbeke et al. (2000)					Corsi (2005)				
Dependent Variable		*Reduce*			*Reduce*		*Reduce_next_year*			*Reduce*		*Maintain*	
Independent Variables	female	+	***	education	+		+		age	+		+	
	children present	+		children present	+	**	+		education	-		+	*
	education	-		frequency of meat consumption	-	**	-	**	household size	+	*	-	
	white	-	**	TV2	+	**	+		big city	+		+	
	age	-	***	age	+	***	+		familiarity with organic products	-		-	
	TV	+		Age*TV2	-	**	-		female	+		+	
	attn	+	***						income	?		-	
Food safety issue	Alar crisis in apples			BSE					Pesticides, drug residues, hormones, additives, bacteria Irradiation, toxines				
Country	USA			Belgium					USA				
Year of crisis	1989			1996					-				
Estimation	Binary logit			Binary probit					OLS				
Sample size	1206			291					236				

Dependent Variables: *Reduce*: Did you reduce your consumption as a result of the issue? (Yes=1), *Reduce_next_year*: Do you intend to reduce your consumption next year? (Yes=1), *Concern*: Are you concerned about the issue (High concern=1), *Maintain*: Were the reductions permanent? (Yes=1)

Indepedent Variables: TV: measures frequency of television news watching, attn: measures the degree of attention placed on news about government action on food safety, enforce: respondent's opinion about the adequacy of food safety regulations (1=adequate), attd: binary variable equal to 1 if the respondent wants a chemical to be used in food production even if its benefits outweigh its risks, label: respondent's opinion on the use of labeling food products about chemicals used (1=labels are helpful), conf1: confidence index on government, chemical manufacturers and growers associations, conf2: confidence index on scientists, laboratories and consumer groups, conf3: confidence index on supermarkets, celebrities and friends, emst: binary variable equal to1 if the respondent is employed full-time, TV2: attention to TV coverage of meat issues. (***, ** and * denote significance at 1%, 5%, and 10% confidence levels respectively).

Studies on Prices

This group of studies makes use of time series methods. One of them by Lloyd et al. (2001) considers the impact of food scares, predominately concerns relating to BSE, on UK beef prices at retail, wholesale and producer levels over the 1990s. They use a co-integrating framework, the results of which show the importance of publicity regarding the safety of food in the transmission of beef prices in the UK. The "food publicity" index that they use has a negative impact on the prices at all levels, a result that is consistent with the effect of an inward shift in the demand function. They also show that the impact of BSE on farm prices is more than double of that of retail prices.

In another study about UK, Sanjuan and Dawson (2003) examined transmission between producer and retail prices for beef, lamb and pork, and the impact of public concern over BSE in the early 1996. They used the cointegration procedure developed by Johansen (2001), which admits structural breaks in the cointegrating space. Results with monthly data for 1986-2000 show that a long-run relationship exists between each producer and retail price; and that a structural break occurs in the beef relationship at the height of the BSE outbreak. They also find evidence of increasing price margins in beef markets.

In a more recent study, Saghaian et al. (2007a) used a cointegration analysis, and historical decomposition, to find that three food safety shocks; E.Coli, FMD, and BSE had different negative impacts on Japanese retail beef prices, suggesting that consumers understood and differentiated among the health risks.

Studies on Food Safety in Turkey

There is only a limited number of studies about food safety in Turkey. In one of them; Akgüngör and Miran (2002) investigated the effect of the BSE scare on beef consumption under the impact of intense media coverage. Using monthly data, a beef demand model for January 1995-February 1997 period is estimated for İzmir Province. Beef sales dropped immediately after the media coverage on BSE in April 1996 and continued through June 1996, when the intense media coverage stopped. The econometric model reveals that beef sales in İzmir would have been 36.4 percent higher if the BSE crisis never occurred. The annual individual willingness to pay is $0.52 per year to avoid consuming BSE contaminated meat.

In a more recent study, Unusan (2005), examined the knowledge and behaviors related to food safety among consumers who had the primary responsibility for food preparation at home. Based on face-to-face interviews conducted with 458 randomly selected households, the study found significant difference among education levels concerning attitude towards food safety and knowledge. No significant effect of demographic profile on food handling practices was found.

Regarding the 2005 H5N1 Avian Influenza crisis in Turkey, Saghaian et al. (2007b) used time-series analysis and historical decomposition with monthly farm, wholesale, and retail chicken price series is used to address the dynamics of price adjustment and causality along the Turkish poultry marketing channel. The authors found a differential impact of the exogenous shock on producers and retailers, leading to widening of price margins and pointing to imperfect price transmission, specifically at the farm level.

CHAPTER 3

DATA AND VARIABLES

Methodology

The dataset used in this research comes from a unique household survey constructed for this study. The survey was conducted in November 2006 and the questionnaire included 134 questions. The a priori determined size of the sample was 1000, resulting in an error margin of 3.1 percent.[3]

The sampling methodology was clustered stratified random sampling. The statistical region units (NUTS-level 1) were determined by the Turkish Institute of Statistics. From each of the twelve regions at NUTS1 level, one province was randomly selected and thus, the survey was conducted in a total of twelve provinces. The distribution of the respondents among rural and urban areas within each province was made according to the proportions determined in the 2000 Population Census. The distribution of the number of respondents among provinces is presented in Appendix A. The selection of districts or villages from each province was made proportional to the city population. A total of 110 districts and 35 villages were determined. Then, two streets were randomly selected from each district and the questionnaire was administered in three randomly selected households in each of these streets. As for villages, ten households were randomly selected from each.

[3] The error margin was calculated assuming the Turkish population to be 70 millions and a confidence interval of 95 percent.

Within each household, the questionnaire was administered with those respondents older than 18 years old. The approximate rejection rate was 40%.

The surveys were conducted by a professional research company through face-to-face interactions. The interviewers and supervisors were given a full day of training by the research team, and the important points to be considered were explained thoroughly. Before the implementation of the survey, two rounds of pre-tests were run to check the clearness of the questions. While the survey was conducted, there was no significant development that would have influenced the answers. After the survey was conducted, a random phone call check was performed for about 30% of the sample and all the surveys were cross checked for any potential logical conflicts. As a result, approximately 10% of the surveys were cancelled, and 1044 surveys were approved as valid. We also excluded from our analysis the respondents who do not recall how the Avian Influenza crisis affected their poultry consumption and those who never eat chicken (for other reasons than avian influenza). Therefore, the final sample size was 961.

The Variables Used in the Analyses[4]

Dependent Variables

Concern

An important question while dealing with consumer responses to food scares is their level of concern about it. Consumers' concern influence demand over tastes and preferences, hence, it is one of the key determinants of consumption decisions

[4] The questions of the survey that were used to generate the variables are presented in Appendix B.

