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Fear and trust: How risk perceptions of avian influenza affect Chinese consumers' demand for chicken

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ABSTRACT

This article quantifies the impact of H7N9 bird flu on chicken demand and consumer willingness to pay (WTP) in China. We measure risk perception, fear and trust against actual reduction in consumption and stated change in WTP for safe chicken between 2012 and 2013. Through a survey conducted in each year on the same Chinese urban consumers, we found that the consumption of chicken never increased after the emergence of H7N9 in 2013, and WTP for safe chicken did not necessarily increase relative to generic risks associated with consuming chicken in 2012. Factors such as the fear of H7N9's spreading, the impact of distrust (especially the distrust in government) enhanced the deviation of consumption and WTP; and the sheer mentioning of H7N9 is more important and negative than whether it was associated with a risk-perception reducing or risk-perception elevating message given to consumers.

1. Introduction

On Feb. 19, 2013 a new type of avian influenza (AI), H7N9, was reported in Shanghai, and once again Chinese consumers were faced with a food scare. Unlike the SARS (severe acute respiratory syndrome) epidemic a decade ago, H7N9 virus showed no signs of human-to-human transmission, and the source of human infections was unclear with a lot of the patients having no obvious contact with poultry. To date no vaccine has been launched, and many Chinese consumers are fearful of this unknown risk. It is difficult to assess the potential economic impact of AI because the H7N9 virus itself is not sufficiently understood and people's response to an outbreak is uncertain.

In this paper, we have at our disposal changes in chicken consumption and changes in WTP for safe chicken, and our interest is in understanding why and when consumption of chicken decreases under a health scare (H7N9 Avian Influenza), and whether the willingness-to-pay (WTP) for safe chicken increases, decreases or remains the same. We developed questions related to the consumption of chicken before and during the H7N9 epidemic in 2013. In 2012 we surveyed 860 consumers in seven Chinese cities to gain a general understanding of safe chicken consumption by the revealed preference method, and determined their WTP for safe chicken in a generic sense. With the onset of the epidemic in 2013 we contacted the same consumers, recording again their chicken consumption, but queried their WTP with specific wording related to H7N9. Through this two-round survey

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of Chinese consumers, we are able to measure with specificity the incremental impact of H7N9 on actual quantities of chicken consumed, and changes to their WTP for safe chicken.

However, since none of our respondents actually contracted H7N9, and the risk of contraction was very small, the utility of health adjustment can only be attributed to cognitive elements and risk perception. The main objective of this article is to explore the impact of risk perceptions such as fear and trust on food consumption. This has been a topic of considerable interest to economists (e.g. Hayes, Shogren, Shin, & Kliebenstein, 1995; Brown, Longworth, & Waldron, 2002; Wang, Mao, & Gale, 2008; Turvey, Onyango, Cuite, & Hallman, 2010; Ortega, Wang, Olynk, Wu, & Bai, 2012; Lim, Hu, Maynard, & Goddard, 2014). In many cases, how consumers respond to a food risk is a matter of judgment and affect with an effective response determined by how one perceives the goodness or badness about an event or stimulus (Finucane, Alhakami, Slovic, & Johnson, 2000; Slovic, Finucane, Peters, & MacGregor, 2004), the images that they form of the disease (Jackson, 2006) or the availability of risk (Tversky & Kahneman, 1973). With a credence component, individuals need more than personal experience to judge the safety of a food item, and often rely on third-party information (e.g. the supplier or government) to regain trust and reduce uncertainty (Bocker & Hanf, 2000; Lang & Hallman, 2005). With the 2013 survey we included a number of questions to measure risk perceptions (affect) along the lines of Kraus and Slovic (1988).

The objective of this paper is to quantify the effect of consumer risk perceptions induced by H7N9 on their demand. It sheds light on these issues with several important contributions. First, we measure the actual reduction in consumption and stated change in WTP due to an observed contemporaneous AI shock. By exploiting the 2013 outbreak of H7N9 and replicating the 2012 survey with the same respondents, we provide a rare glimpse into consumer behavior that can't easily be replicated in a laboratory setting. Second, we take advantage of the change in measured WTP between 2012 and 2013 to identify relative welfare shifts amongst consumers. In our context WTP represents the amount of income that the consumer is willing to give up to consume a given quantity of safe chicken equivalent to what is normally purchased or consumed under normal conditions. Because the WTP captures the compensating variation required to return the consumer to a steady-state chicken consumption level, the WTP measure reflects the relative change in utility between the 2012 and 2013 states of nature. It therefore captures an indirect and relative measure of welfare loss. The third contribution, and perhaps most important, is the econometric investigation of the effects of risk perceptions and trust on changes in chicken consumption and changes in WTP. We find that with the introduction of H7N9, the correspondence between chicken demands (actual consumption) and safe chicken demands (WTP) is not conforming for some individuals, and that changes in consumption and changes in WTP can be linked directly to perceptions of risk. These results suggest that food safety cannot be remedied by market forces alone, and to consider problems of food safety in the absence of psychological considerations may prove fruitless. The fourth contribution is a finding that consumers' heterogeneous responses to food safety risks in different cities appear to support psychological models of risk attenuation and amplification.

2. Literature review

At the consumer level, fear, risk and vulnerability are important economic determinants of response to food safety. Feeling good or bad about a particular risk is referred to by Slovic et al. (2004) as “affect”. If fear is defined at the level of cognition, then affect represents an impact that can exacerbate or countenance the more logical reasoning of cognition. The effect is measured by its degree of amplification which may or may not be attenuated or rational (Pidgeon, Kasperson, & Slovic, 2003) and may linger far longer than the life of the stimuli. In other words, the economic implication of a food safety incident is dynamic (Liu, Huang, & Brown, 1998; Caswell & Mojduszka, 1996) and may display properties of hysteresis (Turvey et al., 2010). While not often used to investigate risk perceptions related to food quality or food scares, Hallman, Hebden, Aquino, Cuite, and Lang (2003) have used similar queries to understand consumer attitudes towards genetically modified food, Turvey, Onyango, Schilling, and Hallman (2009) to investigate consumer response to Mad Cow disease, Lim et al. (2014) to examine the interaction between consumer risk perceptions and their preference for beef from different countries, and Turvey et al. (2010) to investigate risk perceptions on hypothetical incidents of agro-terrorism and bird flu.

Animal disease epidemics and consumer food safety concerns can negatively influence meat markets. Much research has been conducted on this topic, including, for example, Burton and Young (1997) on bovine spongiform encephalopathy (BSE) in the beef market in Great Britain, Lim, Hu, Maynard, and Goddard (2013) on a similar issue in Canada, and the AI in the U.S. by Turvey et al. (2009). Some studies showed that the marginal impact of risk on meat demand was small, with short-lived lagged effects on demand (Smith, van Ravenswaay, & Thompson, 1988; Dahlgran & Fairchild, 1987; Robenstein & Thurman, 1996; Lusk & Schroeder, 2004; Piggott & Marsh, 2004). Dahlgran and Fairchild (1987) tested the marginal effect of negative information about salmonella contamination on chicken demand, and found the effects were <1%, with rapid recovery of consumer's demands. In the United States, the recent cases of mad cow revealed lower fear or higher trust amongst consumers and very little affect as markets rapidly returned to the initial equilibrium states (Turvey et al., 2010). However, the limited effect may have been due to the low risk level. For example, Setbon, Raude, Fischler, and Flahault (2005) found a strong correlation between the perceived risk associated with consuming beef during the BSE crisis in France and the perceived risk reduced beef consumption.

