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The Effects of Avian Influenza News on Consumer Purchasing Behavior

A Case Study of Italian Consumers' Retail Purchases

**Robert H. Beach, Fred Kuchler,
Ephraim Leibtag, and Chen Zhen**

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Abstract

To better understand how information about potential health hazards influences food demand, this case study examines consumers' responses to newspaper articles on avian influenza, informally referred to as bird flu. The focus here is on the response to bird flu information in Italy as news about highly pathogenic H5N1 avian influenza (HPAI H5N1) unfolded in the period October 2004 through October 2006, beginning after reports of the first outbreaks in Southeast Asia and extending beyond the point at which outbreaks were reported in Western Europe. Estimated poultry demand, as influenced by the volume of newspaper reports on bird flu, reveals the magnitude and duration of newspaper articles' impacts on consumers' food choices. Larger numbers of bird flu news reports led to larger reductions in poultry purchases. Most impacts were of limited duration, and all began to diminish within 5 weeks.

Keywords: Avian influenza, bird flu, consumer behavior, food safety, poultry sales and consumption, risk perception and response

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Summary

To better understand how information about potential health hazards influences food demand, this case study examines consumers' responses to newspaper articles on avian influenza, informally referred to as bird flu. The focus here is on the response to bird flu information in Italy as news about highly pathogenic H5N1 avian influenza (HPAI H5N1) unfolded in the period October 2004 through October 2006, beginning after reports of the first outbreaks in Southeast Asia, and extending beyond the point at which outbreaks were reported in Western Europe. Estimated poultry demand, as influenced by the volume of newspaper reports on bird flu, reveals the magnitude and duration of newspaper articles' impacts on consumers' food choices. Larger numbers of bird flu news reports led to larger reductions in poultry purchases. Most impacts were of limited duration, and all began to diminish within 5 weeks.

What Is the Issue?

Claims that outbreaks of HPAI H5N1 sharply reduced poultry purchases have accompanied the discovery of the disease in Asia, Africa, and Europe. However, there has been little empirical analysis of consumer response to these outbreaks. Measuring how bird flu has affected consumer demand for poultry is challenging because consumers' risk perceptions were likely influenced by numerous pieces of information: reports indicating the occurrence of disease among wild birds, domesticated poultry, and humans. These events occurred at different times and in different countries.

Consumer reaction to HPAI H5N1 could have as large an impact on the poultry industry as the disease itself. Yet, for countries with large-scale commercial poultry production that have reported outbreaks, claims that poultry purchases declined significantly following discovery of HPAI H5N1 in wild birds or in isolated cases on farms are a bit puzzling. In these countries, poultry raised indoors under tightly controlled environments are unlikely to contact wild birds or other sources of the disease, and farmers have a strong financial incentive to eradicate the disease if it were found in their commercial flocks. In addition, policymakers have strong incentives to ensure prevention and control of HPAI H5N1 to ensure public health and to maintain domestic and export markets for poultry. In effect, the health risk consumers face from consuming poultry products may be very small, in which case the large reported sales losses appear out of proportion to the risk faced by consumers.

Although there have been three instances of HPAI outbreaks in the United States, none were of the HPAI H5N1 strain. Thus, there is no systematic basis for forecasting how U.S. consumers might react to domestic detection of this particular strain that has resulted in huge losses to the poultry sector in other regions, killed over 200 people in Asia and Africa, and raised concerns of a potential human pandemic. Studying consumer response to bird flu news outside the United States is informative conditional on recognizing why those consumers and U.S. consumers might respond differently to news about health risks. This case study examines the responses of consumers in Italy to media reports on bird flu. Findings could benefit the design of food policy.

What Did the Study Find?

Over the sample period August 2004 through October 2006, European newspapers averaged 324.4 bird flu articles per week that did not mention Italy and 24.7 that did. The number of European newspaper articles on bird flu surged to 2,455 articles in the week ending October 23, 2005, following reports that the virus had been found in Turkey, Romania, and Croatia. Additional spikes followed in January through April 2006 as HPAI H5N1 was identified in Turkey, Romania, and Croatia, and later in Austria, France, Germany, Italy, Sweden, and Switzerland. The weekly number of newspaper articles on bird flu that mentioned Italy was relatively flat but spiked in the week ending February 19, 2006, with the discovery of the H5N1 subtype of HPAI in dead wild swans in southern Italy.

During the same period, newspaper articles on bird flu had a statistically significant effect on sales of poultry products in Italy, both fresh and frozen. At the margin, each additional newspaper article reduced purchases, and did so over time. Results include the following:

- For fresh poultry, historical sales were, on average, 79.8 percent of what they would have been if there had been no news about bird flu.
- Non-Italy-specific news about bird flu reduced fresh poultry sales by an average of 13.5 percent, and Italy-specific news was responsible for a further 6.7-percent drop.
- Non-Italy-specific news and Italy-specific news reduced purchases of frozen and processed poultry by 4.1 percent and 14.6 percent, respectively.

On average, each additional newspaper report about bird flu reduced consumption, but the reductions were not permanent and eventually diminished. For fresh poultry consumption, the largest decline occurred in the second week after the newspaper report was published. For frozen and processed poultry sales, the response to news that was not Italy-specific was largest in the same week the news was reported and declined to about a third of the initial response in the second week. By the fifth week, the response had become negligible. The response to Italy-specific news increased, fell, and increased again before diminishing.

How Was the Study Conducted?

For most countries in which HPAI H5N1 has been detected, there is little publicly available data suitable for quantitative evaluation of the effects on meat consumption. However, Nielsen reported weekly data on quantities purchased and expenditures for 24 categories of poultry, beef, pork, and fish and seafood products in Italy, capturing a large share of the total market for meats. The weekly frequency of the Italian data made it suitable for investigating the temporal behavior of consumer response to the westward-trending bird flu reports as previous research and attributes of bird flu both pointed to short-lived responses. Two separate demand equations were estimated—one for fresh poultry and one for frozen and processed poultry. Each related the quantity demanded to the price of fresh poultry, the price of frozen and processed poultry, prices of beef, pork, and fish and seafood, and indices of

bird flu news. Analysts used the estimated equations to simulate quantities of poultry purchased at retail with and without news reports about avian influenza.

Researchers constructed weekly counts of newspaper articles to address whether changes in consumption were likely related to bird flu versus other explanations. The news index was built from a LexisNexis Academic search of European news articles on bird flu. Splitting the counts into Italy-specific news and non-Italy-specific news partially accounts for different types of risk information in news. Italy-specific news ought to be of greater risk salience to Italians than more general news about bird flu. The non-Italy-specific news, although always greater in volume than Italy-specific news, points to Italian consumers' exposure to information about the situation in the rest of the world.

Introduction

More than 200 million birds worldwide have died or been culled because of highly pathogenic avian influenza subtype H5N1 (HPAI H5N1) since 2003 (FAO, 2006). This has severely impacted the poultry sectors in several countries, primarily in Southeast Asia. In addition, the World Health Organization reports that as of June 19, 2008, there have been 385 confirmed human cases of avian influenza (H5N1) worldwide (WHO, 2008). Of these, 243 resulted in death, implying a fatality rate of 63 percent. Few illnesses have such high rates. Even though many other illnesses may sicken larger shares of the population and cause larger numbers of deaths, this particular virus is seen as a serious public health concern. It is possible that the pathogen might mutate and be easily transmitted among humans while retaining its fatality rate (WHO, 2007).

In countries that have reported finding HPAI H5N1, impacts on commodity markets have varied; in Southeast Asian countries, the disease has sometimes had large negative effects on productivity, supply chains, and Gross Domestic Product (GDP). Many factors help account for variation in supply-side effects of disease discoveries. Disease pressure has varied geographically. Most HPAI H5N1 reports in Europe have been limited to intermittent discoveries of a few wild birds. In Southeast Asia, some outbreaks have persisted, with infections common in both wild and commercial birds.