(Schupp et al., 2003). Getting correct and complete information is crucial to prevent demand shocks. Unfortunately, theory does not provide any clear guidelines about the determinants of the level of concern; hence, the literature mostly focuses on empirically driven conclusions on this variable. For example, Rimal et al. (2001) report that consumers who are aware of causes of a food scare and relevant precautions are not too concerned, and are less likely to take additional safety measures. The question we ask the consumer is "Are you concerned that you or a family member may get infected from eating poultry in case of an AI outbreak?" The dummy variable *concern* is equal to 1 if the respondent has a level of "high concern" about avian influenza, 0 in case of "low concern"; where "high concern" includes "very concerned" and "concerned" responses, and "low concern" includes "somewhat concerned" and "no concern" responses.[5]

Reduce

The consumer may adjust his/her consumption behavior, once he/she gets information about the food scare. To learn whether the household decreases his/her level of consumption we use the binary variable, *reduce,* which takes the value 1 if the respondent reported eating less poultry during the period of the avian influenza crisis. In particular, *concern* is expected to highly reduce the demand for poultry (Schupp et al., 2003). By employing this variable, we are interested in is whether the consumer is vulnerable to the food scare, or not, and do not concentrate on the quantity of change (except for the *frequency* variables discussed below). We also do not look at how the the substitution of poultry meat with other alternative protein sources takes place.

[5] Regressions using "no concern" versus "concern" as the dependent variable yielded similar results.

Maintain

Another important issue related with food safety is whether demand for poultry will return to the pre-crisis levels. Previous research done on BSE shows that following the scare consumer confidence is damaged and restoring it is difficult (Latouche, et al., 1998). Limiting ourselves only to consumers who reduced their poultry consumption during the crisis, we are interested in whether the consumers maintained these reductions in their consumption. The dummy variable *maintain* takes the value 1 if the respondent answers "Yes" to the question "Did your consumption increase back to its pre-crisis level after the AI outbreak was over?"

Explanatory Variables

Using binary variables for *concern*, *reduce* and *maintain*; our aim is to identify the factors which affect the probability of being concerned as well as those which affect the decision to reduce poultry consumption both during and after the crisis. The following explanatory variables are used in the models estimated.

Knowledge about Avian Influenza Transmission Mechanisms

We include a dummy, *knowledge*, which measures the awareness of the respondent about the relationship between eating poultry and the avian influenza transmission. The variable takes the value 1 if the respondent answers the question "Can avian influenza be transmitted through appropriately cooked poultry meat?" correctly. (According to WHO (2007), it is not possible to catch AI from appropriately cooked food).

Frequency of Poultry Consumption

Tastes and preferences of the consumer are represented by this variable since it carries the behavioral decisions of the consumer. Dual arguments can be set forth about the effect of frequency on consumption decisions and determining the total impact becomes an empirical issue. On the one hand, heavy eaters of poultry are expected to be less concerned due to being more informed or not regarding the incidents as significant, and hence they are less likely to reduce their consumptions (Schupp et al., 2003). On the other hand, frequent eaters have more room or opportunity to reduce meat intake, which makes them more likely to reduce (Verbeke et al., 2000). Based on the frequency of poultry consumption revealed by the respondents we constructed the following three dummy variables:

Freq1: Equal to 1 if the respondent eats poultry less than once a week, 0 otherwise.

Freq2: Equal to 1 if the respondent eats poultry once a week, 0 otherwise.

Freq3: Equal to 1 if the respondent eats poultry more than once a week, 0 otherwise.

Confidence in Sources of Information

Consumers' concern and perception of safety may depend on the amount of confidence and trust they place on the opinions of institutions like the government, media and health personnel. Information received from different sources will influence consumption behavior and directly affect people's *concern* level on the food scare (Rimal et al., 2001). The government's role of regulating risk is also closely related with communicating risks to consumers in an effective manner, and hence, decrease the level of information asymmetry that consumers suffer (Lobb, 2004; Loureiro and Umberger, 2007). Assigning such a role to governments is proposed to be true for both higher and lower income countries (Caswell and Joseph,

2006). It is also hypothesized that media tends to sensationalize food safety hazards, hence, the inclusion of this variable will control for potential impacts and especially volume and speed of coverage of the incidents in the media on consumption behavior. Following a food scare, short-term decreases in demand are especially attributed to excess media coverage (Lobb, 2004, Böcker and Hanf, 2000; Verbeke et al., 2000). We asked the respondents whether they trust government authorities, health professionals and the media on the issue of avian influenza. Based on these responses we constructed the following three dummies.

ConfGov: Equal to 1 if the respondent trusts the accuracy of AI information provided by government agencies.

ConfHealth: Equal to 1 if the respondent trusts the accuracy of AI information provided by health professionals.

ConfMedia: Equal to 1 if the respondent trusts the accuracy of AI information provided by the media.

For the variables *ConfGov, ConfHealth,* and *ConfMedia,* the variable is equal to 1 if the respondent gives "trust completely" and "trust somewhat" responses, while the variable is equal to 0 if the respondent answers "low trust" and "no trust".

Equivalised Household Income

Income is another important determinant of consumption. Knight (2004) noted that studies such as Byrne et al., 1991; Nayga, 1996; Pilisuk et al., 1987 demonstrated people with higher incomes to be less concerned about food safety issues than those with lower incomes. This may be attributed to substitution effects, since it will be easier for consumers with high income to switch to alternative meats from poultry. To obtain equivalised household income, we used the following method:

Respondents were first asked to reveal the total monthly income received by all the members of the household from all sources. Then the reported income was divided by equivalised household size calculated according to the modified OECD scale (which gives a weight of 1.0 to the first adult, 0.5 to other persons aged 14 or over who are living in the household and 0.3 to each child aged less than 14).[6] Finally we construct the following dummy variables by ranking the respondents according to their equivalised incomes and dividing them into three groups.

Income1: Equal to 1 if the respondent's equivalised monthly income is less than 240 YTL.

Income2: Equal to 1 if the respondent's equivalised monthly income ranges between 240-463 YTL.

Income3: Equal to 1 if the respondent's equivalised monthly income is greater than 463 YTL.

Other variables

Other variables included in our regressions are as follows.

Health: It is hypothesized that those consumers who are in good health are less concerned about food safety due to being less vulnerable to risk (Rimal et al., 2001). This binary variable is equal to 1 if the respondent reveals that he/she is in excellent or good health condition; equal to 0 otherwise.

Age: Continuous variable denoting the age of the respondent.

Gender: Research shows that females are expected to be more concerned with food safety problems than males (Altekruse et al., 1995; Herrman et al., 1997; Knight

[6] Because we did not have data on the number of children aged below 14 in each household, we adjusted these weights based on the fact that 30 percent of the overall Turkish population is aged below 14.

et al., 2004). We construct *gender* as a binary variable equal to 1 if the respondent is female.

Location: Binary variable equal to 1 if the respondent lives in an urban area, 0 if the respondent lives in a rural area. We classify the location as rural if it is a village or town.

Education: Years of formal schooling attained by the respondent.

Regarding *age*, *location*, and *education* findings of past studies yielded inconsistent results (Schupp et al., 2003), thus the impact of these variables on the dependent variables needs to be determined empirically.

Summary Statistics

Table 3 shows that the respondents in our sample were on average 39 years old, 51 percent of them were female, and they had on average 7.6 years of schooling with an average of four household members. Thirty-eight percent of the respondents had a monthly equivalised income less than 240 YTL, 31 percent between 240-463 YTL and 31 percent more than 463 YTL. Among the respondents 25 percent said they eat poultry less than once a week, 45 percent once a week and 30 percent more than once a week. Considering the location of respondents, 68 percent lived in urban areas. In addition, 60 percent stated that they were in excellent or good health condition. Among the consumers, 60 percent trusted information revealed by government agencies, the corresponding amount was 52 percent with media outlets and 94 percent with health professionals. Sixty-two percent of respondents said they knew that the AI would not be transmitted if poultry meat was appropriately cooked. Regarding the consumers' concern about the AI, 68 percent revealed that they were

either concerned or very concerned. Once the epidemic occurred 69 percent reduced their poultry consumption, and among these, 79 percent returned to their pre-epidemic consumption levels once the AI threat was over. Thus, the AI crisis, although overcome to some extent, also left long-term effects on consumption.