Recent studies have integrated risk perceptions such as trust and fear into economic models (e.g. Meijboom, Visak, & Brom, 2006; Hassouneh, Radwan, Serra, & Gil, 2012). Heterogeneous consumer risk perceptions have been suggested and tested in the existing literature. One study carried by Yang and Goddard (2011) found that consumer groups in Canada responded differently to a perceived BSE food safety issue. The aggregate beef consumption of BSE impacts in Canada was different than those in the United Kingdom, Germany, and Japan (Burton & Young, 1996; Verbeke & Ward, 2001; Mazzocchi, Lobb, Traill, & Cavicchi, 2008; Lim et al., 2013).

Furthermore, food safety risk perceptions are not only related to socioeconomic characteristics, experiences and culture, but also to trust in various information sources including product labels, government, academic researchers, dieticians and physicians (Dosman, Adamowicz, & Hrudey, 2001; Lobb, Mazzocchi, & Traill, 2007; Mazzocchi et al., 2008; Tonsor, Schroeder, & Penning, 2009; Lang & Hallman, 2005). As noted by Kornelis, Jonge, Frewer, and Dagevos (2007), the availability of multiple sources of information does not imply that every consumer equally weights or even uses the same sources. Consumers' risk behavior is influenced by the information providers (Slovic, 1993, 1999). Some studies investigating food safety use a single food safety index (e.g. Burton & Young, 1996). In contrast, we measure consumer risk perceptions of food safety resulting from different types of fear and different sources of trust which may differ amongst individuals and markets.

3. Empirical model and variables

3.1. Econometric specification

In our empirical investigation to follow we have two critical measures for 2012 and 2013; the first is the actual consumption of chicken as revealed by respondents, and the second is WTP for safe chicken. The measured chicken consumption captures the Marshallian demand for chicken under market conditions including a quality differential which may be endogenous to price. The change in consumption when due to price effects, holding quality constant, captures movements along a single demand curve. But if prices are relatively constant, and the change is in quality, then demand will shift from one demand curve to another in price-quantity space. The second measure is the change in WTP between 2012 and 2013 which captures changes in expenditure holding utility constant. It may be convenient to think of this utility function capturing the substitution between the reference good (chicken) and other goods.

The characteristic demand theory presented by Lancaster (1971) assumes that products are consumed because of the utility derived from their characteristics. Food safety is an attribute valued by consumers (Antle, 1996; Wang et al., 2008). Consumers' actual consumption and stated WTP for each attribute (e.g. safety) can therefore be isolated.

At first we used a simple linear model to analyze the impact of fear and trust on actual consumption. $Cons_{2013}$ is the consumption for chicken in 2013. *Fear* and *trust* are vectors of observable characteristics of individual risk perceptions respectively. Z is the vector of control variables such as: (1) knowledge about AI; (2) new information about AI; (3) city dummies for controlling the AI incidence and price differences; (4) other basic characteristics including gender, age, family size, the proportion of children and/or elderly in a household, education and income; and (5) lagged consumption and WTP to identify the initial demand. μ is a random variable accounting for unobservable characteristics. The model can be written as:

$$Cons_{2013} = \beta_0 + \beta_1 \cdot Fear + \beta_2 \cdot Trust + \beta_3 \cdot Z + \mu_1 \tag{1}$$

Second, we calculated the stated WTP and also used a linear model to analyze the effect of fear and trust. WTP_{2013} is the WTP for safe chicken in 2013. The independent variables in equation (2) are the same as in last equation.

$$WTP_{2013} = \beta_4 + \beta_5 \cdot Fear + \beta_6 \cdot Trust + \beta_7 \cdot Z + \mu_2 \tag{2}$$

Secondly, we analyzed the dynamics considering both of the consumption and WTP. There could be nine situations for the change of consumption and WTP: $\Delta Cons < 0$ & $\Delta WTP < 0$, $\Delta Cons < 0$ & $\Delta WTP = 0$, $\Delta Cons < 0$ & $\Delta WTP > 0$; and $\Delta Cons = 0$ & $\Delta WTP < 0$, $\Delta Cons = 0$ & $\Delta WTP = 0$, $\Delta Cons = 0$ & $\Delta WTP > 0$; and $\Delta Cons > 0$ & $\Delta WTP < 0$; $\Delta Cons > 0$ & $\Delta WTP = 0$; $\Delta Cons > 0$ & $\Delta WTP > 0$. The three cases associated with $\Delta Cons > 0$ did not exist in our data. Some of the remaining cases are straightforward, but some need attention (for example, when $\Delta WTP = 0$). To better understand the relationship between consumption and WTP, as well as the shock elasticity (Eq. (3)), we parse the different possible combinations in ΔWTP and $\Delta Cons$ into the 6 possibilities observed in our data. We present a multinomial model relative to the $\Delta WTP = 0$ and $\Delta Cons = 0$ group.

At last, we combine these various concepts to provide a measure of the percentage change in the Marshallian demand given a percentage change in WTP. This 'shock' elasticity measure is given by

$$\eta = \frac{\dfrac{Cons_{2013} - Cons_{2012}}{Cons_{2012}}}{\dfrac{WTP_{2013} - WTP_{2012}}{WTP_{2012}}} \tag{3}$$

With boundaries $\eta \in (-\infty, \infty)$, the 'shock' elasticity provides a measure of relative (in comparison to absolute) welfare loss from an unforeseen food risk. In general we expect that this ratio would be negative; that is, a measureable increase in WTP would correspond with a measurable decrease in quantity consumed due to health concerns. However, the WTP is actually comprised of an additional demand component, health. Thus the expenditures do not only represent a demand for a return to consumption of chicken, but also include, endogenously, a demand for safe chicken and healthy food. While chicken has close substitutes priced in the market, health itself is a non-tradeable, non-marketable good for which a near-linear indifference curve cannot be expected.

Substitutability for health can only be expressed through consumption changes in chicken, but the intensity of fear about poor health will be captured in the WTP.

The denominator of elasticity measures the relative change in incremental expenditures consumers are willing to make in order to reduce risk to the initial welfare measure (in 2012). Thus the elasticity measure captures the relative change in observed Marshallian demand to WTP. If $\eta=0$, demand response to the new H7N9 information is Marshallian neutral, and if $\Delta WTP=0$, the elasticity is undefined. We do find amongst our respondents situations in which $\Delta WTP \leq 0$ is a curious outcome, especially since we find no consumer willing to increase consumption in the presence of H7N9. If this holds with a strict equality, then consumers are not differentiating the risk from H7N9 from other generic food safety risks, and the elasticity measure is undefined because of WTP indifference. But if WTP decreases, this could signify that consumers do not perceive H7N9 as being more risky than generic food safety risks. This would be indicated by a non-negative elasticity measure for $\Delta Cons \leq 0$. If $\eta=0$ then $\Delta Cons=0$, which indicates that consumers have not reduced consumption or changed Marshallian demand, even though there is a change in WTP. When $\eta=-1$ the percentage change in WTP exactly offsets the change in Marshallian demand. However, because of the integrability condition, this should not be interpreted as 1:1 tradeoff between WTP and Marshallian demand, but rather as demand falls consumers would be willing to pay an equivalent amount to restore consumption to initial levels. For $-1<\eta<0$ the change in Marshallian demand is less than the change in WTP, indicating that for consumers in this situation the utility loss from quality exceeds the utility loss from consumption. They are less likely to consume chicken. In contrast if $\eta<-1$, the change in consumption exceeds the change in WTP for safety. To varying degrees these consumers will have a guttural response to food safety and their own personal health well in excess of their WTP for reduced risk.

Table 1
Demographics, fear and trust in 2013.