Poultry production practices vary significantly across countries and even within a country, which also affects the degree to which outbreaks affect a market. Outbreaks have been more frequent where the conditions under which poultry is raised are not tightly controlled. Where poultry is housed in enclosed buildings and farmers exercise careful control over feed and environmental conditions, outbreaks have been relatively rare and eradication has generally been quick. In the outbreaks of 2003 and 2004, veterinary services in Southeast Asia were not prepared to mitigate impacts of HPAI H5N1 outbreaks. Direct losses were highest in Vietnam (44 million birds, amounting to approximately 17.5 percent of the poultry population) and Thailand (29 million birds, 14.5 percent of the poultry population) (McLeod et al., 2005).

Incentives to eradicate the disease are not uniform across countries. Some countries have left responses to outbreaks to individual farmers, and others have required the slaughter of millions of birds, with widely varying levels of compensation.[1] For small-scale operations, eradication may be economically infeasible. In Southeast Asia, farm biosecurity—enclosing birds—accounts for most of the investment cost (McLeod et al., 2005).

In addition, the way in which countries' trading partners respond to outbreaks can have an effect on economic impacts of the disease. Some countries that supplied poultry in international markets lost export markets following reports of outbreaks.[2] Importing nations have sometimes accepted exporters' actions as being sufficient to control bird flu, but others have shut down imports.

But, as in the analysis of markets for almost any good or service, understanding the structure of the supply side does not provide enough infor-

[1]Production losses have taken two forms: birds have died from contracting bird flu, and birds have been culled to prevent spread of the disease.

[2]Bird flu outbreaks in Thailand and China disrupted their exports as some importing countries stopped importing (Blayney et al., 2006).

mation to forecast impacts of changed market conditions. The potential threat to human life makes HPAI H5N1 more than a productivity concern. Conceivably, consumers could largely ignore bird flu outbreaks.[3] If consumers felt that bird flu posed little to no risk to their own health, they may not substantially alter their meat and poultry expenditures in response to news about outbreaks. In that case, productivity losses and/or additional disease prevention and control expenses may actually result in increased market prices for poultry. On the other hand, if outbreak reports led consumers to significantly change their perceptions of health risks from consuming poultry, large numbers of consumers could reduce poultry consumption or even stop eating poultry products on news of an outbreak. In that case, aggregate demand may fall along with the reduced supply, prices may fall, and direct production losses might account for only a small part of the reduction in poultry sales. Market outcomes may differ, depending on the conditions associated with an individual outbreak. The NPD Group noted that the third bird flu case found in a chicken flock in Japan provoked a particularly large negative consumer reaction because media reports claimed the affected farmer disguised the fact that an infection occurred in his flock and continued to distribute chickens and eggs (NPD Group, 2006b).

If analysts were completely uncertain about how consumers might respond to an outbreak, they would have no ability to predict market outcomes. Even armed with subtle and detailed knowledge of the current structure of the poultry industry, its supply chain, and the conditions under which international trading occurs, analysts would be unable to offer much insight on retail-consumer market impacts.

Currently, the effects of HPAI H5N1 on demand for poultry products are unknown and, so far, largely unexplored. Many analysts have examined poultry consumption statistics before and after outbreaks and have attributed observed differences to the outbreaks. For example, NPD Group described the situation in Germany as follows:

> Bird flu appeared in October 2005 for the first time in Europe and was massively discussed in the German media. Chicken consumption during the time interval from October 2005 to March 2006 declined by -2.0 percent compared to the previous year (NPD Group, 2006a).

While these types of comparisons may be carefully constructed, they are potentially confounded with systematic movements in poultry demand: chicken demand may have been falling even without bird flu discussions in the media. The comparisons do not account for the principal factors likely to influence poultry consumption, such as the price of chicken and the prices of other meats.

In estimating the impacts of outbreaks of avian influenza on poultry demand, this report first accounts for the typical factors that influence food choices, including relative prices of poultry and other meats as well as established trends and seasonality in poultry consumption. It then accounts for remaining changes in consumption based on the degree to which consumers' fears of a new food safety risk—HPAI H5N1—rise and fall. This analysis examines three questions about bird flu-induced reductions in poultry demand:

[3]USDA's long-term projections report formally assumes bird flu will not significantly affect overall consumer demand for poultry (USDA, OCE, WAOB, 2007). McLeod et al. (2005) make the same assumption.

- How fast does news about bird flu raise consumers' risk perceptions and reduce poultry purchases?
- How large is the reduction?
- How long does the reduction last?

Data on media coverage were used to construct indices representing the amount of information on bird flu being presented to consumers each week. This methodology was used to conduct a case study using data on purchase patterns in Italy.

Knowing how consumers responded to these announcements and, more generally, to news about the safety of the food supply, is important for the design of food policy. Public information programs that effectively communicate risk information could prevent consumers from responding out of proportion to the risks they face. Consumers and food suppliers both might gain if consumers do not avoid foods that are safe. When consumers make informed risk decisions, they create incentives for food suppliers to take cost-effective safety precautions. Also, accurate assessments of consumer responses to food safety risk information will help the public sector gauge the need for industry relief.

In the private sector, understanding how consumers worldwide react to food safety news is important from a marketing perspective. Exports of U.S. poultry may be buffeted by food safety news overseas if consumers at export destinations worry about the safety of poultry products.

Data

This research first accounts for systematic and routine movements in poultry purchases stemming from changes in retail prices, ongoing longrun consumption trends, and seasonal purchase patterns. It then examines the quantity and timing of bird flu news coverage to help explain remaining variation in purchases. Thus, data focus on prices and quantities of poultry purchased at retail, and quantity of bird flu newspaper reports at different times.

Retail Purchase Data

Publicly available data for quantitative evaluation of the effects of bird flu concerns on meat sales are limited. The Nielsen Company provided data on meat purchases for 14 foreign countries that have experienced bird flu outbreaks.

This study focuses on Italy because the currently available Nielsen sales data for Italy are the most complete and consistent series in the international dataset. Italian data start from the week ending October 10, 2004, and end in the week ending October 1, 2006, yielding a total of 104 weekly observations. According to Nielsen, the data comprise audited scanner data that cover the following types of outlets in Italy: self-service, grocery, and discount for beef, pork, and turkey; and hypermarkets, supermarkets, self-service, grocery, and discount for chicken, fish, and seafood. Moreover, the dataset reports expenditures and volumes for 24 categories of poultry, beef, pork, and fish and seafood products. These products include five categories of beef (fresh fixed-weight products, frozen fixed-weight products, frozen

ready-to-eat meals based on beef, beef lunch meat, and beef hot dogs), four categories of pork (fresh fixed-weight products, frozen fixed-weight products, frozen ready-to-eat meals based on pork, and pork hot dogs), three categories of turkey (fresh fixed-weight products, frozen ready-to-eat meals based on turkey, and turkey hot dogs), four categories of chicken (fresh fixed-weight products, frozen fixed-weight products, frozen ready-to-eat meals based on chicken, and chicken hot dogs), four categories of fish (fresh fixed-weight products, frozen fixed-weight products, frozen ready-to-eat meals based on fish, and canned and preserved fish), and seafood (fresh fixed-weight products, frozen fixed-weight products, frozen ready-to-eat meals based on seafood, and canned and preserved seafood). Nielsen data capture a large percentage of the markets for these products, estimated by Nielsen at between 85 and 93 percent of each market for products with reported coverage estimates.[4] A caveat is that the data do not include fresh random-weight products and do not report coverage estimates for fresh meats.

The time period covered by the Italian data provides a unique opportunity for examining how consumers' risk perceptions evolve due to changes in information, as consumers were repeatedly presented with information that might suggest increased risk from food. Data cover the period in which HPAI H5N1 was reported across Asia, followed by reports in the Middle East, Eastern Europe, and finally Western Europe, including the first reports of HPAI H5N1 in wild birds in Italy. In early February 2006, Italian authorities announced that lab tests confirmed HPAI H5N1 in dead wild swans found in southern Italy. This news validated forecasts made by scientists several months earlier that the virus would move into Western Europe (WHO, 2006).