The cross tabulation among two of the dependent variables; *concern* and *reduce* is presented in Table 4. For cross tabulations among other selected variables, see Appendix C.

Table 3. Summary Statistics on Variables Used

Variable	N	Mean	Std.Dev.	Min.	Max.
Knowledge	961	0,62	0,49	0,00	1,00
Maintain	667	0,79	0,41	0,00	1,00
Concern	957	0,68	0,47	0,00	1,00
Reduce	961	0,69	0,46	0,00	1,00
Age	961	38,87	15,01	18,00	87,00
Gender	961	0,51	0,50	0,00	1,00
Education	961	7,58	3,98	0,00	17,00
Income1	924	0,38	0,49	0,00	1,00
Income2	924	0,31	0,46	0,00	1,00
Income3	924	0,31	0,46	0,00	1,00
Freq1	961	0,25	0,43	0,00	1,00
Freq2	961	0,45	0,50	0,00	1,00
Freq3	961	0,30	0,46	0,00	1,00
Location	961	0,68	0,47	0,00	1,00
ConfGov	928	0,76	0,43	0,00	1,00
ConfHealth	950	0,94	0,25	0,00	1,00
ConfMedia	924	0,52	0,50	0,00	1,00
Health	956	0,60	0,49	0,00	1,00

Table 4. Cross Tabulation of *Concern* vs. *Reduce*

		REDUCE		
		0	1	
CONCERN	0	121	186	307
	1	179	471	650
	Total	300	657	957

Collinearity Diagnostics

Multicollinearity is the extent to which a variable can be explained by the other variables in the analysis. Existence of multicollinearity will result in unstable estimates for regression coefficients, therefore before proceeding with the estimations; several procedures to detect multicollinearity are performed. These include calculating variance inflation factor (VIF) and tolerance values, and checking the correlation matrix.

Tolerance is the amount of variability of the selected independent variable not explained by the other independent variables. Thus a tolerance close to 1 means there is minor multicollinearity, whereas a value close to 0 suggests that multicollinearity may be a threat.

The reciprocal of tolerance is known as the variance inflation factor (VIF). VIF shows how much of the variance of the coefficient estimate is being inflated by multicollinearity. A commonly given rule of thumb is that VIFs of 10 or higher may be a reason for concern.

Finally, as a rule of thumb, values higher than 0.7 in absolute value in the correlation matrix should be a reason for concern.

Using the above mentioned methods, no multicollinearity problem was detected among the variables. For details, see Appendix D.

CHAPTER 4

ESTIMATION RESULTS

Estimation of a Recursive Binary Choice Model for *Concern* and *Reduce*

Using the variables presented in the Chapter 3, we construct the following two regression equations.[7]

$$Reduce = f_1 (\text{Constant}, Knowledge, Freq2, Freq3, ConfGov, ConfHealth, ConfMedia, Income2, Income3, Health, Gender, Age, Location, Education, Concern, u_1) \quad (1)$$

$$Concern = f_2 (\text{Constant}, Knowledge, Freq2, Freq3, ConfGov, ConfHealth, ConfMedia, Income2, Income3, Health, Gender, Age, Location, Education, u_2) \quad (2)$$

The preceding is a recursive binary choice model since *Concern* is included both as a dependent and explanatory variable. To develop the estimators, we first present the model in simpler terms.

$$Reduce^* = \beta' x + \gamma Concern + u_1 \quad (3)$$

$$Concern^* = \alpha' x + u_2 \quad (4)$$

where $Reduce^*$ and $Concern^*$ are latent variables and *Reduce* and *Concern* are dichotomous variables that take the following values:

Reduce = 1 if $Reduce^* > 0$; 0 otherwise

Concern=1 if $Concern^* > 0$; 0 otherwise,

[7] In our models, we assume that the relative price of poultry meat with respect to its substitutes (fish, red meat etc.) is the same accross the locations where the survey was conducted.

x is a vector of exogenous variables, α and β are vectors of parameters, γ is a scalar parameter, and the error terms u_1 and u_2 are assumed to be distributed bivariate normal with mean 0 and variance 1, and ρ represents the correlation coefficient between u_1 and u_2 .

As shown in Greene (1998) and Greene (2003), despite simultaneity, this multiple equation specification (equations 3 and 4) for two dichotomous variables can be consistently estimated by Full-Information Maximum Likelihood Method. The intuition behind this result is that the probability terms that enter into the likelihood function can be decomposed in the conditional and marginal probabilities for *Concern.* For example,

Prob[*Reduce*=1, *Concern*=1]
= Prob[*Reduce*=1|*Concern*=1] x Prob[*Concern*=1]
= {BVN(*Reduce*, *Concern*=1) / Prob[*Concern*=1] } × Prob[*Concern*=1],

where BVN is used to denote the cumulative distribution function of the bivariate normal distribution. The preceding result has an important implication for this model. Inserting the variables of the model, we obtain

Prob[*Reduce*=1, *Concern*=1]
= [BVN(β′x + γ*Concern*, α′x, ρ) / Φ(α′x)] × Φ(α′x)
in which Φ(α′x) = Prob[*Concern* = 1].

This is a univariate probit model for *Reduce*. After canceling the same terms in the numerator and denominator, we are left with just the bivariate probability,

Prob[*Reduce* = 1, *Concern* = 1] = BVN(β′x + γ, α′x, ρ).

The remaining three probability terms can be constructed analogously to obtain

Prob[Reduce = 0, Concern = 1] = BVN(-β′x - γ, α′x, -ρ) ,
Prob[Reduce = 1, Concern = 0] = BVN(β′x, α′x, -ρ) ,
Prob[Reduce = 0, Concern = 0] = BVN(-β′x, -α′x, ρ) .

Greene (1998) points out that these are just the terms that enter the usual likelihood function for the bivariate probit model. Therefore, in the bivariate probit model,

unlike in the linear simultaneous equations model we can just put *Concern* in the right hand side of the *Reduce* equation and develop the estimators as if there was no simultaneity problem.

Exogeneity Tests

To test for exogeneity of *Concern,* we first use the Rivers-Vuong (1988) approach. In the first step, the assumed endogenous variable; *Concern*, is regressed on the assumed exogenous variables (x). In the second step, the residuals of the first step regression are used as independent variables (along with *concern* and x) to estimate the dependent variable *Reduce.* The usual probit t statistic on the residuals is a valid test of the null hypothesis that *Concern* is exogenous. (Following Lopez (2004), the usual probit standard errors are assumed to be valid for the purpose of testing for endogeneity). Using the Rivers-Vuong (1988) approach, we concluded that endogeneity of *Concern* was not present in our dataset with our specification. The results of the test are presented in Appendix E.