Variables	Mean	Std. Dev.
Gender		
Male (1 = male; 0 = female)	0.51	0.50
Age in 2013		
Age (years)	38.73	12.13
Family type in 2013		
Total household population (heads)	3.88	1.23
The proportion of children (%)	0.10	0.14
The proportion of elder (%)	0.09	0.17
Education dummy in 2013		
High school (1 = yes, 0 = no)	0.29	0.45
Undergraduate (1 = yes, 0 = no)	0.47	0.50
Postgraduate (1 = yes, 0 = no)	0.06	0.25
Income dummy in 2013		
1501 ~ 3000 RMB (1 = yes, 0 = no)	0.37	0.48
3001 ~ 4500 RMB (1 = yes, 0 = no)	0.26	0.44
4501 ~ 6000 RMB (1 = yes, 0 = no)	0.16	0.36
6001 ~ 7500 RMB (1 = yes, 0 = no)	0.07	0.26
>7500 RMB (1 = yes, 0 = no)	0.09	0.29
Fear questions (strongly agree = 5,agree = 4, neutral = 3, disagree = 2, strongly disagree = 1)		
$Fear_1$: I would not eat any other new food (1 ~ 5)	2.99	1.11
$Fear_2$: Eating AI infected chicken will immediately kill me (1 ~ 5)	4.04	1.13
$Fear_3$: AI risk cannot easily be controlled (1 ~ 5)	3.07	1.07
$Fear_4$: AI risk is increasing (1 ~ 5)	3.76	1.09
$Fear_5$: AI can kill many people (1 ~ 5)	2.68	0.94
$Fear_6$: AI is contagious among humans (1 ~ 5)	3.05	1.14
$Fear_7$: I am personally at AI risk (1 ~ 5)	2.56	1.10
Trust questions (strongly trust = 5, trust = 4, neutral = 3, mistrust = 2, strongly mistrust = 1)		
$Trust_1$: I trust ministry of agriculture (1 ~ 5)	3.17	1.05
$Trust_2$: I trust ministry of health (1 ~ 5)	3.40	1.06
$Trust_3$: I trust research institutes (1 ~ 5)	3.40	1.00
$Trust_4$: I trust local government (1 ~ 5)	3.00	1.18
$Trust_5$: I trust TV news (1 ~ 5)	3.22	0.97
$Trust_6$: I trust network news (1 ~ 5)	3.15	0.93
$Trust_7$: I trust scholars (1 ~ 5)	3.09	1.09
$Trust_8$: I trust friends and relatives (1 ~ 5)	3.32	0.96
$Trust_9$: I trust chicken sales staff (1 ~ 5)	1.98	0.96
Knowledge in 2013		
Cognitive level about AI	2.39	1.27

Note: For the education dummies, the compulsory education (1 ~ 9 years) is omitted; the education years of high school are 10 ~ 12 years; the education years of undergraduate are 13 ~ 16 years; the education years of postgraduate are >16 years. For the income dummies, the range of 0 ~ 1500 RMB is omitted.

3.2. Measuring the risk-perception

In the survey of 2013, we added questions about fear and trust for H7N9 (see Table 1). In accordance with Kraus and Slovic (1988), we designed seven questions with answers from 1 to 5 (strongly agree = 5, agree = 4, neutral = 3, disagree = 2, strongly disagree = 1) to reflect the characteristics of fear: (1) *I would not eat any other new food*; (2) *Consuming AI infected chicken would kill me immediately*; (3) *AI risk cannot easily be reduced or controlled*; (4) *AI risk is increasing*; (5) *AI can kill many people*; (6) *AI is contagious among humans*; and (7) *I am personally at risk for AI.*

To determine how specific information sources may influence consumer behavior, consumer trust (strongly trust = 5, trust = 4, neutral = 3, mistrust = 2, strongly mistrust = 1) on nine information sources were surveyed, they were (1) ministry of agriculture, (2) ministry of health, (3) research institutes, (4) local government, (5) TV news, (6) network news, (7) scholars, (8) friends/family/relatives, and (9) chicken sales staff.

We also investigated consumer knowledge in 2013 by asking five knowledge questions about N7H9. That is, where does H7N9 virus come from? How long is the dormant period of H7N9? What are the common symptoms of human H7N9 infection? Do you know the antigenic variation of H7N9? What are the transmission routes of H7N9? Generally each respondent answered more than two questions correctly. Each time consumers answered a question correctly, a counter variable takes one.

Furthermore, a subset of participants was randomly subjected to one of three information treatments. The first provided no additional information on H7N9. The two other treatments were designed to communicate positive and negative images of H7N9 which could either decrease or increase risk perceptions. For the risk-perception reducing information respondents were told that experts pointed out that, in general, "*the AI virus is not strong enough to resist the external environment, high temperature, UV light, various disinfectants, and is easy to be killed. The virus can be eliminated in one minute at 100 °C. The chicken can be safe to eat after being cooked thoroughly*". Risk-perception elevating information included the statement "*the incubation period of the H7N9 virus is generally <7 days. The disease can progress rapidly, although transmission of H7N9 virus between human beings has not been reported yet, there is a risk that mutations in the virus could ease the spread*". As a hypothesis, risk reducing information was to build trust while risk-perception elevating information was generally associated with fear. The risk-perception reducing and risk-perception elevating treatments were each assigned to 20% of the samples, while the remaining 60% were not provided with any new information about H7N9.

4. Survey for safe chicken (2012) and H7N9 (2013)

4.1. The survey

The main purpose of this research is to investigate the impact of China's bird flu (H7N9) on consumer demand for chilled chicken (rather than live chicken) in 2013. Our approach was to take advantage of the emergence of the H7N9 in 2013 and compare consumers' behavior "without AI" in 2012 to "with AI" in 2013. The survey was fielded in seven Chinese cities including: Nanjing, Changzhou, Zhenjiang, Lianyungang, Linyi, Zaozhuang, and Chengdu. According to outbreaks of H7N9 in 2013, we divided the seven cities (which were surveyed in both years) into three types: cities in the "high incidence" province (Nanjing, Changzhou, Zhenjiang, and Lianyungang in Jiangsu province), cities in the "low incidence" province (Linyi and Zaozhuang in Shandong province) and cities in the "zero incidence" province (Chengdu in Sichuan province). Nanjing, Chengdu and Linyi were selected to represent larger cities, Changzhou and Lianyungang represented medium-sized cities, and Zhenjiang and Zaozhuang for smaller cities.[2]

The surveys were administered to the same group of respondents in April 2012 and 2013. In 2012 we asked generic questions regarding food safety in chilled chicken without any mentioning of H7N9 and in 2013 in the midst of the outbreak we resurveyed the group again. Since these respondents were surveyed both times (before and after the H7N9 outbreak), the data formed a "natural experiment". The survey in 2012 was a food safety survey which contained questions regarding the WTP for a safe chicken, actual consumption of chicken per week,[3] education, income and other demographic information (e.g. gender, age). The survey in 2013 was in April which was within 60 days of the 2013 bird flu outbreak. In addition to the WTP for a safe chicken and actual consumption of chilled chicken per week, the questionnaire in 2013 also contained the question about the information, knowledge, fear and trust regarding H7N9.

In order to calculate the WTP, we assumed that there were two types of chilled chicken on the market. One was ordinary chicken, which had an average chance of being contaminated. The other was safe chicken which was treated by ozone disinfectant, a substance mainly used to control bird flu. Both surveys began with moderators providing each subject with a neutral description of the food irradiation process. We labeled the ordinary chilled chicken at 30 RMB per chicken (1.5 kg). This represented the average chilled chicken price in the supermarkets of the seven cities. Then we asked the WTP for safe chicken. Respondents

[2] In 2013, there are 8.188, 14.170 and 10.159 million population in Nanjing, Chengdu and Linyi (larger cities group); 4.692 and 4.428 million population in Changzhou and Lianyungang (medium-sized cities group); and 3.165 and 3.801 million population in Zhenjiang and Zaozhuang (smaller cities group).