The frequency of the Italian data—weekly, as opposed to quarterly or annually—was critical to this project because at the outset the duration of HPAI H5N1 impacts on poultry demand was unknown. The study team hypothesized that news reports about bird flu might reduce poultry consumption and have some lasting effects but not persist indefinitely. If advertising is expected to have protracted effects on consumer demand, it is not unreasonable to expect food safety information to have lasting effects on demand as well. But, previous studies have suggested that consumers respond quickly to news that microbial organisms or chemicals have contaminated particular foods. Consumers may fully adjust their food choices to news indicating safety has been compromised and to news that food is again safe all within a matter of weeks (Dahlgran and Fairchild, 2002). This rapid adjustment is in contrast to consumer responses to news relating particular diet and lifestyle choices to negative long-term health outcomes, such as linkages between saturated fat consumption and cardiovascular disease. If news about such linkages did influence, for example, red meat consumption, changes in demand would only be discernable over a period of years.

If consumers make food choices based on health risks posed by foods, consumers would presumably purchase less chicken if news reports about bird flu made them believe risks had increased.[5] Namely, news coverage of AI might lead consumers to believe the likelihood of contracting bird flu was higher than before or that disease outcomes were worse than previously thought. There is good reason to think that, in Italy, such impacts would have been temporary: there had not been a human illness in Italy to confirm the heightened risk of human HPAI H5N1 infection that consumers could draw

[4]The main limitation to drawing inferences from retail purchase data is that not all food is purchased from grocery stores to be eaten at home. Some food is purchased at restaurants, and behavior toward prepared food conceivably could differ from behavior toward food eaten at home. Euromonitor data (2000-05) indicates food-away-from-home expenditures were 33-35 percent of all food spending in Italy, compared with 43-44 percent in the United States.

[5]News is not necessarily all inflammatory or all pointing to increased food safety risk. NPD Group (2006a) highlighted the balance with which German media reported on bird flu:

> The media continued to confirm that there was no risk of the infection transmitted to humans, if the poultry is properly cooked.

Still, the only reason for such balance to appear in newspaper reports is that they first report increasingly westward outbreaks among wild birds and domesticated poultry, and human illnesses. Thus, it can be assumed that consumers interpret newspaper reports as pointing to increased risks. A potential follow-up to this study would categorize news reports as positive or negative or even by degree of how positive or negative they are when developing media indices.

from news reports; also, HPAI H5N1 had not been found in domesticated birds, so Italian consumers might eventually infer that HPAI H5N1 was unlikely to enter their food supply and that the risk had passed.[6]

Both the poultry industry and policymakers have strong incentives to keep consumers safe from exposure to HPAI. As long as these protective measures are effective, even in the event of HPAI H5N1 outbreaks in birds there would not be human deaths or illnesses that would confirm consumers' worst fears. Private financial incentives to keep consumers safe arise partially from the ease with which bird flu illnesses might be traced. So far, each human case has been newsworthy worldwide. Symptoms and outcomes are generally distinct and clearly linked to exposure to infected birds or to other people who had been directly exposed to infected birds (WHO, 2006). The rapid onset of the disease means that if the source of exposure were food, the food and the retailer from which it was purchased would be easily identified. No retailer wants to be identified with a product that makes customers sick. That identification could instantly destroy the value of a brand name, potentially rendering any investment in brand or good will worthless. Public sector incentives to prevent and control HPAI H5N1 arise from the need for government agencies to protect public health as well as avoid potentially major economic losses.

Entirely different findings would likely result from a study based on data from a country in which human cases of bird flu have been reported. So far, human cases of bird flu have been confirmed in Asia, the Middle East, and Africa (WHO, 2008). Available data, however, are not sufficient to conduct a retrospective study quantifying consumer purchase responses to news reports of disease outbreaks in those countries.

Counts of Newspaper Articles About Bird Flu

The study team constructed weekly counts of newspaper articles about bird flu to examine whether changes in poultry purchases were likely related to heightened consumer awareness of bird flu. The LexisNexis Academic search engine was used to search for news stories related to bird flu. Because the focus was on the impacts of news reports in Italy, the team limited the scope of the search to European newspapers and constructed two data series: an Italy-specific index and an index pertinent to the rest of the world (here denoted as non-Italy-specific news). While the weekly counts of Italy-specific newspaper reports are intended to capture information on bird flu that is related to Italy, the weekly counts of non-Italy-specific news are designed to reflect Italian consumers' exposure to information about outbreaks in the rest of the world as reported by European news sources.

Italian consumers do not read all European newspapers. But they do receive news through a variety of channels, and media coverage of avian influenza in major European newspapers is expected to be correlated with the exposure of Italian consumers to AI news. Limiting the search to the relatively small sample of Italian newspapers would likely not be as effective at revealing the timing and relative volume of news from all sources as would searching the entire gamut of European newspapers.

The keywords searched in LexisNexis were *avian flu* or *avian influenza* or *bird flu* and not *Italy* for non-Italy-specific news, and *avian flu* or *avian influenza* or

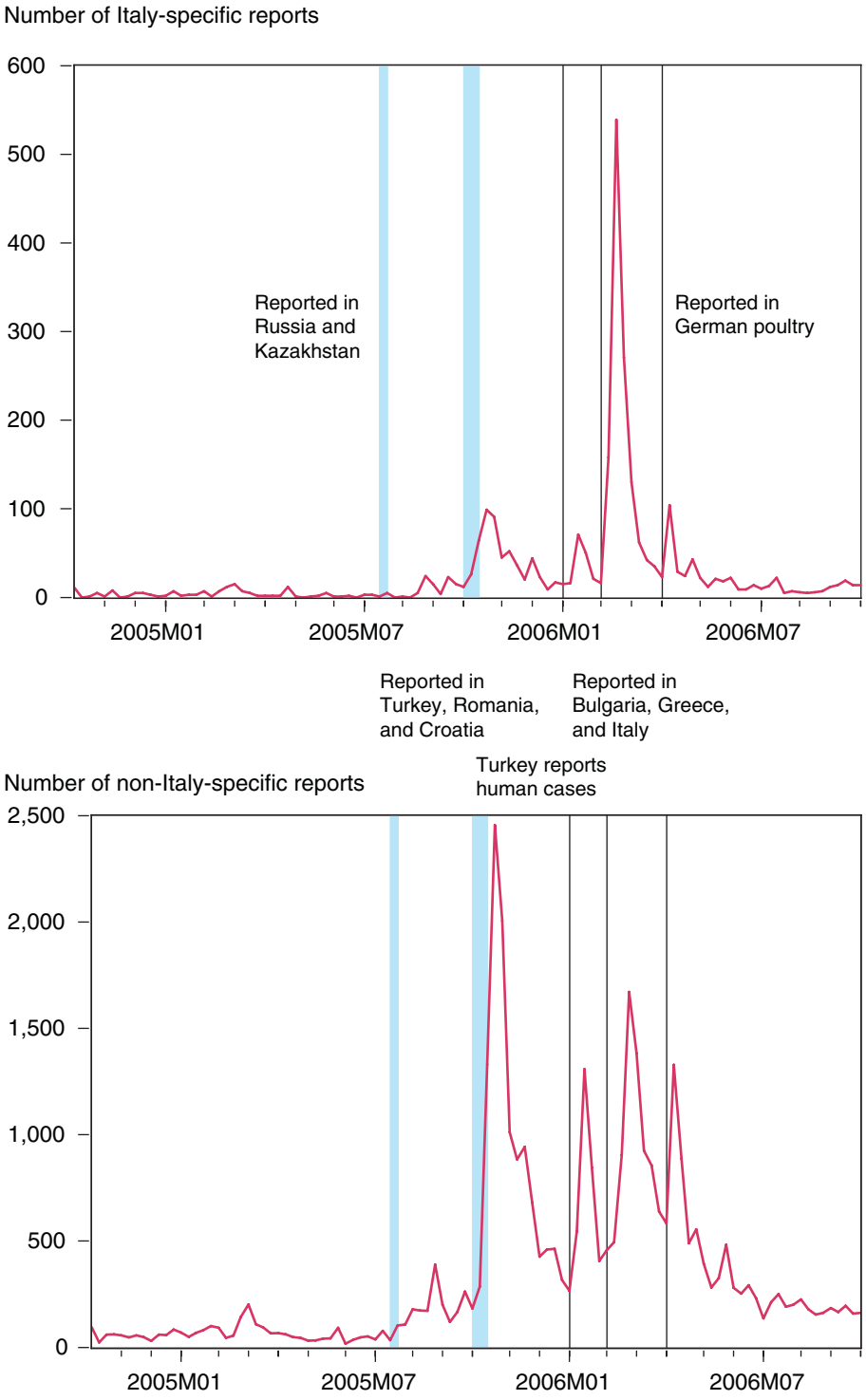
[6]U.S. consumers are further removed from H5N1, the strain of highly pathogenic avian influenza that is currently circulating in Asia and Europe. H5N1 has not been found in the United States. Historically, there have been three instances of highly pathogenic avian influenza found in the United States. In 1924, HPAI H7 was in east coast live bird markets; and HPAI H5N2 was found in chickens in Pennsylvania, Maryland, and Virginia in 1983-84, and in Texas in 2004.