However, Wooldridge (2002, p.478) notes that there is a more efficient test for exogeneity. First, we estimate a bivariate probit model allowing the correlation coefficient between the error terms; ρ to vary freely. A likelihood ratio test of the significance of ρ is a direct test of the exogeneity of *Concern.* If ρ equals zero, then *Concern* is exogenous and it is appropriate to use the univariate probit model. If ρ is non-zero then *Concern* is endogenous, the univariate probit results are biased, and the bivariate probit model should be used. In our case, the likelihood ratio test statistic can not reject the null hypothesis that $\rho = 0$. Therefore, the model is re-estimated with ρ constrained to equal to 0. This is equivalent to estimating the two

equations by simple, univariate, binomial probit methods, using maximum likelihood as the estimation criterion (Greene, 1998). The results of both estimations are presented in Table 5.[8]

Marginal Effects

As explained in Greene (1998), the coefficients in a binary choice model can be misleading, so we calculate the marginal effects and base our inferences on these. In a simple binary probit model, we would have

$$E[y|x] = \Phi(\beta'x) = \text{Prob}[y = 1]$$

so that, for a continuous variable, z_i,

$$\partial E[y|x]/\partial z = \partial\Phi(\beta'x_1)/\partial z = \phi(\beta'x) \times \beta_z$$

where $\phi(\bullet)$ is the density function of the standard normal distribution and β_z is the coefficient on that variable. If z is a binary variable, then the appropriate way to measure the marginal effect is to use

$$\text{Effect on } E[y|x] = E[y|x, z=1] - E[y_1|x, z=0]$$

In the general bivariate probit model, the marginal effect is calculated according to the following formula (Greene, 1998). For a variable z that might appear in either equation, we have

$$\partial BVN(\Phi(\beta'x + \gamma, \alpha'x, \rho)/\partial z = \{\phi(\beta'x + \gamma)\Phi[(\alpha'x - \rho(\beta'x + \gamma))/\sqrt{1-\rho^2}\,]\}\beta_z + \{\phi(\alpha'x)\Phi[(\beta'x + \gamma) - \rho(\alpha'x))/\sqrt{1-\rho^2}\,]\}\alpha_z$$

[8] A two-stage procedure parallel to 2SLS will produce inconsistent estimators (Wooldridge, 2002, p.478).

Table 5. Single Equation and Bivariate Probit Estimates

	Single equation			Bivariate probit		
	Coefficient	Std.Err.		Coefficient	Std.Err.	
Reduce Equation						
Knowledge	-0,1780	0,0958	*	-0,0130	0,1092	
Freq2	0,1761	0,1140		0,0150	0,1238	
Freq3	0,1851	0,1264		0,0256	0,1335	
ConfGov	0,1886	0,1086	*	0,1472	0,1034	
ConfHealth	0,2129	0,1777		0,0918	0,1744	
ConfMedia	0,1622	0,0946	*	0,0208	0,1030	
Income2	0,0958	0,1145		0,1002	0,1060	
Income3	-0,0656	0,1251		-0,0980	0,1163	
Health	-0,0926	0,0995		-0,1043	0,0922	
Age	0,0001	0,0035		0,0026	0,0033	
Gender	0,0066	0,0937		-0,0731	0,0915	
Location	0,2645	0,1015	***	0,2866	0,0945	***
Education	-0,0116	0,0146		-0,0077	0,0136	
Concern	0,2415	0,0986	**	1,4662	0,3662	***
Constant	-0,1568	0,3195		-0,9443	0,3748	**
Concern Equation						
Knowledge	-0,3290	0,0957	***	-0,3211	0,0956	***
Freq2	0,2887	0,1132	***	0,3004	0,1123	***
Freq3	0,2843	0,1258	**	0,2738	0,1244	**
ConfGov	0,0206	0,1090		0,0536	0,1090	
ConfHealth	0,1656	0,1793		0,1377	0,1807	
ConfMedia	0,2737	0,0940	***	0,2836	0,0927	***
Income2	-0,0499	0,1132		-0,0159	0,1138	
Income3	0,1100	0,1271		0,1187	0,1256	
Health	0,0533	0,0997		0,0401	0,0990	
Age	-0,0063	0,0035	*	-0,0062	0,0034	*
Gender	0,1810	0,0939	*	0,1613	0,0939	*
Location	-0,1384	0,1025		-0,1293	0,1013	
Education	-0,0062	0,0146		-0,0052	0,0144	
Constant	0,4284	0,3140		0,4024	0,3143	
N = 863						
Concern (Probit): Log-likelihood: -513.92, LR chi2(13) = 43.06,						
Prob>chi2 = 0.0000, Pseudo R2 = 0.0402						
Reduce (Probit): Log-likelihood: -515.13, LR chi2(14) = 39.05,						
Prob>chi2 = 0.0004, Pseudo R2 = 0.0365						
Estimate of rho = -0.76645, Std. Error of rho = 0.2451						
LR test of rho=0, chi2(1)=0.920459, Prob>chi2=0.3374						

Note: *** Significant at 1%, ** significant at 5%, * significant at 10%.

In our model, since ρ equals zero, the calculations are simplified. Following the notation in Greene (1998), we denote *Reduce* by y_1 and *Concern* by y_2. Therefore, the conditional mean function in the model analyzed here is

$$\begin{aligned} E[y_1|x] &= E_{y2}\, E[y_1 \mid x, y_2] \\ &= \text{Prob}[y_2 = 1]\, E[y_1 \mid x, y_2 = 1] + \text{Prob}[y_2 = 0]\, E[y_1 \mid x, y_2 = 0] \\ &= \Phi(\alpha'x)\, \Phi(\beta'x + \gamma) + \Phi(-\alpha'x)\, \Phi(\beta'x), \end{aligned}$$

where we have used the symmetry of the normal distribution in $\Phi(-\alpha'x) = 1 - \Phi(\alpha'x)$. For y_2,

$$E[y_2|x] = \Phi(\alpha'x_2).$$

Therefore, the marginal effects in the *Concern* equation are exactly those shown above for the univariate probit model. But the marginal effect of a change in a variable in the *Reduce* equation will be a sum of terms. One will account for the direct effect of a change in that variable on the probability that y_1 equals one, and the other will measure the indirect effect of the change in this variable on the probability that y_2 equals 1 in the *Concern* equation which, in turn, affects the probability that y_1 equals one. Thus:

(1) For a continuous variable, z, which appears in x, we have

$$\begin{aligned} \partial E[y_1|x]/\partial z = &[\Phi(\alpha'x)\, \phi(\beta'x + \gamma) + \Phi(-\alpha'x)\, \phi(\beta'x)]\, \beta_z \quad \text{(direct effect)} \\ &+ [\phi(\alpha'x)\, \Phi(\beta'x + \gamma) + \phi(-\alpha'x)\, \Phi(\beta'x)]\, \alpha_z \quad \text{(indirect effect)} \end{aligned}$$

where β_z and α_z are the coefficients on z in the two equations.