[3] For consumption, respondents can be asked to recall what they have consumed in past certain period. Usually food consumed a few days before can be recalled with relative ease. For instance, China Health and Nutrition Survey (CHNS) instrumented a 3-day recall request for each person in each day in their sample. However, the frequency of chicken consumption is low as most Chinese households eat one chicken per one or two weeks. As a result, we asked our respondents to recall chicken consumption in the previous seven days.

were asked to choose a premium payment card with values of 0, 10, 20, and 30. If the respondent selected a premium higher than 30 RMB, then he/she was asked to write down the specific amount (e.g. 35 RMB) above the ordinary chilled chicken price.[4]

In the WTP card question, if the individual chose a card value C_i as the highest acceptable price, the true WTP would lie somewhere between card value C_i and the next card value C_{i+1} ($C_{i+1} > C_i$). Thus the chosen WTP card reflects the lower bound of WTP (Cameron, 1987). For example, if a respondent indicated that he/she is willing to pay 30 RMB for a safe chicken, then the true WTP must be between 30 and 40 RMB, with 30 RMB being the lower bound. An alternative approach is to model WTP through a random utility framework (see example of Hu, Woods, Bastin, Cox, & You, 2011). In this paper, we do not apply the method Hu et al. (2011) approach so our measure of WTP will understate (by an amount <10 RMB) the true WTP. Thus our estimate is conservative. The study was conducted during the very first large scale outbreaks of bird flu in recent years in China. Most consumers did not have a good knowledge about bird flu and how to protect themselves from it. As a result, consumers' perceptions on the issue and actions to avoid bird flu can be expectedly overheated during this period. To generate results that are more in line with what the market may be during a less intensified time, we would like to be conservative in both WTP estimates and factors affecting WTP. Econometrically, Cameron (1987) showed that the OLS/GLS type of regression generates less efficient parameter estimates. Nevertheless, the less efficient OLS/GLS approach is consistent with our goal of offering a more conservative measure since it will make it less likely to reject the null hypothesis that a coefficient is zero. This enables us not to exaggerate factors that may have an impact on WTP.

In the 2013 survey, the same respondents (contacted by telephone) were asked whether they were willing to pay for an increased price of safe chicken. In the face of the AI outbreak, the respondents were presented the same WTP questions as were in 2012. Respondents were also allowed to enter an amount they would be willing to pay.

In the original 2012 survey, surveyors interviewed respondents at random in front of major supermarkets during both weekends and week days. The sampling strategy for conducting interviews in the downtown area of the seven cities does not allow the sample results to be generalized to the Chinese population as a whole; however, such a sample may be appropriate for studying H7N9.[5]

Surveyors (students from local colleges) were trained to collect data at supermarkets in April 2012. In April 2013, the surveyors carried out a 15 ~ 30 min follow-up telephone interview with the consumers who were intercepted in 2012 and whose contact information was kept. Repeated calls were placed until respondents agreed to participate again in 2013.

4.2. Descriptive statistics

A total of 860 people were surveyed in 2012, and 94% of them also replied to a follow up survey in 2013. In total, we use a final sample size of N = 802 participants. There were 129, 110, 99, 109, 129, 100, and 126 observations in Nanjing, Changzhou, Zhenjiang, Lianyungang, Linyi, Zaozhuang, and Chengdu respectively. All individuals in the sample indicated that they ate chilled chicken before the outbreak of H7N9. In return for participating, each subject was offered a payment of 50 yuan in both 2012 and 2013.

In our survey (see Table 1), over 40% of respondents were main shoppers in their households. About half were female and the average age was 38.73. 29% of the respondents had high school education, 47% had undergraduate education, and 6% had postgraduate education. The average monthly pre-tax income per adult in 2013 was 4579 RMB ($U.S. 727). The average family size was about 4 persons.

In Table 1, most of respondents thought it would be fatal if they ate infected chicken (mean of question "*consuming AI infected chicken would kill me immediately*" is 4.04), but personally believe they are not at risk (mean of question "*I am personally at AI risk*" is 2.56). We found that research institutes and ministry of health were relatively trusted by consumers and chicken sales staffs were always distrusted. The mean and standard deviation of the counter variable (knowledge) are 2.39 and 1.27 respectively.

In this section we provide an overview of results related to changes in chicken consumption and WTP between 2012 and 2013. With the exception of H7N9 in 2013, the economic and food safety conditions were unremarkably similar, so that as an 'event' the emergence of avian influenza can be viewed as a systemic treatment effect. This treatment effect is later modified in the econometric analyses to capture local effects at cities in which AI was endemic and those where no bird flu was recorded. Table 2 cross-tabulates the actual change in chilled chicken consumption per week (one chicken is 1.5 KG). The first observation is that no individual surveyed increased chicken consumption over the period. Only 18.2% (N = 146) remained at the same consumption level. Overall, the effects of H7N9 caused approximately 82% of the consumers decreasing chicken consumption, with 56% (N = 449) halting consumption entirely.[6]

Table 3 compares WTP for the two years. Since the price of regular chicken was 30 RMB, an indication of 30 RMB implies a 0 WTP for safe chicken. In the upper off-diagonal and in the last column it is shown that 47% (N = 377) of respondents increased

[4] In 2012, respondents were indeed allowed to give a WTP higher than 60 RMB per chicken (premium higher than 30 RMB per chicken). It was a self-writing option. But nobody actually revealed a WTP higher than 60 RMB per chicken in 2012. It may reflect that the respondents were not so worried about the food safety of chicken in 2012; but their food safety concerns were raised significantly with H7N9 in 2013.

[5] Up to May 1st, a total of 128 cases of H7N9 human infection had been confirmed in mainland China. To be specific, there are 46 cases in Zhejiang, 33 cases in Shanghai, 27 cases in Jiangsu, 5 cases in Jiangxi, 4 cases in Fujian, 4 cases in Henan, 4 cases in Anhui, 2 cases in Shandong, 2 cases in Hunan, and 1 case in Beijing. Shanghai, Nanjing, and some other cities suspended live poultry transactions and prohibited the entry of exotic live poultry. So sampling in Jiangsu, Shandong and Sichuan province could be appropriate to represent the "high incidence" province, "low incidence" province and "zero incidence" province separately.

[6] The reduced consumption is unlikely to be a result of increasing price because the market price of chilled chicken has actually decreased from 16.73 RMB/kg in the April of 2012 to 15.32 RMB/kg in the April of 2013.

Table 2
Samples' actual consumption per week in 2012 and 2013.

$Cons_{2012}/Cons_{2013}$		Cons in 2013						Total
		0 chicken	0.25 chicken	0.5 chicken	1 chicken	2 chickens	3 chickens	
Cons in 2012	0.25 chicken	180	70	0	0	0	0	250
	0.5 chicken	155	21	26	0	0	0	202
	1 chicken	78	108	30	26	0	0	242
	2 chickens	35	0	41	3	18	0	97
	3 chickens	1	0	0	2	2	6	11
Total		449	199	97	31	20	6	802

Note: The table cross-tabulates the actual change in chilled chicken consumption per week (one chicken is 1.5 kg). For example, "0.25 chicken" means someone consumes one chilled chicken within a 4 week period. The table reports the number of observations in each category.

their WTP, including some 31.1% (N = 250) who's WTP exceeded 60 RMB. Along the diagonal approximately 25% (N = 202) of respondents did not change WTP between 2012 and 2013 and in the lower off-diagonal 29% (N = 233) actually reduced their WTP.

Table 4 combines the relationships in Tables 2 and 3 by matching chicken consumption in 2012 with WTP in 2013. Virtually all categories indicated decreased consumption between 2012 and 2013 with the only exception of the 30 RMB (zero premium) for the 0.25 chicken category. This is because of a reduction in other categories, e.g. from 1 chicken to 0.25 chicken. The critical observation, however, is in the 0-chicken column which shows that 449 consumers would not choose to consume chicken, even though they had a positive WTP for safe chicken. Of these, 55.7% (N = 250 or 31.2% of all consumers) would be willing to pay >60 RMB, a premium of >30 RMB above market prices for safe chicken.