bird flu and *Italy* for Italy-specific news.[7] Not surprisingly, the weekly average number of European news articles about bird flu that do not specifically mention Italy (324.4) is far greater than those that do refer to Italy (24.7) (fig. 1).

The first wave of concern in the European media started in late July 2005, when HPAI H5N1 moved northwesterly from its origins in Southeast Asia to

Figure 1

Weekly number of European newspaper reports about bird flu



Source: USDA, ERS using data from LexisNexis academic search engine.

[7]The searches used English keywords. News referring to these keywords is expected to be correlated with news referring to AI keywords in other languages.

the Russian Federation and adjacent parts of Kazakhstan, affecting domestic and migratory birds. European media coverage of the disease intensified in October 2005 following reports of outbreaks in Turkey, Romania, and Croatia. This resulted in a high of 2,455 articles in the week ending October 23, 2005. Counts revealed additional, but smaller, spikes in media attention in January through April 2006, as Turkey reported its first two human cases as well as poultry outbreaks, and HPAI H5N1 was identified in additional countries in Europe (e.g., Austria, France, Germany, Italy, Sweden, Switzerland) and elsewhere.

The number of articles trended strongly downward from early April 2006 through the end of the sample period. Across the entire sample, weekly counts of Italy-specific newspaper reports were generally relatively flat, with several articles per week. The exception was a spike of 539 articles in the week ending February 19, 2006, corresponding to the discovery of HPAI H5N1 in dead wild swans in southern Italy.

Estimating How Long Consumers Remember the News

Information on food safety is expected to have effects that persist over time. Therefore, an empirical issue for studies of the effects of food safety on demand is determining the appropriate length and shape of the distributed lag structure for variables expected to influence consumers' risk perceptions. In previous studies, authors have followed several alternative strategies. Burton and Young (1996) used contemporary and cumulative numbers of bovine spongiform encephalopathy (BSE) articles as the demand shifters for transitory and permanent quality shocks, respectively. This practice appears to be appropriate for their case, because the study's sample ended in the third quarter of 1993, when BSE in Great Britain showed no sign of relenting. There was no reason to expect the components of permanent shocks to decay, and, with quarterly data, transitory shocks might run their course within each period. But, for other food safety incidences, it is likely that the effect of media coverage on consumption might decay over time.

Smith et al. (1988) constrained their milk media index to follow a second-order Almon polynomial. Dahlgran and Fairchild (2002) specified a geometric decay for their media index. The advantage of this approach is that it reduces the multicollinearity among lagged indices. A potential drawback is that it imposes a specific structure on the distributed lag, which may lead to inconsistent parameter estimates if the imposed structure is incorrect (Judge et al., 1988).

Alternatively, Marsh et al. (2004) and Piggott and Marsh (2004) did not impose any functional structure on the distributed lags of media indices. Instead, these studies started with a relatively large number of lags and sequentially reduced the number of lags, selecting the preferred model as the one with the best statistical fit. Although this approach is free from the danger of imposing incorrect functional structure, it may be plagued by multicollinearity of the lagged media indices.

This analysis uses an alternative approach to investigate the lag structure of media indices. This lag structure, which was originally proposed by Mitchell and Speaker (1986), is known as the polynomial inverse lag (PIL). The PIL has several advantages over other commonly used lag structures such as the Almon (1965) lag. First, the researcher does not need to specify *a priori* the lag length or impose an endpoint restriction because the PIL has an infinite distributed lag structure. Second, the PIL is linear in the transformed exogenous variables (i.e., the weekly count of newspaper articles on bird flu). As explained in the paragraph that follows, this latter property makes it convenient to test for the best specification for the lag structure.

Consider the following regression equation:

$$Y_t = b + \sum_{i=0}^{\infty} w_i X_{t-i} + e_t \qquad (1)$$

where Y_t is poultry sales in period t, X_τ is the weekly count of newspaper articles in period τ with $\tau \leq t$, b is a collection of other explanatory variables (e.g., meat prices, seasonal dummy variables) and their associated coefficients,

and e_t is the regression residual. Although the empirical demand model may take a more sophisticated form, equation (1) can be used to provide a simple illustrative example of how the PIL works. This equation cannot be estimated directly as written due to the infinite lag distribution for *X*. To derive an estimable form of equation (1), Mitchell and Speaker (1986) propose the following transformation:

$$Y_t = b + \sum_{j=2}^{n} a_j Z_{jt} + R_t + e_t, \qquad (2)$$

where $Z_{jt} = \sum_{i=0}^{t-1} \frac{X_{t-i}}{(i+1)^j}$, $j = 2,...,n$, $R_t = \sum_{j=2}^{n} \sum_{i=t}^{\infty} \frac{a_j X_{t-i}}{(i+1)^j}$, and *n* is the degree of polynomial for the PIL structure, which has to be determined empirically. With the sample t=1,2,…,T, data are available to calculate Z_{jt}, but the remainder term R_t cannot be calculated from the data because it includes infinite lags. Mitchell and Speaker showed that with *t* greater than eight, R_t becomes negligible. Therefore, a practical solution to the unobserved R_t problem is to exclude the first eight data points and conduct econometric analysis on the remaining data without the R_t term.[8]

[8]The estimable version of the PIL truncates negligible terms used in calculating the Z_{jt} values but can be used to obtain the effects of X on Y over any time interval.