(2) For a binary variable, q, which appears in x, we have

$$\begin{aligned} E[y_1 \mid x, q=1] - E[y_1 \mid x, q=0] = &[\Phi(\alpha'x)\, \Phi(\beta'x + \gamma) + \Phi(-\alpha'x)\, \Phi(\beta'x)] \mid q=1 \\ &- [\Phi(\alpha'x)\, \Phi(\beta'x + \gamma) + \Phi(-\alpha'x)\, \Phi(\beta'x)] \mid q=0. \end{aligned}$$

(3) For the second, endogenous binary variable, y_2, we have

$$E[y_1 \mid x, y_2 = 1] - E[y_1 \mid x, y_2 = 0] = \Phi(\beta'x + \gamma) - \Phi(\beta'x)$$

In all cases, standard errors are computed using the delta method (Greene, 1998). Let $\delta_k(\beta,\alpha,\gamma,\text{data})$ equal the marginal effect, which is computed using the parameter estimates and some configuration of the data; in the computations below, the sample means are used, with dummy variables set to zero and one. Let

$$\Delta_\beta = \partial\delta_k(\beta,\alpha,\gamma,\text{data})/\partial[\beta',\gamma]$$
$$\Delta_\alpha = \partial\delta_k(\beta,\alpha,\gamma,\text{data})/\partial\alpha'$$

Since ρ is zero, our model is estimated using separate probit equtions. Let V_b denote the estimated asymptotic covariance matrix of the estimates in the *Reduce* equation and V_a denote the same for *Concern* equation. Then, an estimate of the asymptotic variance for the estimated marginal effect is

$$\text{Asy.Var.}\delta_k = \Delta_\beta V_b \Delta_\beta' + \Delta_\alpha V_a \Delta_\alpha'$$

The square root gives the estimated standard error for the estimator.

The estimated marginal effects of the variables in the two equations are given in Table 6.

Table 6. Estimated Marginal Effects for *Concern* and *Reduce*

Reduce Equation						
	Direct	Indirect	Total	Std.Err.	t-ratio	
Knowledge	-0,0616	-0,0199	-0,0815	0,0406	-2,0073	**
Freq2	0,0613	0,0017	0,0631	0,0359	1,7564	*
Freq3	0,0634	0,0006	0,0641	0,0381	1,6813	*
ConfGov	0,0675	-0,0056	0,0619	0,0360	1,7221	*
ConfHealth	0,0776	-0,0014	0,0763	0,0575	1,3256	
ConfMedia	0,0568	0,0020	0,0588	0,0322	1,8251	*
Income2	0,0332	-0,0047	0,0285	0,0259	1,0988	
Income3	-0,0231	0,0053	-0,0178	0,0405	-0,4402	
Health	-0,0322	0,0047	-0,0275	0,0341	-0,8082	
Age	0,0000	-0,0032	-0,0031	0,0024	-1,3082	
Gender	0,0023	0,0048	0,0071	0,0297	0,2380	
Location	0,0945	-0,0126	0,0819	0,0373	2,1971	**
Education	-0,0041	-0,0031	-0,0072	0,0088	-0,8112	
Concern	0,0863	-	0,0863	0,0358	2,4089	**
Concern Equation						
Knowledge	-0,1126	-	-0,1126	0,0319	-3,5335	***
Freq2	0,1002	-	0,1002	0,0388	2,5798	**
Freq3	0,0962	-	0,0962	0,0410	2,3456	**
ConfGov	0,0072	-	0,0072	0,0384	0,1883	
ConfHealth	0,0599	-	0,0599	0,0668	0,8968	
ConfMedia	0,0958	-	0,0588	0,0328	1,7934	*
Income2	-0,0176	-	-0,0176	0,0400	-0,4393	
Income3	0,0381	-	0,0381	0,0435	0,8762	
Health	0,0187	-	0,0187	0,0351	0,5330	
Age	-0,0022	-	-0,0022	0,0012	-1,7986	*
Gender	0,0632	-	0,0632	0,0327	1,9340	*
Location	-0,0478	-	-0,0478	0,0349	-1,3695	
Education	-0,0022	-	-0,0022	0,0051	-0,4245	

Note: *** Significant at 1%, ** significant at 5%, * significant at 10%.

Results

Concern

The regression results reveal that several factors significantly affect consumers' *concern* about the AI virus and its possible consequences on their health. Based on the marginal effect of *knowledge* we observe that (consistent with our expectation) consumers, who are aware of the fact that the AI virus was not transmitted through appropriately cooked food, were less likely to be concerned that they might be affected by the virus. This means that poultry consumers who learned about the way the virus is transmitted know that; once they take the precautions they will not be infected by the virus. In terms of its total marginal effect, *knowledge* has the most substantial negative effect on the probability of being concerned.

We also find that frequent poultry eaters are more likely to be concerned (the calculated two marginal effects are the largest positive ones). Even though we would expect that frequent consumers would have collected information on the virus transmission mechanism, we observe that they are still concerned about being infected. Frequent poultry eaters might have panicked and irrationally thought that eating poultry more frequently makes them more prone to risk.

Estimated coefficients pointed out that those respondents who had confidence on the comments of coverage of the AI in the media were more concerned. On this point, one explanation might be that people learn from media sources, but excess exposure to the news on the issue in the media also raises their level of concern. When a food scare occurs, trust in information provided by the media amplifies the negative effects (Mazzochi, 2004). Similarly, previous research also indicates that

especially negative news had more impact on the consumers than positive news (Böcker and Hanf, 2000).

On the other hand, confidence on government agencies and health professionals did not have an effect on *concern*. We also observe that older consumers are less concerned about the AI. Expecting that younger people consume meat more and follow media more frequently, they are more likely to be concerned about infection. Our estimation also shows that females are more concerned compared to males, which is another expected result, since females are socialized to be the primary care provider and nurturer within the family.

Regarding the statistically insignificant estimates on *income* and *location* one explanation is that following the news on the pandemic, panic hit all Turkish consumers in a rather undiversified way (see also Corsi, 2005). The estimates for the variables *education* and *health* are statistically insignificant.[9]

Reduce

Based on our estimations, we infer that consumers who are concerned about AI transmission reflect this in their consumption behavior and reduce their poultry meat consumption. This estimate has the largest positive magnitude. We also find that consumers who had *knowledge* did not decrease their poultry consumption during the AI outbreak period, where the estimate has the largest negative magnitude. This result emphasizes the point that the negative impact of the pandemic on the poultry sector could have been alleviated by informing consumers about it. Hence,

[9] Use of index variables for socio-economic development level of the provinces did not affect the estimation results; hence, we decided to use *location* to control for differences between urban and rural areas.

combining the results of the two regressions, *knowledge* affected *reduction* both directly and also indirectly through *concern*. This implies that the impact of the pandemic during the crisis period can be reduced through decreasing peoples' *concern* about the virus and increasing their *knowledge* about bird flu transmission mechanisms.

Consumers who live in urban areas were more likely to reduce their poultry consumption following the pandemic. In our sample the majority of the respondents, with 54 percent, who lived in rural areas as compared to only nine percent in urban areas, raised their own poultry at home. Therefore, those living in rural areas may find it harder to reduce their poultry consumption and switch to other sources of protein.[10]

We derive that people who consume poultry meat frequently are more likely to reduce their consumption during the food scare. One explanation suggested by Verbeke et al. (2000) is that frequent eaters have more room or opportunity to reduce meat intake. In terms of its effect on *Reduce*, nearly all of the effect of frequency is the direct effect on the probability itself, as opposed to the indirect effect on the probability of being concerned.