5. Results

5.1. Basic regression

We estimated the models using FGLS (feasible generalized least squares) and found that the results did not change according to OLS estimation technique. Table 5 presents the result for consumption and WTP in 2013 and the change in consumption and change in WTP between 2012 and 2013. Because the estimated coefficients (marginal effects) are virtually identical using either consumption in 2013 or the change of consumption between 2012 and 2013 as the dependent variable, we discuss only the results for the actual consumption in 2013. The same argument applies for WTP.

We would generally expect a variable to have opposite signs in consumption and WTP, and this is what we find for the most part. Three risk perception variables were significant: "*Eating AI infected chicken will immediately kill me*" is a measure of dread. The more consumers believed in this statement, the lower consumption ($\beta = -0.045$) and the higher WTP ($\beta = 2.718$) was. Respondents who perceived the incident to be on the rise would decrease consumption and increase WTP ($\beta = -0.018$, $\beta = 3.913$). A rising incidence of AI might signify loss of control by the government. Duration and intensity might also be captured by "*AI is contagious among humans*" which led to a decrease in consumption, but had no effect on WTP. Variables "*AI can kill many people*" and "*I am personally at risk for AI*" were not significant in either equation, suggesting that consumers might find it difficult to internalize risk, or even death, from AI. This is quite different from the significant variable "*Eating AI infected chicken will immediately kill me*" which was conditioned on actually eating infected chicken. In other words, while consumers might believe that eating an infected chicken would lead to death, this might not be the same perception as the more ubiquitous risk of harm without the knowledge of consumption.

The extent by which consumers trusted information and information sources could also be important determinants of consumption and WTP. However, our results did not reveal this relationship. Consumers who generally trusted the research

Table 3
Samples' stated WTP in 2012 and 2013 (RMB per 1.5 kg chicken).

WTP_{2012}/WTP_{2013}		WTP in 2013					Total
		30 RMB	40 RMB	50 RMB	60 RMB	>60 RMB	
WTP in 2012	30 RMB	68	37	7	8	78	198
	40 RMB	75	65	33	11	52	236
	50 RMB	57	13	32	31	80	213
	60 RMB	60	11	17	27	40	155
	>60 RMB	0	0	0	0	0	0
Total		260	126	89	77	250	802

Note: The table cross-tabulates the actual change in chilled chicken WTP (one chicken is 1.5 kg). For example, "50 RMB" means someone revealed a 50 RMB WTP (20 RMB premium) for one chicken (1.5 kg). The table reports the number of observations in each category. WTP = 30, 40, 50, 60 RMB correspond to the choice of premium payment card with values of 0, 10, 20, 30 RMB; WTP > 60 RMB correspond to the premium payment >30 RMB which is out of the choice of all the given payment card so a self-writing value is asked.

Table 4
Dynamic of consumption and WTP.

WTP	Cons											
	0 chicken		0.25 chicken		0.5 chicken		1 chicken		2 chickens		3 chickens	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
>60 RMB	0	250	0	0	0	0	0	0	0	0	0	0
60 RMB	0	23	42	29	29	16	54	3	29	5	1	1
50 RMB	0	36	61	28	58	15	64	7	30	3	0	0
40 RMB	0	35	77	50	67	24	65	9	22	6	5	2
30 RMB	0	105	70	92	48	42	59	12	16	6	5	3
Total	0	449	250	199	202	97	242	31	97	20	11	6

Note: The table cross-tabulates the actual change in chilled chicken WTP and consumption (one chicken is 1.5 kg). The table reports he number of observations in each category.

institutes, friends and relatives would consume less. This might signify a loss in confidence in these sources. Likewise, significant reductions in WTP, not actual consumption, were related only to trust in local government.

What appeared to be the most significant effect was the amplification of risks associated with specific cities. In the high incidence cities of Nanjing, Changzhou, Zhengjiang and Lianyungang, consumption was negatively affected by being in these cities compared to being in the zero-incidence city Chengdu (the omitted category in the regression). In Zhengjiang the amplification of risk actually led to an increase in WTP ($\beta = 19.345$) compared to those in Chengdu. The impact on WTP was not significant for Nanjing and Changzhou, but negative for Lianyungang ($\beta = -11.300$). For low incidence cities Linyi, there was no significant impact on consumption compared to Chengdu, but there was significant reductions in WTP ($\beta = -30.220$). Although somewhat mixed, relative to expectations, the results are generally supportive of an amplification response to consumption and WTP due to the different levels of exposure to AI in the cities studied.

Relative to no additional statement at all, providing either risk-perception reducing information or risk-perception elevating information, had negative impact on consumption ($\beta = -0.049$ and -0.033 respectively). It appeared that providing any details about H7N9, whether positively or negatively led to heightened perception of risk thus lower consumption. It may reflect that the consumers may not trust in the additional information. They have built up risk-perception about H7N9 by themselves which is not susceptible to the interference of external information provided by investigators. So no matter whether the additional information is positive or negative, once the H7N9 is mentioned, the consumers will show high levels of fear and low levels of trust (in the additional information) and will reduce their consumption. The group seeing additional information did not change their WTP. Knowledge about H7N9 appeared to have no effect on consumption or WTP.

In Table 5, we find that lagged consumption had a significant positive effect on $Cons_{2013}$, while lagged WTP did not impact WTP_{2013}.[7]

In addition, we investigated restricted variable models. (1) Firstly, we restricted the risk perception variables to be zero. In all cases the Wald statistic indicated the collective significance of these variables but the adjusted R^2 statistic dropped in all equations compared to those in Table 5. An important observation in models with risk perceptions unrestricted and with trust, cities, and stimulus variables restricted, the signs and significance of the risk perception variables remained the same. Thus, we conclude that the risk perception variables were robust to model specification. (2) Secondly, we restricted the trust variables, and again in all models the Wald statistic indicates that, collectively, trust contributes to the explanatory power of the regressions, although we note that the drop in adjusted R-square from the baseline regression in Table 5 is significantly smaller. Indeed, as with the baseline results in Table 5, where different variable groupings were excluded, the trust variables did not materially improve the explanation of consumption and WTP. This confirms our previous conclusion that trust may not be as powerful an influence on food consumption and WTP as the risk perception variables. (3) Thirdly, the city incidence variables are also important. Collectively restricting the city dummy variables to zero affects the explanatory power of the base regression (Wald statistics are significant). The respective adjusted R-square for base model and restricted regression across models are (0.624, 0.496), (0.240, 0.100), (0.513, 0.151), and (0.231, 0.049) respectively. These results show the robustness of our main results. In combination with the risk perception variables, the evidence is clear and robust to model specification that when it comes to food consumption and WTP risk perceptions, and the social amplification of risk as measured by the endemic nature of H7N9 dominate choices. (4) At last, we removed the risk perception reducing and elevating variables, to find little effect on model fit.

5.2. Joint effects

In Table 6, we present a multinomial model relative to the $\Delta WTP = 0$ and $\Delta Cons = 0$ group. The results were very much consistent with those in Table 5 for $\Delta Cons < 0$. However, for $\Delta Cons = 0$ we found very little significance of the risk perception with "*AI Risk cannot be easily controlled*" and "*AI is contagious among humans*" being the exceptions. We did find that in terms of

[7] To investigate the potential correlation in the errors between the WTP and consumption equations we also estimated the equations using 3SLS with $Cons_{2013}$ and WTP_{2013} as endogenous variables. The 3SLS model showed that $Cons_{2013}$ and WTP_{2013} did not impact each other simultaneously, and the Hausman test failed to indicate an endogenous relationship between WTP and consumption. Furthermore, the 3SLS model did not materially or qualitatively change the main results in Table 5.