After dropping the first eight data points, the Z_{jt}, (t=9,10,11,…,T) are computed as follows:

For j = 2:

$$Z_{2t} = \sum_{i=0}^{t-1} \frac{X_{t-i}}{(i+1)^2} = \frac{X_t}{1^2} + \frac{X_{t-1}}{2^2} + \frac{X_{t-2}}{3^2} + \frac{X_{t-3}}{4^2} + ... + \frac{X_1}{t^2};$$

For j = 3:

$$Z_{3t} = \sum_{i=0}^{t-1} \frac{X_{t-i}}{(i+1)^3} = \frac{X_t}{1^3} + \frac{X_{t-1}}{2^3} + \frac{X_{t-2}}{3^3} + \frac{X_{t-3}}{4^3} + ... + \frac{X_1}{t^3};$$

For j = 4:

$$Z_{4t} = \sum_{i=0}^{t-1} \frac{X_{t-i}}{(i+1)^4} = \frac{X_t}{1^4} + \frac{X_{t-1}}{2^4} + \frac{X_{t-2}}{3^4} + \frac{X_{t-3}}{4^4} + ... + \frac{X_1}{t^4};$$

For j = 5:

$$Z_{5t} = \sum_{i=0}^{t-1} \frac{X_{t-i}}{(i+1)^5} = \frac{X_t}{1^5} + \frac{X_{t-1}}{2^5} + \frac{X_{t-2}}{3^5} + \frac{X_{t-3}}{4^5} + ... + \frac{X_1}{t^5};$$

and so on, until reaching the term Z_{nt}. A remaining issue is selection of the appropriate *n* —the degree of the polynomial. The selection process can start with a relatively high degree (e.g., n = 5), in which case equation (2) can be written as

$$Y_t = b + a_2 Z_{2t} + a_3 Z_{3t} + a_4 Z_{4t} + a_5 Z_{5t} + e_t. \qquad (3)$$

To determine the optimal n, regression equation (3) is fit a number of times, successively dropping the highest degree term. The choice of appropriate degree is then determined by the ability of the model to fit the data. The model with the best fit can be selected based on the Akaike information criterion, the Schwarz criterion, adjusted R^2, or other measures of model fit.

Finally, the weights (w_i) on X_τ in equation (1) can be recovered using estimates of a_j ($j = 2,\ldots,n$). The formula for calculating weight w_i is

$$w_i = \sum_{j=2}^{n} \frac{a_j}{(i+1)^j}, \; i = 0,...,t-1. \tag{4}$$

Equation (4), along with estimated values for a_j, is used to calculate the weights on current and lagged number of newspaper articles on bird flu in the demand equation.

Estimating News Impacts on Poultry Demands

This study was an effort to conduct a first-order analysis of the effects of AI news on consumer behavior and employed a relatively simple log-log demand specification.[9] It estimated weekly demand for two products: fresh poultry, and frozen and processed poultry. In each demand function, weekly prices of the two poultry products are included as explanatory variables along with weekly prices of beef, pork, and fish and seafood. Inspection of the data revealed some similarities between the Italian and U.S. markets. In Italy, quantities of poultry purchased have been rising over time. Thus, the estimated demands include a time trend to reflect changes in meat demand due to factors such as changes in income, population, and diet preferences. Also, like the U.S. purchases, Italian purchases display regular, seasonal patterns, so estimated demand includes indicator variables identifying purchases made in summertime and December.

[9]Estimating more complex functional forms and conducting comprehensive specification testing is outside the scope of this exploratory project.

The estimated demand equation for fresh poultry is as follows:

$$\begin{aligned} ln(qfshp) = {} & 24.739 - 2.286\ ln(pfshp) - 0.012\ ln(pfrzp) + 0.722\ ln(pbf) - 2.459\ ln(ppk) \\ & (1.716)\quad (0.299)\qquad (0.458)\qquad (0.647)\qquad (0.594) \\ & - 1.593\ ln(pfh) - 0.011\ summer + 0.099\ newyear - 0.022\ z2avrow \\ & (0.290)\qquad (0.027)\qquad (0.034)\qquad (0.008) \\ & + 0.021\ z3avrow - 0.044\ z2avit + 0.040\ z3avit + 0.006\ time \qquad (5) \\ & (0.009)\qquad (0.021)\qquad (0.022)\qquad (5.7E-4) \\ & R^2 = 0.829;\ \ AIC = -269.7;\ \ DW = 2.027;\ \ N = 104;\ \hat{\rho}_1 = -0.286 \\ & \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (0.105) \end{aligned}$$

Here, *qfshp* is the weekly quantity of fresh poultry sold; *pfshp, pfrzp, pbf, ppk,* and *pfh* are prices of fresh poultry, frozen and processed poultry, beef, pork, and fish and seafood, respectively[10]; *summer* is a dummy variable equal to 1 if the week is in June, July, or August, and 0 otherwise; *newyear* is a dummy variable equal to 1 if the week is in December, and 0 otherwise; *z2avrow* and *z3avrow* are the second- and third-degree polynomials for the square root of the number of non-Italy-specific newspaper reports variable, respectively; *z2avit* and *z3avit* are analogously defined variables for the square root of Italy-specific newspaper reports; *time* is a linear time trend; $\hat{\rho}_1$ is the estimated coefficient for the first-order autocorrelation of the regression residual; and the numbers in parentheses below the coefficients are the estimated standard errors. Average prices are derived by dividing total weekly sales values by quantities sold. To account for diminishing returns to additional media information, this analysis used the square root of both non-Italy-specific newspaper reports and Italy-specific newspaper reports in generating the PIL terms following the procedure detailed above.

[10]The cross-price elasticities for pork and fish are negative, indicating that they are complements to poultry. This finding may be related to the relatively simple functional form used for this study. It is possible there are excluded meat demand shifters that are simultaneously affecting demand for poultry, pork, and fish. Another possibility is that there are minimum quantities of these meats that are typically purchased with little price responsiveness (e.g., subsistence levels) and then remaining super-numerary expenditures allocated to meat are divided between poultry, beef, pork, and fish and seafood (Piggott and Marsh, 2004). In this case, higher prices would increase expenditures on the fixed subsistence quantities and reduce super-numerary expenditures, which may result in a reduction in total consumption of all meats even if there is a relative shift of super-numerary consumption from pork and fish to poultry.

The Akaike information criterion was used to determine the model with the best fit. The model was found to perform best when both the non-Italy-specific newspaper reports and Italy-specific newspaper reports enter with

three as the highest degree of polynomial. A first-order autocorrelation correction was found to be sufficient.

The price elasticity of demand for fresh poultry was estimated to be -2.286. In a study of Italian meat demand, Fanelli and Mazzocchi (2002) found the own-price demand elasticity for poultry to be between -1.481 and -1.250, depending on model specification. The difference between this study's estimate and that of Fanelli and Mazzocchi may stem from two factors. First, the Nielsen data are weekly, whereas Fanelli and Mazzocchi used monthly data. Consumers are more price responsive in the short run than in the long run because of inventory behavior (see, for example, Wohlgenant and Hahn (1982); Hendel and Nevo (2006)). Second, if prices are simultaneously determined with quantities, the estimated elasticity may be biased upward (in absolute value) (Reiss and White, 2005). For agricultural products, endogeneity is more likely to be a problem in high-frequency data because supply is to some extent predetermined in the short run. To correct for this potential bias, this study would have to identify supply shifters that are highly correlated with prices but not with the disturbances and use instrumental variables in estimating the model. The tradeoff is the loss of efficiency in exchange for avoiding potential inconsistency. Although outside the scope of the present study, exploring endogeneity is a potentially important extension.

The frozen poultry equation along with the estimated coefficients and standard errors are as follows:

$$\begin{aligned} ln(qfrzp) = {} & 18.891 - 0.020\ ln(pfshp) - 1.172\ ln(pfrzp) + 0.462\ ln(pbf) - 0.915\ ln(ppk) \\ & \quad (1.073) \quad (0.192) \quad\quad (0.297) \quad\quad (0.398) \quad\quad (0.405) \\ & - 1.028\ ln(pfh) - 0.020\ summer + 0.018\ newyear - 0.002\ z2avrow \\ & \quad (0.190) \quad\quad (0.016) \quad\quad (0.021) \quad\quad (8.2E{-}4) \\ & - 0.398\ z2avit + 2.388\ z3avit - 4.537\ z4avit + 2.544\ z5avit + 0.001\ time \qquad (6) \\ & \quad (0.073) \quad\quad (0.607) \quad\quad (1.368) \quad\quad (0.836) \quad\quad (0.004) \\ & R^2 = 0.907; \quad AIC = -357.9; \quad DW = 2.011; \quad N = 104; \hat{\rho}_1 = -0.158 \\ & \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (0.108) \end{aligned}$$

Here, *qfrzp* denotes the weekly quantity of frozen and processed poultry sold; *z4avit* and *z5avit* are, respectively, the fourth and fifth degrees of polynomial for the square root of Italy-specific newspaper reports, and all other variables are defined as earlier for the fresh poultry equation.