A rather ambiguous result was that the consumers who were confident in government agencies, as sources of information, did not reflect this confidence in their consumption decisions and still reduced their consumption levels. This is an unexpected result since government officials emphasized that eating properly cooked poultry is safe. On this point, one explanation proposed by Rimal et al. (2001) is that the degree of confidence determines consumption behavior. In other words those

[10] Many farmers were unwilling to let government officials cull their poultry despite the fact that they would be financially compensated. One explanation might be the lower level of education among rural residents (in the sample 42 percent of urban residents completed high school or a higher level of education as compared to only 23 percent for those living in rural areas).

respondents who trust the government only somewhat, rather than completely, might have altered their consumption as a precaution. Once more we observe that confidence in media is a significant factor. Consumers who trust the information they receive from media outlets decrease their consumption during the crisis time, supporting our expectations stated above. Confidence on health professionals came out as an insignificant factor.

We also found that estimates for *age, gender, education, income,* and *health* had no significant impact in reduction of poultry consumption.

Estimation of a Model for *Maintain*

The analysis for *Maintain* differs from the previous ones, since we excluded the consumers who did not decrease their levels of poultry consumption during the outbreak from our original sample. This new sample was restricted to consumers having reported a reduction in their consumption.

Within this analysis, using the following equation, we examined the factors that helped consumers return to their pre-outbreak consumption levels. The exogeneity of *Concern* is tested using the Rivers-Vuong (1988) approach (see Appendix E) and the variable is found to be exogenous. Considering the potential sample selection problem arising from selecting only the observations making it to the maintain regression, we employ the Heckman's (1979) two-step estimation procedure (Greene, 2003, p.784).

> *Maintain* = f_3 (Constant, *Knowledge, Freq2, Freq3, ConfGov, ConfHealth, ConfMedia, Income2, Income3, Health, Gender, Age, Location, Education,Concern,* u_3)

The results are presented in Table 7.

Table 7. Probit Estimates for *Maintain*

	Coef.	dF/dx		Std.Err	z	P>|z|	x-bar
Knowledge	0.0377	0.0108		0.0348	0.310	0.755	0.608
Freq2	0.3723	0.1051	*	0.0406	2.590	0.010	0.455
Freq3	0.5114	0.1339	***	0.0393	3.410	0.001	0.299
ConfGov	0.2494	0.0715	*	0.0405	1.760	0.078	0.755
ConfHealth	0.0072	0.0021		0.0747	0.030	0.978	0.933
ConfMedia	-0.0607	-0.0174		0.0351	-0.500	0.620	0.520
Income2	-0.2540	-0.0728	*	0.0441	-1.650	0.099	0.314
Income3	-0.6006	-0.1721	***	0.0471	-3.660	0.000	0.311
Health	-0.0054	-0.0015		0.0377	-0.040	0.967	0.611
Age	-0.0014	-0.0004		0.0013	-0.310	0.757	38.758
Gender	-0.0617	-0.0177		0.0347	-0.510	0.610	0.489
Education	0.0182	0.0052		0.0054	0.970	0.333	7.702
Location	0.1665	0.0488		0.0416	1.170	0.241	0.675
Constant	0.4732	-		-	-	-	-
Concern	-0.0977	-0.0280		0.0387	-0.720	0.470	0.679
N = 602							
Wald Chi-Squared(14) = 26.62, prob>chi2 = 0.0216							

Note: *** Significant at 1%, ** significant at 5%, * significant at 10%.

The estimated coefficients on *income2* and *income3* revealed that consumers with higher incomes kept their consumption at reduced levels, even after the crisis was over. For these consumers this result may be explained by substituting other higher priced protein sources (like red meat or fish) for poultry products, which may not be the case for low income consumers.

With the *Maintain* regression our findings showed that among the consumers who reduced their poultry consumption during the pandemic period, frequent eaters were more likely to return to their pre-pandemic consumption levels. This may indicate that for the sample analyzed, food scares do not permanently affect tastes and consumption patterns of frequent eaters. Similarly, heavy consumers might be more informed on food safety than others. Combining the results from the three

regressions, we observe that frequent users are more concerned, reduce their consumption during the crisis, but return to their pre-consumption levels once the crisis is over.

Based on the estimates from the *Reduce* regression, we had found that consumers who had confidence in government agencies as sources of information nevertheless reduced their consumptions. However, with the *Maintain* regression we observe that this reduction was of a short-term since the same consumers are more likely to return to their pre-pandemic consumption levels. These results highlight that the impact of government agencies on consumers is still significant, but mostly in the post-pandemic period.

Other than these factors, there seemed to be no particular socio-economic or demographic determinant of the decision to maintain the reduction after the bird flu outbreak was over, which is also true for confidence on health professionals and media, *health*, *knowledge* and *concern* variables.

CHAPTER 5

CONCLUSION

This research analyzed the consumer responses to the recent avian influenza outbreak that affected the Turkish consumers and the poultry sector between October 2005 and March 2006. Using a household survey that we conducted in November 2006, our objective was to make an attempt to understand the consumer behaviour during and after the food scare in Turkey. The results of this study are not only important for Turkey, but also for other transition and emerging economies that are vulnerable to be heavily hit by similar food scares. Especially, developing strategies to communicate food risk issues more effectively with the corresponding consumer segments, restoring public confidence, and dealing with demand shocks following food scares are the crucial issues that need to be resolved.

Table 8 provides a summary of the regression results. As can be seen from the table, we infer that consumers who are *concerned* are more likely to reduce their consumption during the outbreak. Studies in the literature such as Knight et al. (2004) and Rimal et al. (2001) investigate the determinants of consumers' concern about food safety issues but do not treat *concern* as an explanatory variable that affects consumers' decision to change their consumption behavior. In that sense, the present study differs from previous literature.

Our results also indicate that those respondents who have *knowledge* are less likely to be concerned and to reduce their poultry consumption during the AI

outbreak period. As noted by Rimal et al. (2001), this result is consistent with the findings by Zimmerman et al. (1994) that when knowledge level is low, opinions are often based on pre-existing global attitudes towards related food safety issues.

Table 8. Summary of Regression Results

	Reduce		*Concern*		*Maintain*	
	dF/dx		dF/dx		dF/dx	
Knowledge	-0,0815	**	-0,1126	***	0.0108	
Freq2	0,0631	*	0,1002	**	0.1051	*
Freq3	0,0641	*	0,0962	**	0.1339	***
ConfGov	0,0619	*	0,0072		0.0715	*
ConfHealth	0,0763		0,0599		0.0021	
ConfMedia	0,0588	*	0,0958	*	-0.0174	
Income2	0,0285		-0,0176		-0.0728	*
Income3	-0,0178		0,0381		-0.1721	***
Health	-0,0275		0,0187		-0.0015	
Age	-0,0031		-0,0022	*	-0.0004	
Gender	0,0071		0,0632	*	-0.0177	
Location	0,0819	**	-0,0478		0.0052	
Education	-0,0072		-0,0022		0.0488	
Concern	0,0863	**	-		-0.0280	

Note: *** Significant at 1%, ** significant at 5%, * significant at 10%.

We found that the media had a strong influence on consumers but excess exposure to the news on the outbreak in the media also raised consumers' level of *concern* on getting infected. Consistent with previous literature, we found that unfavorable information from the media appears to have a particularly potent effect on purchase intentions (Lobb, 2004; Böcker and Hanf, 2000; Verbeke et al., 2000). Importantly, consumers who had confidence in government agencies as sources of information still reduced their consumptions. But this reduction was of a short-term since the same consumers returned to their pre-pandemic consumption levels. So, the

impact of government agencies on Turkish consumers is still significant, but mostly in the post-pandemic period.