Table 5
FGLS regression on Cons and WTP.

Variables	$Cons_{2013}$	WTP_{2013}	ΔCons	ΔWTP
Fear in 2013				
$Fear_1$: I would not eat any other new food	−0.003	−0.163	0.013	−1.011
$Fear_2$: Eating AI infected chicken will immediately kill me	−0.045***	2.718***	−0.068***	3.426***
$Fear_3$: AI risk cannot easily be controlled	0.000	0.037	0.0003	0.320
$Fear_4$: AI risk is increasing	−0.018***	3.913***	−0.069***	4.439***
$Fear_5$: AI can kill many people	0.002	2.452***	−0.034**	2.738**
$Fear_6$: AI is contagious among humans	−0.025***	−0.280	−0.018	0.395
$Fear_7$: I am personally at risk for AI	0.001	−0.329	0.008	−0.394
Trust in 2013				
$Trust_1$: I trust ministry of agriculture	−0.006	−0.606	−0.001	1.512
$Trust_2$: I trust ministry of health	0.011	0.607	0.016	0.744
$Trust_3$: I trust research institutes	−0.016**	−0.525	0.023	−1.039
$Trust_4$: I trust local government	0.004	2.480**	0.010	2.520**
$Trust_5$: I trust TV news	−0.006	−1.037	−0.046***	−1.995
$Trust_6$: I trust network news	−0.002	0.643	0.011	1.193
$Trust_7$: I trust scholars	0.005	0.352	−0.023	−1.231
$Trust_8$: I trust friends and relatives	−0.014**	0.482	−0.038***	0.583
$Trust_9$: I trust chicken sales staff	0.010	−1.242	0.021	−2.139*
High incidence city dummy				
Nanjing	−0.039	3.708	−0.105*	−5.656
Changzhou	−0.043*	−0.371	−0.156**	−7.181*
Zhengjiang	−0.069**	19.345***	−0.194**	17.862***
Lianyungang	−0.022	−11.300***	0.035	−21.501***
Low incidence city dummy				
Linyi	0.009	−30.220***	0.104*	−40.649***
Zaozhuang	0.053*	4.900	−0.249***	−9.326*
New stimulus dummy in 2013				
Risk-perception reducing information	−0.049***	2.472	−0.130***	2.225
Risk-perception elevating information	−0.033**	2.581	−0.006	1.170
Knowledge in 2013				
Cognitive level about AI	0.002	0.637	−0.019*	0.387
Lagged WTP				
WTP in 2012	0.000	0.165**	–	–
Lagged consumption				
CONS in 2012	0.276***	−0.450	–	–
Gender				
Male	−0.010	−1.715	−0.035	−2.296
Age in 2013				
Age	−0.0002	0.018	−0.0002	0.010
Family type in 2013				
Total household population	−0.009*	−1.817***	0.006	−0.780
The proportion of children	−0.065	17.251***	−0.114	13.573*
The proportion of elder	0.057	2.023	−0.168*	4.296
Education dummy in 2013				
High school	−0.012	0.868	0.030	0.377
Undergraduate	−0.018	7.517**	−0.018	5.902*
Postgraduate	0.073**	3.703	0.141	0.887
Income dummy in 2013				
1501 ~ 3000 RMB	0.003	−1.112	0.106*	−0.580
3001 ~ 4500 RMB	−0.026	−1.568	0.016	−1.785
4501 ~ 6000 RMB	−0.025	−2.182	0.012	−0.495
6001 ~ 7500 RMB	−0.059*	−1.324	−0.076	−2.563
>7500 RMB	−0.023	−5.006	−0.067	−6.653
Constant	0.476***	24.030***	0.316**	−9.320
Observation	802	802	802	802
Adj R^2	0.458	0.835	0.641	0.278
F statistics	17.53***	100.26***	37.76***	8.91***

Note: Asterisk (*), double asterisk (**) and triple asterisk (***) denote variables significant at the 10%, 5% and 1% significance levels respectively.

Table 6
Multinomial logistic regression (base case: $\Delta WTP = 0$ & $\Delta Cons = 0$).

Variables	Conditions				
	$\Delta WTP > 0$ & $\Delta Cons = 0$	$\Delta WTP < 0$ & $\Delta Cons = 0$	$\Delta WTP = 0$ & $\Delta Cons < 0$	$\Delta WTP > 0$ & $\Delta Cons < 0$	$\Delta WTP < 0$ & $\Delta Cons < 0$
Fear in 2013					
$Fear_1$: I would not eat any other new food	0.045	0.244	0.228	0.083	0.248
$Fear_2$: Eating AI infected chicken will immediately kill me	0.417	0.423	1.005***	1.042***	0.892***
$Fear_3$: AI risk cannot easily be controlled	0.693*	0.025	−0.135	−0.156	−0.144
$Fear_4$: AI risk is increasing	−0.349	−0.263	0.451**	0.471***	0.537***
$Fear_5$: AI can kill many people	0.241	−0.100	0.012	0.039	−0.206
$Fear_6$: AI is contagious among humans	−0.535	−0.529*	0.159	0.277	0.390**
$Fear_7$: I am personally at risk for AI	−0.683	0.327	−0.123	0.044	−0.120
Trust in 2013					
$Trust_1$: I trust ministry of agriculture	1.712**	0.622*	0.583**	0.491**	0.394
$Trust_2$: I trust ministry of health	−1.706**	−0.259	−0.404	−0.213	−0.066
$Trust_3$: I trust research institutes	0.882*	−0.029	0.421	0.074	0.010
$Trust_4$: I trust local government	−0.453	−0.754**	−0.263	−0.131	−0.290
$Trust_5$: I trust TV news	0.251	0.719*	−0.103	0.292	0.523*
$Trust_6$: I trust network news	0.175	−0.190	0.230	0.097	−0.054
$Trust_7$: I trust scholars	−0.208	0.146	−0.009	−0.224	0.037
$Trust_8$: I trust friends and relatives	0.040	−0.239	0.034	0.131	0.142
$Trust_9$: I trust chicken sales staff	−0.176	0.160	0.058	−0.112	−0.070
High incidence city dummy					
Nanjing	−0.029	2.781**	2.767***	1.320**	2.287***
Changzhou	−0.949	2.703**	1.894**	0.484	1.725**
Zhengjiang	−17.469	2.666*	0.754	0.800	1.303*
Lianyungang	−0.701	3.605***	2.451***	0.025	1.878**
Low incidence city dummy					
Linyi	0.249	3.845***	2.243***	−0.693	2.655***
Zaozhuang	−0.030	−12.782	0.228	0.343	1.021
New stimulus dummy in 2013					
Risk-perception reducing information	0.654	1.127*	1.652***	1.270***	1.018**
Risk-perception elevating information	0.865	0.662	1.335***	1.085**	0.045
Knowledge in 2013					
Cognitive level about AI	−0.149	−0.286	−0.381**	−0.193	−0.042
Lagged WTP					
WTP in 2012	−0.131***	0.118***	−0.036*	−0.004	0.098***
Lagged consumption					
CONS in 2012	−0.375	0.501	0.758**	0.473*	0.458
Gender					
Male	0.042	−0.670	0.708*	0.025	−0.183
Age in 2013					
Age	−0.046	−0.058**	−0.001	−0.024*	−0.021
Family type in 2013					
Total household population	0.051	−0.123	−0.322**	−0.051	0.131
The proportion of children	0.325	0.053	2.050	0.820	1.795
The proportion of elderly	−0.104	−0.137	0.111	0.403	0.267
Education dummy in 2013					
High school	−0.999	−1.133	0.823	−0.056	0.149
Undergraduate	−0.769	−0.516	−0.210	0.102	0.066
Postgraduate	−0.653	−1.126	−1.188	−0.931	−1.985**
Income dummy in 2013					
1501 ~ 3000 RMB	16.455	0.235	0.575	0.192	0.506
3001 ~ 4500 RMB	16.205	−0.133	0.904	0.621	1.044
4501 ~ 6000 RMB	15.587	−1.468	0.627	−0.014	−0.061
6001 ~ 7500 RMB	16.344	−16.075	2.172*	1.459	2.194*
>7500 RMB	16.133	−0.170	1.034	0.311	0.795
Constant	−12.196	−6.054*	−7.624	−5.906***	−13.94***
Observation	802				
Adj. R^2	0.343				

Note: Asterisk (*), double asterisk (**) and triple asterisk (***) denote variables significant at the 10%, 5% and 1% significance levels respectively.