The own-price elasticity for frozen and processed poultry is -1.172, which is much less elastic than estimated for fresh poultry, as expected. Coefficients on the *summer* and *newyear* dummy variables are not statistically significant for frozen poultry demand. The model with the best fit in terms of AIC and adjusted R^2 is the one with the highest degrees of polynomials of 2 and 5, respectively, for non-Italy-specific newspaper reports and Italy-specific newspaper reports. All coefficients on the Italy-specific newspaper reports terms are statistically significant at the 1-percent level, while the coefficient on the second-degree polynomial of the square root of non-Italy-specific newspaper reports is significant at the 5-percent level.

Simulating Results of Bird Flu News on Poultry Demand

These results indicate that media information on avian influenza had a statistically significant effect on sales of both fresh and frozen poultry products in Italy. The model results revealed that newspaper reports had an impact that persisted over time. In addition to the polynomial transformations that specified the lag structure of newspaper reports on poultry purchases, the square root of the counts of newspaper reports was used to allow for declining marginal effects of newspaper reports. Additional reports contribute to an increase in total impact on meat purchases, but at a declining rate.

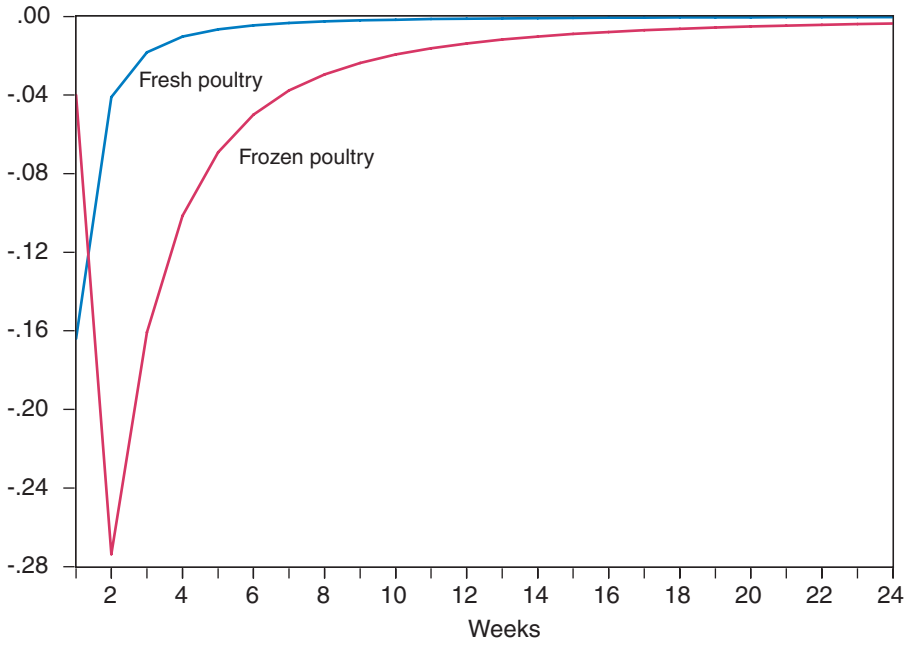
Constructing a model that would detect impacts that persist across weeks and that increase at a decreasing rate means the covariates related to newspaper reports are polynomial transformations of square roots of the original weekly counts of newspaper reports. In effect, the relative magnitudes of the coefficients are not very intuitive. To gain more insight on these effects, this analysis used the coefficient estimates on the polynomials to derive the weights on the square roots of the media indices. These weights are the w_i in equation (1), while X is the square root of the media indices. Interpretation of the weights is straightforward for a single newspaper report. In this case, a value of -0.0060 would indicate a 0.6-percent decrease in purchases for a particular week. These percentage decreases in purchases over time are plotted in figures 2 and 3. A second newspaper report would create a smaller impact than the first, but one for which the relative week-to-week impacts follow the same patterns. The square root transformation means that four reports would double the impacts displayed in the figures.

Time patterns of results indicate the response of fresh poultry consumption to AI news peaked in the second week after the initial newspaper reports. For non-Italy-specific news, the response of fresh poultry sales in the second week was more than five times the size of the instantaneous response in the first week. The difference between the first-week response and second-week response was less pronounced for bird flu news pertinent to Italy but was still about 50 percent larger in the second week than in the first week.

For frozen and processed poultry sales, the response to news was qualitatively more distinct between news about the rest of the world and news related to Italy. For non-Italy-specific news, the response was monotonic over time. The response peaked in the same week the news was reported and declined to about a third of the initial response in the second week. By the fifth week, the size of the response was already negligible. The temporal response to Italy-specific news had a more complex pattern. The size of the response first peaked in the second week then dropped to about a fifth of the peak level in the following week, after which the response increased again and did not dissipate even after the 24th week. Although not the expected temporal response, this pattern was robust across multiple specifications of the model. It is possible that this is reflective of inventory behavior with frozen and processed poultry products or other factors contributing to more complex dynamics in the consumer response for frozen and processed poultry products in Italy.

Figure 2

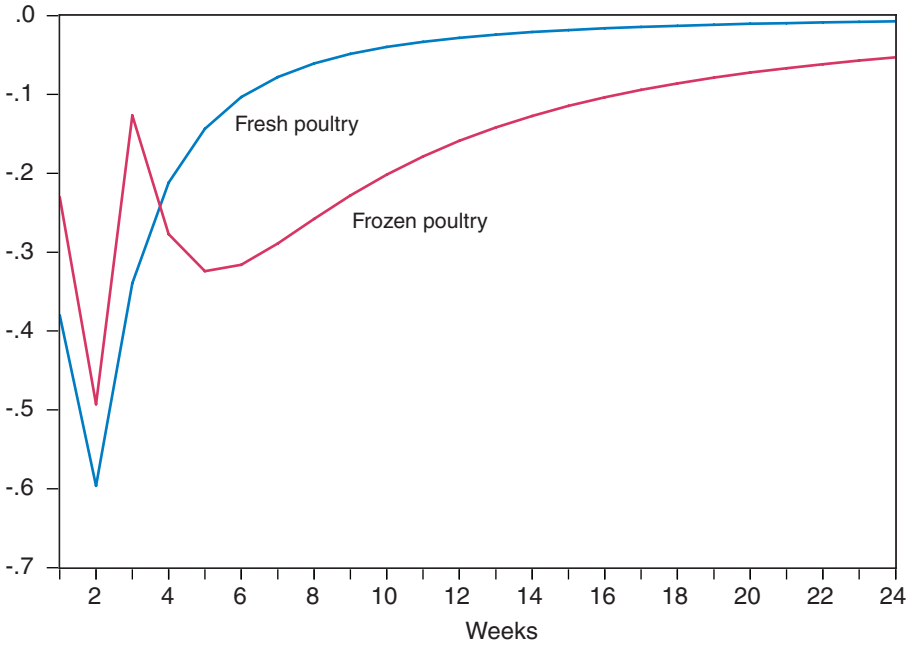
Weekly reduction in poultry purchases associated with a marginal increase in non-Italy-specific newspaper reports



Source: USDA, Economic Research Service.

Figure 3

Weekly reduction in poultry purchases associated with a marginal increase in Italy-specific newspaper reports



Source: USDA, Economic Research Service.

To evaluate the impact of avian influenza media coverage on sales of poultry products, this analysis conducted two counterfactual experiments to simulate how consumers may have responded without concerns regarding avian influenza. The first experiment simulated sales of poultry products had there been no Italy-specific news about bird flu. This effect is achieved by setting the newspaper report variables *avit* to zero and simulating quantities with the rest of the price, trend, and seasonality variables set at their historical values. On top of the first experiment, the indicator of non-Italy-specific bird flu news, *avrow*, was further set to zero and quantities were simulated with the remaining variables. This second experiment offers some insight into potential market conditions had there been no news on bird flu in European news sources.