Regarding frequency variables, our results depart from previous studies such as Schupp et al. (2003) and Verbeke et al. (2001) since we infer that frequent poultry eaters are more likely to be *concerned* and more likely to *reduce*. But consistent with our expectations, they are more likely to return to their pre-crisis consumption levels since they have a strong preference for poultry.

Finally, we found that females and younger respondents are more likely to be *concerned.* In addition, consumers living in urban areas were more likely to *reduce* their poultry consumption during the pandemic, and those with higher income are less likely to go back to their pre-crisis consumption levels.

The above results have important implications for policy makers. The study clearly indicates that the negative impact of the pandemic on the poultry sector could have been alleviated by informing consumers about it. The recommendation for the policy makers or any interested party is that through decreasing peoples' *concern* about the virus, and increasing their *knowledge* about bird flu transmission mechanisms, the impact of the pandemic during the crisis period can be reduced. Second, positive messages should be emphasized in the media. Effective communication by the government is also crucial since those who have confidence on government are more likely to return to their pre-crisis consumption levels. Such effectiveness should also accentuate the power of media outlets while dealing with future scares. Finally, campaigns can target the consumers living in urban areas during the outbreak, and those with higher incomes after the outbreak to alleviate the negative impact of food safety scares on demand.

The major limitation of the study results from the data collection method. Since the survey method relies on self reported responses, potential differences from actual behavior may present a source of bias.

Future research may analyze the impacts of the pandemic on consumers using a demand side approach. Using household budget surveys (which were not available for Turkey for the year 2005 when this research was conducted) structural analysis of elasticities and preference-taste relationships can be performed. Measuring consumers' willingness-to-pay for non-risky poultry meat during times of food scares would also provide additional information on hypotheses we tested in this research.

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APPENDICES

Appendix A. Distribution of Respondents among Regions

Table 9. Target Distribution of Respondents

	NUTS-1 Region	Province	Number of surveys	Urban	Rural
1	İstanbul	İstanbul	148	134	14
2	Aegean	İzmir	132	81	51
3	Mediterranean	Adana	128	77	52
4	Southeastern Anatolia	Gaziantep	97	61	36
5	Western Anatolia	Ankara	95	73	22
6	Eastern Marmara	Bursa	85	57	28
7	Western Black Sea	Zonguldak	72	36	37
8	Middle Anatolia	Kayseri	62	35	27
9	Middle-Eastern Anatolia	Van	55	30	25
10	Eastern Black Sea	Trabzon	46	23	23
11	Western Marmara	Tekirdağ	43	24	19
12	North-Eastern Anatolia	Erzurum	37	19	18
	Total		1000	649	351

Table 10. Actual Distribution of Respondents

	NUTS-1 Region	Province	Number of surveys
1	İstanbul	İstanbul	178
2	Aegean	İzmir	142
3	Mediterranean	Adana	129
4	Southeastern Anatolia	Gaziantep	100
5	Western Anatolia	Ankara	108
6	Eastern Marmara	Bursa	74
7	Western Black Sea	Zonguldak	71
8	Middle Anatolia	Kayseri	65
9	Middle-Eastern Anatolia	Van	54
10	Eastern Black Sea	Trabzon	46
11	Western Marmara	Tekirdağ	41
12	North-Eastern Anatolia	Erzurum	36
	Total		1044

Appendix B. Survey Questions

Reduce

Consider the bird flu outbreak period (October 2005-March 2006). How did your consumption change compared to pre-crisis period?

- No change
- Increased
- Decreased
- Do not know

Concern

Are you concerned that you or a family member might be infected from poultry if a bird flu outbreak occurs?

- Very concerned
- Concerned
- Somewhat concerned
- Not concerned
- Do not know

Maintain

Consider the period after the bird flu outbreak (after March 2006). Did your consumption increase back to its pre-crisis level?

- Yes
- No
- Do not know

Knowledge

Is the following statement correct?

Avian influenza can not be transmitted through appropriately cooked poultry meat.

- o Correct
- o Incorrect
- o Do not know

Frequency

How often do you consume poultry (chicken, turkey, duck, goose etc.) meat?

- o Never
- o Once a month
- o Once a week
- o 2-3 times a week
- o 4-5 times a week
- o 6 times a week or more

Confidence in Sources of Information

How much do you trust the accuracy of avian influenza information from the following sources?

	Trust completely	Trust somewhat	Trust a little	Does not trust	Not sure
Government					
Health professionals					
Media					

Household Income

What is the total income received by all the members in your household?

- Less than 150 millions TL
- 150-250 millions TL
- 250-350 millions TL
- 350-450 millions TL
- 450-550 millions TL
- 550-750 millions TL
- 750 millions -1 billion TL
- 1 - 1.5 billions TL
- 1.5 - 2 billions TL
- 2 - 3 billions TL
- 3 - 5 billions TL
- More than 5 billions TL

Health

How would you assess your own health status?

- Excellent
- Good
- Mediocre
- Bad
- Need continuous care

Age

What is your birth date?

Location

What is your city of residence?

Education

What is the highest education level you completed?

- Can not read and write
- Can read and write but have no degree
- Primary school
- High school
- University
- Master's
- Ph.D.

Appendix C. Cross Tabulations among Selected Variables

Table 11. Cross Tabulation of Frequency vs. Income

	Income1	Income2	Income3	Does not know	Total
Freq1	49%	28%	19%	4%	100%
Freq2	34%	33%	31%	3%	100%
Freq3	29%	29%	37%	5%	100%

Table 12. Cross Tabulation of Frequency vs. Gender

	Female	Male	Total
Freq1	54%	46%	100%
Freq2	49%	51%	100%
Freq3	50%	50%	100%

Table 13. Cross Tabulation of Frequency vs. Age

	<30	30-50	>50	Total
Freq1	35%	43%	22%	100%
Freq2	34%	41%	24%	100%
Freq3	40%	41%	20%	100%

Table 14. Cross Tabulation of Frequency vs. Education

	No degree	Primary school	High school or more	Total
Freq1	11%	58%	31%	100%
Freq2	10%	56%	34%	100%
Freq3	9%	48%	43%	100%

Table 15. Cross Tabulation of Frequency vs. Knowledge

	Knows	Does not know	Total
Freq1	63%	37%	100%
Freq2	61%	39%	100%
Freq3	62%	38%	100%

Table 16. Cross Tabulation of Reduce vs. Confidence on Government

	Trusts completely	Trusts Somewhat	Does not trust	Does not trust at all	Does not know	Total
Reduced	50%	25%	9%	12%	4%	100%
Did not reduce	38%	31%	13%	16%	2%	100%

Table 17. Cross Tabulation of Reduce vs. Confidence on Media

	Trusts completely	Trusts Somewhat	Does not trust	Does not trust at all	Does not know	Total
Reduced	23%	29%	24%	20%	4%	100%
Did not reduce	18%	26%	31%	21%	4%	100%

Table 18. Cross Tabulation of Education vs. Knowledge

	Knowledge	
Years of schooling	Does not know	Knows
0	9%	5%
4	5%	2%
5	41%	42%
8	12%	13%
11	21%	28%
13	1%	2%
15	10%	8%
17	1%	0%
Total	100%	100%