Table 7
Estimation of shock elasticity (dependent variable is $|\eta|$).

Variables	$\eta \leq 0$	$\eta > 0$
Fear in 2013		
$Fear_1$: I would not eat any other new food	−0.172***	−0.072
$Fear_2$: Eating AI infected chicken will immediately kill me	0.167**	−0.222**
$Fear_3$: AI risk cannot easily be controlled	0.020	0.000
$Fear_4$: AI risk is increasing	0.028	0.177*
$Fear_5$: AI can kill many people	0.069	−0.051
$Fear_6$: AI is contagious among humans	0.027	−0.009
$Fear_7$: I am personally at risk for AI	0.048	−0.045
Trust in 2013		
$Trust_1$: I trust ministry of agriculture	−0.004	−0.094
$Trust_2$: I trust ministry of health	0.008	0.118
$Trust_3$: I trust research institutes	0.024	−0.058
$Trust_4$: I trust local government	0.032	0.010
$Trust_5$: I trust TV news	−0.156	−0.102
$Trust_6$: I trust network news	0.012	0.224*
$Trust_7$: I trust scholars	−0.001	0.128
$Trust_8$: I trust friends and relatives	0.061	−0.104
$Trust_9$: I trust chicken sales staff	−0.065	0.077

Note: Asterisk (*), double asterisk (**) and triple asterisk (***) denote variables significant at 10%, 5% and 1% respectively.

trust, if they trusted the ministry of agriculture, consumers were more likely to change their consumption or WTP. The coefficient of "*I trust the ministry of agriculture*" is significant and positive in 4 out of 5 equations, which indicates the effect of trust in the ministry of agriculture should be heterogeneous. The reason may lie in that the Ministry of agriculture is the major official news source with much of the good or bad news regarding H7N9 reported by it.[8] It is possible that upon hearing or reading H7N9 news from the Ministry of agriculture, respondents may react differently because their understanding of H7N9 is ambiguous.

The city incidence variables also provided some interesting results, the most striking being that none of the incidence variables were significant for consumers who increased WTP but did not change consumption. For those individuals whose WTP in 2012 was lower, their WTP in 2013 increased. Yet, there was an increased likelihood that consumers with a decrease in WTP and no change in consumption came from high incidence cities. Similar levels of significance applied to the other Logit groupings (other situations).

Likewise, risk-perception reducing or elevating information had virtually no influence on membership of the two $\Delta Cons = 0$ groups while having much stronger influence on the likelihood of being in the $\Delta Cons < 0$ groups. Knowledge of H7N9 did not appear to have a strong or consistent influence on group membership.

Habit formation also had an influence on group membership. The higher the WTP observed for safe food in 2012 the less likely that membership would belong to $\Delta WTP > 0$, and would be more likely to be in the $\Delta WTP < 0$ group. This suggested that with the revelation of H7N9, consumers actually would reassess their WTP. In other words, if WTP in 2012 was high, the change in WTP would be smaller, probably because "food safety" in 2012 already took AI into overall considerations of food-related risks. Similarly, the more chicken consumed in 2012 the more likely the consumers would be in the $\Delta Cons < 0$ groups.

Finally, we calculated the relative (shock) elasticity and provide results in Table 7. The purpose of doing this is to measure differences in actual chicken consumption against the desire for safe chicken to the risk perception (and others factors). Here we take the absolute value of the elasticity so that an increase in the regression coefficient would indicate increases in elasticity. An expected elasticity is one in which an increase in WTP for safe chicken coincided with a decrease in chicken consumption. There were 419 samples with an expected elasticity (denominator ≠ 0 & $\eta \leq 0$) which came from the groups of $\Delta Cons < 0$ & $\Delta WTP > 0$; $\Delta Cons = 0$ & $\Delta WTP < 0$; and $\Delta Cons = 0$ & $\Delta WTP > 0$. We found that trust seemed not to be important for the shock elasticity, but $Fear_2$ (*Eating AI infected chicken will immediately kill me*) significantly enhanced the shock elasticity. There were 191 samples with an unexpected elasticity (denominator ≠ 0 & $\eta > 0$) which came from the group of $\Delta Cons < 0$ & $\Delta WTP < 0$. We found that trust in network news would cause the unexpected elasticity to increase while $Fear_2$ (*Eating AI infected chicken will immediately kill me*) had an opposite effect.

5.3. Robustness check with principal component analysis

Although we believe that the problem of multicollinearity is moderate and the results of independent fear and trust questions are more easily understood, we further investigated the robustness of our assumption by extracting fear and trust factors using

[8] For example, there can be both negative and positive information in one news story; the headline "Gov't Pumps More Funds into H7N9-hit Poultry Sector" reported that "the latest figures from the China Animal Agriculture Association show that the industry has recorded >40 billion yuan in losses since the H7N9 outbreak in March" and "to prevent the spread of the H7N9 virus, the government has ordered poultry to be culled in some areas since March. It also closed live poultry markets to reduce human contact with birds". http://english.agri.gov.cn/hottopics/ah/201308/t20130819_20124.

Table 8
Robustness check with score of fear and trust.

Variables	$Cons_{2013}$	WTP_{2013}	Multinomial logistic regression (base outcome: ΔWTP = 0 & ΔCons = 0)					Shock elasticity	
			ΔWTP > 0 & ΔCons = 0	ΔWTP < 0 & ΔCons = 0	ΔWTP = 0 & ΔCons < 0	ΔWTP > 0 & ΔCons < 0	ΔWTP < 0 & ΔCons < 0	η ≤ 0	η > 0
$Fear_{MICRO}$	−0.107***	7.245***	−0.333	−11.746	0.861***	1.075***	0.954***	0.054	−0.152*
$Fear_{MACRO}$	−0.115***	7.450***	0.332	0.155	1.058***	1.244***	1.071***	0.266***	−0.040
$Trust_{OFFICIAL}$	−0.047***	1.865	0.182	0.058	0.295	0.266*	0.402**	−0.052	0.082
$Trust_{PRIVATE}$	−0.040***	1.255	0.111	0.105	0.082	0.272*	0.290*	−0.001	0.052
$Trust_{SUPPLY}$	0.021*	−0.311	−0.224	−0.001	0.102	−0.052	−0.065	−0.013	0.073

Note: Asterisk (*), double asterisk (**) and triple asterisk (***) denote variables significant at the 10%, 5% and 1% significance levels respectively.