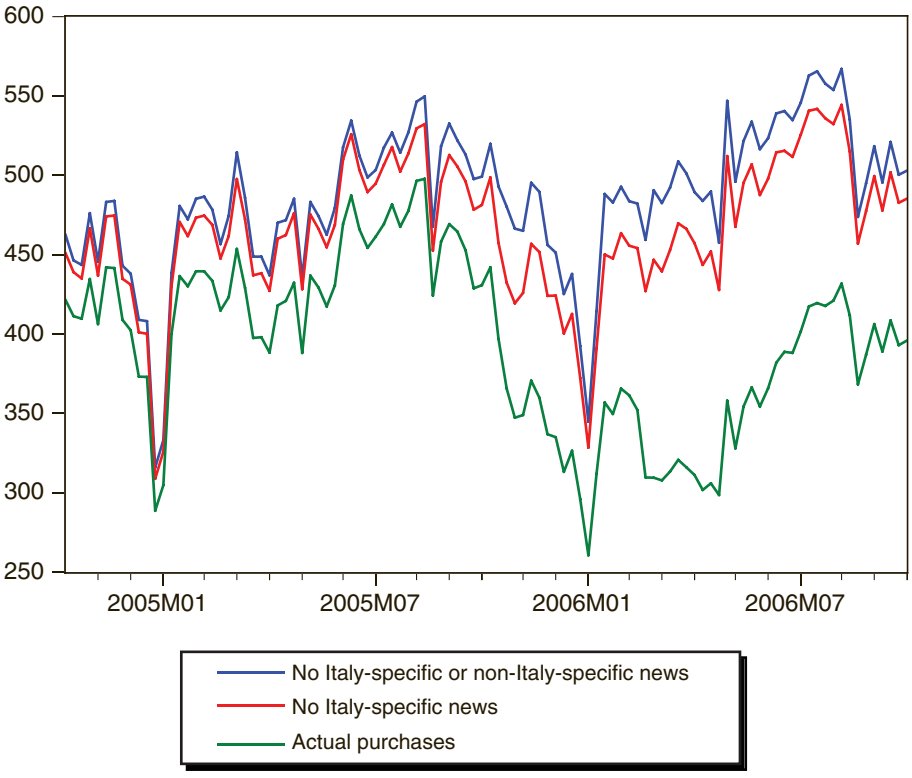
For frozen and processed poultry, it appears that non-Italy-specific news together with Italy-specific news reduced purchases only slightly more than Italy-specific news alone (fig. 4). In effect, for frozen and processed poultry, non-Italy-specific news had a small impact on purchases relative to the impact of Italy-specific news. In contrast, for fresh poultry, non-Italy-specific news is calculated to reduce purchases more than Italy-specific news (fig. 5).

This finding may reflect the timing of outbreaks in different locations. Outbreaks in Western Europe outside of Italy, and the associated media attention, occurred prior to heightened Italy-specific news. Thus, Italian consumers already may have made substantial adjustments to their consumption of fresh poultry, which is likely to be perceived as a greater risk than

Figure 4

Actual and simulated frozen and processed poultry purchases in Italy

Kilograms per week (thousands)

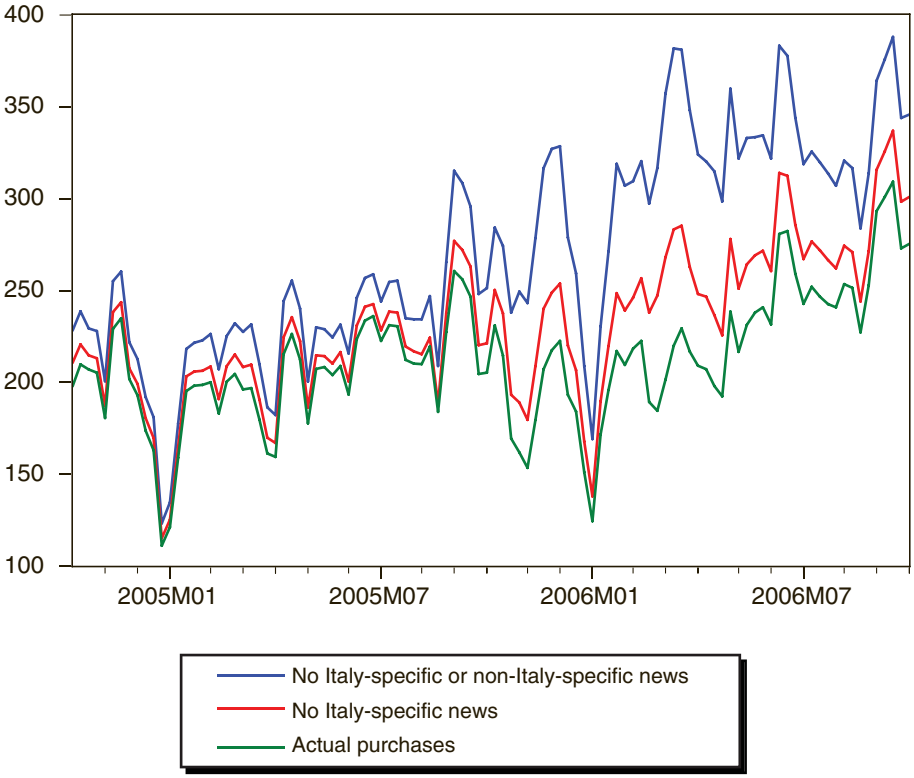


Source: USDA, Economic Research Service.

Figure 5

Actual and simulated fresh poultry purchases in Italy

Kilograms per week (thousands)



Source: USDA, Economic Research Service.

frozen and processed poultry. Discovery of H5N1 in wild birds in Italy and the increase in Italy-specific news, however, appears to have contributed to declines in consumption of frozen and processed poultry similar to earlier declines in fresh poultry.

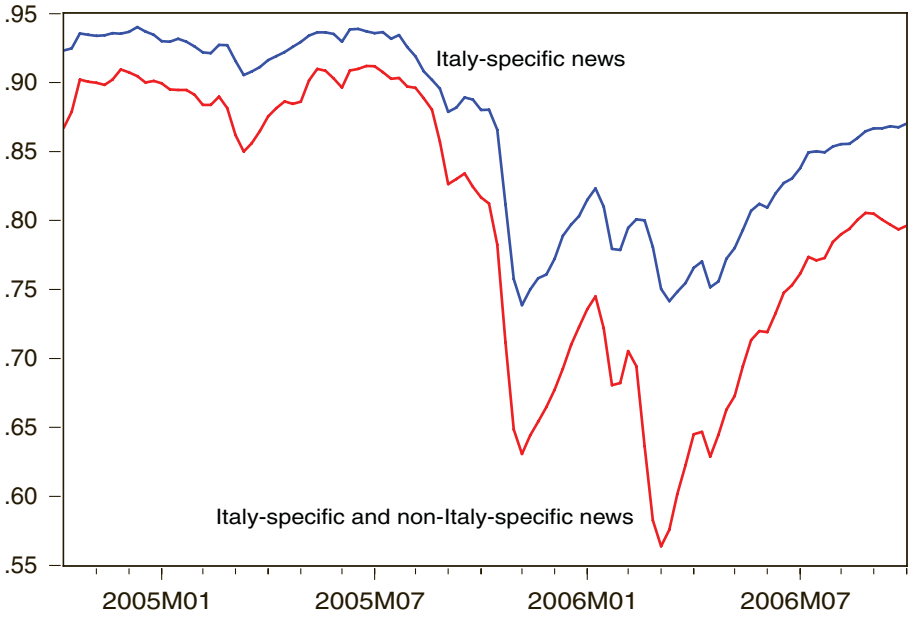
Two additional graphs illustrate the proportionate reduction in sales related to news on avian influenza. Figure 6 plots the historical sales of fresh poultry as a percentage of the simulated sales with no reporting of bird flu by European news sources, and as a percentage of the simulated sales when there was no Italy-related news but there still was news about bird flu in the rest of the world reported by European news agencies. Figure 7 plots these percentages for frozen and processed poultry.