Table 19. Cross Tabulation of Knowledge vs. Location

	Location		
	Rural	Urban	Total
Does not know	26%	74%	100%
Knows	36%	64%	100%

Appendix D. Collinearity Diagnostics

Table 20. VIF and Tolerance Values for the Variables

Variable	VIF	SQRT-VIF	Tolerance	R-Squared
Knowledge	1.05	1.03	0.9496	0.0504
Age	1.37	1.17	0.7275	0.2725
Gender	1.07	1.03	0.9340	0.0660
Education	1.56	1.25	0.6431	0.3569
Income2	1.45	1.21	0.6875	0.3125
Income3	1.79	1.34	0.5600	0.4400
Freq2	1.68	1.30	0.5937	0.4063
Freq3	1.75	1.32	0.5724	0.4276
Location	1.16	1.08	0.8634	0.1366
Reduce	1.04	1.02	0.9633	0.0367
ConfGov	1.07	1.03	0.9345	0.0655
ConfHealth	1.06	1.03	0.9427	0.0573
ConfMedia	1.08	1.04	0.9253	0.0747
Maintain	1.05	1.02	0.9533	0.0467
Concern	1.06	1.03	0.9394	0.0606
Health	1.20	1.10	0.8314	0.1686
Mean VIF	1.28			

Table 21. Correlation Matrix

	Knowledge	Age	Gender	Education	Income2	Income3	Freq2	Freq3	Location	Reduce
Knowledge	1									
Age	-0.1273	1								
Gender	-0.0213	-0.1353	1							
Education	0.0404	-0.3373	-0.0948	1						
Income2	0.0346	-0.0596	-0.0010	0.1054	1					
Income3	-0.0676	-0.0087	-0.0260	0.3324	-0.4629	1				
Freq2	-0.0104	0.0139	-0.0495	-0.0059	0.0019	-0.0243	1			
Freq3	-0.0133	-0.0416	0.0318	0.0997	-0.0260	0.1496	-0.6200	1		
Location	-0.0968	-0.0438	0.0298	0.2568	0.0371	0.2539	-0.0204	0.1073	1	
Reduce	-0.0492	0.0697	-0.0522	-0.0581	0.0185	0.0157	0.0225	0.0356	-0.0096	1
ConfGov	0.0513	-0.0079	0.0396	-0.1641	-0.0717	-0.0559	-0.0038	-0.0418	-0.0361	-0.0338
ConfHealth	-0.0472	0.0484	0.0160	-0.0885	-0.0324	0.0562	0.0142	0.0200	0.0474	0.0532
ConfMedia	0.0060	0.0775	0.0028	0.0220	-0.0631	0.1574	-0.0048	0.0228	0.0230	0.0673
Maintain	0.0211	-0.0289	-0.0207	0.0037	0.0145	-0.1167	0.0333	0.0642	0.0246	-0.0062
Concern	-0.1147	-0.0587	0.0740	-0.0129	-0.0514	0.0636	0.0318	0.0584	-0.0150	0.1104
Health	0.0539	-0.3747	-0.0622	0.2202	0.0089	0.0526	0.0251	0.0204	-0.0055	0.0200
	ConfGov	ConfHealth	ConfMedia	Maintain	Concern	Health				
ConfGov	1									
ConfHealth	0.1125	1								
ConfMedia	0.0904	0.1657	1							
Maintain	0.0708	-0.0060	-0.0355	1						
Concern	-0.0197	0.0673	0.0882	-0.0300	1					
Health	-0.0156	-0.0408	-0.0575	0.0108	0.0514	1				

Appendix E. Rivers-Vuong (1988) Test

Table 22. Results of the Rivers-Vuong (1988) Test for Exogeneity of *Concern* in *Reduce* Regression

Dependent Variable: REDUCE
Method: ML - Binary Probit
Sample(adjusted): 2 960
Included observations: 863
Excluded observations: 96 after adjusting endpoints
Convergence achieved after 4 iterations
Covariance matrix computed using second derivatives

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONCERN	-0.052725	0.623163	-0.084608	0.9326
AGE	-0.000288	0.003113	-0.092537	0.9263
KNOWLEDGE	-0.208487	0.102006	-2.043875	0.0410
GENDER	0.027622	0.115085	0.240012	0.8103
EDUCATION	-0.011415	0.014981	-0.761977	0.4461
LOCATION	0.251433	0.101922	2.466915	0.0136
HEALTH	-0.083948	0.106250	-0.790094	0.4295
INCOME2	0.091391	0.114433	0.798642	0.4245
INCOME3	-0.056267	0.124204	-0.453020	0.6505
FREQ2	0.208250	0.141949	1.467082	0.1424
FREQ3	0.216941	0.152569	1.421919	0.1550
CONFGOV	0.193726	0.112314	1.724860	0.0846
CONFHEALTH	0.241561	0.216933	1.113526	0.2655
CONFMEDIA	0.189826	0.111225	1.706680	0.0879
RES_CONCERN	0.293974	0.634930	0.463002	0.6434

Mean dependent var	0.689455	S.D. dependent var	0.462985
S.E. of regression	0.455460	Akaike info criterion	1.228612
Sum squared resid	175.9121	Schwarz criterion	1.311354
Log likelihood	-515.1461	Hannan-Quinn criter.	1.260283
Avg. log likelihood	-0.596925		
Obs with Dep=0	268	Total obs	863
Obs with Dep=1	595		

Table 23. Results of the Rivers-Vuong (1988) Test for Exogeneity of *Concern* in *Maintain* Regression

Dependent Variable: MAINTAIN
Method: ML - Binary Probit
Sample(adjusted): 2 955
Included observations: 602
Excluded observations: 352 after adjusting endpoints
Convergence achieved after 4 iterations
Covariance matrix computed using second derivatives

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONCERN	0.742129	0.850388	0.872695	0.3828
AGE	-0.000173	0.004056	-0.042588	0.9660
KNOWLEDGE	0.125635	0.131406	0.956085	0.3390
GENDER	-0.119387	0.150502	-0.793256	0.4276
EDUCATION	0.017963	0.019256	0.932867	0.3509
LOCATION	0.203802	0.139825	1.457553	0.1450
HEALTH	-0.025910	0.141787	-0.182742	0.8550
INCOME2	-0.239958	0.154048	-1.557686	0.1193
INCOME3	-0.627502	0.164762	-3.808533	0.0001
FREQ2	0.283458	0.187103	1.514984	0.1298
FREQ3	0.424683	0.199290	2.130981	0.0331
CONFGOV	0.236029	0.146439	1.611784	0.1070
CONFHEALTH	-0.065787	0.316456	-0.207885	0.8353
CONFMEDIA	-0.138456	0.145489	-0.951657	0.3413
RES_CONCERN	-0.836785	0.865774	-0.966517	0.3338

Mean dependent var	0.784053	S.D. dependent var	0.411820
S.E. of regression	0.406393	Akaike info criterion	1.047755
Sum squared resid	96.94623	Schwarz criterion	1.157396
Log likelihood	-300.3742	Hannan-Quinn criter.	1.090429
Avg. log likelihood	-0.498960		
Obs with Dep=0	130	Total obs	602
Obs with Dep=1	472		