Principal Component Analysis (PCA). The estimated results show that our estimations are robust. We report the model with PCA as follows; first, we calculated the *Z*-value for each fear and trust variables. Two "fear" factors were extracted. The KMO value was 0.706, and the Chi-Square for Bartlett's Test was 889.336. The Eigenvalues of the first two components were >1. These two factors explained 50.725% of the total variance. We defined the first factor of fear as micro-fear (or fear related to getting sick) which was composed of $Fear_6$ (score = 0.719), $Fear_7$ (score = 0.608), $Fear_1$ (score = 0.593) and $Fear_5$ (score = 0.511), and we defined the second factor of fear as macro-fear which was composed of $Fear_4$ (score = 0.716), $Fear_3$ (score = 0.705) and $Fear_2$ (score = 0.676). We extracted three trust factors; the KMO value was 0.818, and the Chi-Square for Bartlett's Test was 2608.522. The Eigenvalues of the first three components were >1. These three factors explained 67.321% of the total variance. We defined the first factor of trust as "official-trust" which was composed of $Trust_1$ (score = 0.832), $Trust_2$ (score = 0.823), $Trust_4$ (score = 0.764), $Trust_3$ (score = 0.750) and $Trust_7$ (score = 0.647); the second factor of trust was defined as "private-trust" which was composed of $Trust_8$ (score = 0.775), $Trust_6$ (score = 0.746) and $Trust_5$ (score = 0.547); and the third factor of trust was "supplier-trust" which was composed of $Trust_9$ (score = 0.932). Table 8 displays the result of the fear and trust factors to consumption, WTP as well as shock elasticities.

In the $Cons_{2013}$ and WTP_{2013} equation, both of the micro and macro fear, showed significantly negative effect on $Cons_{2013}$ ($\beta = -0.107$ and $\beta = -0.115$) and significantly positive effect on WTP_{2013} ($\beta = 7.245$ and $\beta = 7.450$). Official and private trust showed negative effect on $Cons_{2013}$, while trust in supplier showed positive effect on $Cons_{2013}$. In addition, the score of trust did not affect WTP_{2013}.

In the multinomial logistic regression, we found that no matter how WTP responded, fear in general would reduce Chinese consumers' actual chicken consumption. At the same time, the reactions in their WTP were heterogeneous. This suggests that the greater the perceived risk, the more complex consumers may behave; that is, some would keep their WTP unchanged, some would be willing to pay higher premium to buy safe chicken, and some would decrease their WTP because of the mistrust in food safety. For the last case, the possible reason is that somebody may treat the so called safe chicken as a "Giffen good" or inferior good because they did not believe it could be as safe as it was claimed. These individuals would decrease their consumption and WTP simultaneously.

For shock elasticities, while trust may have only minimal effect, fear factors on the other hand had significant effect moving consumers to different shock elasticity groups.

6. Conclusion

In this article we examined the psycho-economic impact of H7N9 avian influenza on Chinese consumer demand and WTP for safe chicken. Our sample of 802 consumers were first surveyed in 2012 before the emergence of H7N9 in 2013, and then resurveyed after the H7N9 discovery. Two key pieces of information gathered were actual chicken consumption and WTP for safe chicken. In addition, the 2013 survey queried consumers on various aspects of knowledge, risk perceptions, and trust. The cities where respondents were located were identified, allowing for an assessment related to the intensity of infection.

The most interesting observation from an economic point of view is that while consumption never increased for consumers between 2012 and 2013, the emergence of H7N9 did not necessarily lead to an increase in WTP relative to generic food-related risks in 2012. We found from these natural conditions that the WTP for safe chicken did not necessarily increase with reductions in chicken consumption. Chicken, has many close meat substitutes including beef and lamb (Wong, Selvanathan, & Selvanathan, 2015; Säll & Gren, 2015),[9] suggesting that the iso-utility indifference curve would be linear and that $\frac{\Delta Cons}{\Delta WTP}<0$. But this is not found generally, suggesting that WTP does not always follow the Marshallian demand when it comes to food quality and safety. Instead, we show that psychological factors related to risk perception can affect the relationship between ΔCons and ΔWTP in many different ways, positive or negative, shifting demand up or down. On this point our analysis is in agreement with Hanemann (1991) and Shogren, Shin, Hayes, and Kliebenstein (1994) that when health is considered as a credence attribute of food, the non-substitutability of health in private or public markets adds varying degrees of curvature to the indifference curves leading to $\frac{\Delta Cons}{\Delta WTP}$ relationships that are not linear in scale.

[9] Wong et al. (2015) model the demand for the various types of meat in Australia using data from 1962 to 2011 and find that the cross-price elasticities of chicken-pork and chicken-mutton are negative, indicating that are pairwise complements; and cross-price elasticities of chicken-beef and chicken-lamb are positive indicating that are pairwise substitutes. Säll and Gren (2015) also find a similar result, that is chicken-pork are pairwise complements and chicken-beef are pairwise substitutes.

From the behavioral point of view, our results can be explained by behavioral factors rooted in social psychology. These hold across various robustness checks. The perception of risk generally led to decrease in demand and increased WTP, but the risks perceived were not necessarily the same for either. Trust in different institutions and information sources did not appear to be a strong determinant of consumer response in consumption or WTP, perhaps because the information provided by those sources are mixed and at times ambiguous; but risk amplification did. Consumers in cities in which H7N9 was endemic were far more responsive than those in cities that had low or no incidence.

Our results are similar to some previous studies. For example, Haab, Whitehead, Parsons, and Price (2010) stated that consumers, in order to protect their health from the risk of seafood, would decrease their consumption of seafood. Yang and Goddard (2011), and Lim et al. (2013) found that consumers were willing to pay more for safe beef to avoid the risk associated with BSE in Canada. Thus fear is found to be the impetus for consumers to eat less and pay a higher premium for safe chicken.

We also believe that trust (in different institutions and information sources) and fear may work simultaneously but with opposite roles, (Bocker & Hanf, 2000; Meijboom et al., 2006) but we find no meaningful relationship to support this. Perhaps this is because our survey timeframe was within 60 days of the start of the H7N9 epidemic which was the peak period of this round, and so consumer ambiguity and uncertainty may dominate any messages from trusted sources (e.g. the Ministry of Agriculture). This has also important policy implications for information from private sources but more specifically public sources such as the government and scholars. The findings from Ortega, Wang, Wu, and Olynk (2011) indicates that while the trust in the government may seem to be eroding in the face of recent food safety scandals in China, consumers were less confident on non-government food safety controls than government-led control measures, and this seems to be consistent with our findings. It may take a long time to regain consumers' confidence and demand when consumers are already confused and oversaturated by the media (Hassouneh et al., 2012).

Our results differ from previous studies in other ways. For example, Wessells, Kline, and Anderson (1996) and Parsons, Morgan, Whitehead, and Haab (2006) found that seafood consumption decreased with negative information and increased with some types of positive information. Smith et al. (1988); Hu, Adamowicz, and Veeman (2009); Haab et al. (2010) found that negative food safety information tends to decrease consumption, while positive information does not necessarily have the opposite effect. We find that reinforcing any information about H7N9, positive or negative, reinforced negative consumption and perceptions. Perhaps this is because trust in positive information is still not high in China (Sirieix, Kledal, & Sulitang, 2011; Chen, 2013). For example, Wu, Wang, Zhu, Hu, and Wang (2015) found that the WTP for certified traceable food in China was very "limited". This therefore suggests that government and private entities involved in food safety labeling, information and consumer education have a substantial amount of work to do to gain the trust of the Chinese consumers.

Finally, with the evidence at hand, we recommend that further research explore changes in consumption and WTP from a psychological point of view. It seems on the surface that the change in consumption might well be an emotional response to risk, while the changes to WTP a rational response to risk. Recent models in psychology based on this dual process in a utility framework (Kahneman, 2011; Schulze & Wansink, 2012; Loewenstein & O'Donoghue, 2004; Mukherjee, 2010) could possibly add clarity to the complex interactions of food safety, and risk perceptions. Schulze and Wansink (2012), for example, show consumers' responses to perceived risk as a mix of proportional and dichotomous (safe/unsafe, good/bad) responses that are relatively more continuous in situations where deliberation is possible, and more dichotomous in emotional or stressful circumstances. Their dual-process model seems to reconcile what is observed in our data. For example our findings that different aspects of risk perceptions affect consumption, while other affect WTP suggest that a more complex model may be at play.

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