For fresh poultry, historical sales were, on average, 79.8 percent of what they would have been if both *avrow* and *avit* were zero. If there were no Italy-specific news but still non-Italy-specific news, average sales were simulated to be 86.5 percent of what they would have been without news on bird flu. In other words, non-Italy-specific news reduced fresh poultry sales by an average of 13.5 percent, and Italy-specific news was responsible for a further 6.7-percent drop in sales relative to the unaffected case. For frozen and processed poultry, *avrow* and *avit* are responsible for a 4.1-percent and 14.6-percent drop in sales, respectively.

Figure 6

Proportion of baseline fresh poultry purchases remaining with AI news impacts

Purchases with news impacts as a proportion of purchases without news impacts

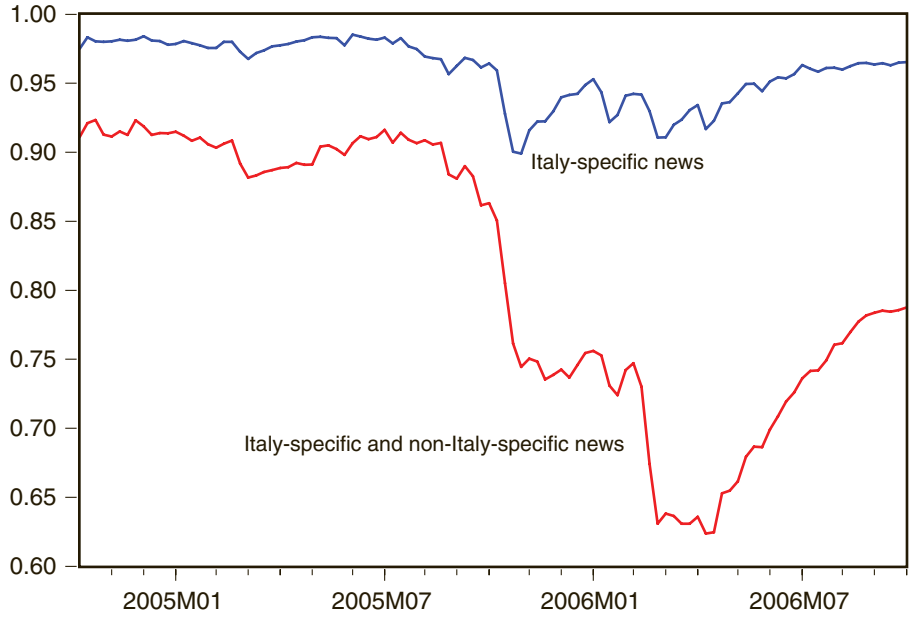


Source: USDA, Economic Research Service.

Figure 7

Proportion of baseline frozen and processed poultry purchases remaining with AI news impacts

Purchases with news impacts as a proportion of purchases without news impacts



Source: USDA, Economic Research Service.

However, examining sample averages masks the magnitude of some shortrun effects. Sales of poultry in Italy plummeted in October 2005 following news reports that the virus had spread beyond the Russian Federation and neighboring Kazakhstan into Turkey, Romania, and Croatia. The situation was further aggravated when the virus was found in wild swans in southern Italy in February 2006. As shown in figures 6 and 7, Italy-specific news and other European news were estimated to have combined to reduce fresh poultry sales by as much as 43.6 percent in the week ending March 5, 2005. In percentage terms, the largest reduction in frozen and processed poultry sales occurred in the week ending April 16, 2005, when sales dropped by 37.5 percent.

Conclusion

Interpreting These Results—How Different Should We Expect a U.S. Experience With Bird Flu To Be?

The Italian case study could be used to predict a U.S. response to bird flu news if Italian and U.S. food demands, food choices, risk preferences, and risk perceptions were alike. Italian and U.S. consumers do exhibit some similar characteristics, but there are striking differences as well. Aspects of these differences help explain why a U.S. response to news about bird flu might be larger or smaller than the Italian response.

The Italian retail market for poultry differs from the U.S. market in numerous ways. An obvious difference is the amount of poultry consumed. U.S. consumers eat far more chicken per capita than do Italians—60.4 pounds in 2005 in the U.S. versus. 23.5 pounds in Italy.[11] Differences in income drive many of the differences in meat consumption patterns. Per capita income for 2006 was estimated at $43,500 in the United States and $29,700 in Italy (Central Intelligence Agency, no date). And, income was allocated differently in each country. Food accounts for 16.59 percent of expenditures in Italy, compared with 9.73 percent in the United States. This difference equates to food commanding a 70-percent larger share of household expenditures in Italy than in the United States (USDA, ERS, 2003). Italian income and price elasticities of demand for meat (responsiveness to changes in income and prices) are approximately three times as high as those in the United States (USDA, ERS, 2003). In summary, the income differences give U.S. consumers greater ability to make dietary changes, yet the elasticities reveal that Italians are three times as responsive as Americans to changes in prices or income.

Nevertheless, the two countries exhibit some attributes of food consumption that are nearly identical. Expenditures for meat are more alike than those for other food groups, as meat makes up 23.58 percent of total food expenditures in Italy and 19.58 percent in the United States. Over the long run, Italian meat consumption has changed in ways that are quite similar to changes in the United States. Over the 1970s and 1980s, Italian chicken consumption doubled (Dono and Thompson, 1994). Further, in both countries, the changes in the pattern of meat consumption raised the question of whether the changes indicated changing preferences—concern over blood cholesterol and how it might be reduced with a shift toward white meat—or whether movements in relative prices and income explain the change. The changing patterns of meats consumed and the shared evolution of food concerns both point to similarities in food demand. Further, income growth and globalization of the food retail and foodservice industry are giving rise to increasingly similar food consumption patterns across the world (Frazão et al., 2008). Further convergence is likely.

All food, regardless of country of origin, carries with it some health risks. Thus, it would be reasonable to suppose that all consumers (U.S. and Italian) always make food choices conscious of the health risks posed by consuming foods. The different average income levels in each country point to different responses to

[11]U.S. per capita food consumption is represented here by food availability (USDA, ERS, 2007). Italian consumption was calculated from total consumption (USDA, FAS, 2006) and population (Central Intelligence Agency, no date).

new foodborne health risks. Assuming that health and safety are normal goods and respond positively to increases in income, relatively larger responses to risks identical to those in Italy could be expected in the United States. Also, the larger income levels in the United States indicate that U.S. consumers might have more options for mitigating impacts of any new health risk.

But having the ability to make dietary changes and actually making changes are not one and the same. The extent of reactions to news about human health and safety likely depends on consumers' perceptions of changing health risks. Determining whether U.S. consumers would make as large a change in food choices as Italian consumers did requires answering two questions. First, would bird flu news raise risk perceptions of U.S. consumers as much as it did for those of Italian consumers? Second, would changing risk perceptions have as much impact on Americans' food choices as on Italians' food choices?

Harrison et al. (2004) surveyed Italian and U.S. consumers, attempting to compare risk perceptions and preferences. Although the study focused on potential risks posed by genetically modified (GM) foods and not on HPAI H5N1, it did survey consumers in metropolitan areas of each country on the issue of acceptance of foods and health risks posed by foods.

Harrison et al. found that Italian consumers are different from U.S. consumers, as Italians are less likely to purchase GM foods. But the two groups of consumers exhibited strong similarities that could have been reasonably anticipated. In both countries, higher levels of perceived risks decreased the likelihood that a consumer would purchase GM foods. Perceived risk was the most important factor in purchase decisions in both countries—more important than trust in government oversight, knowledge or awareness of GM foods, or demographics. Surprisingly, given Europe's recent experiences with mad cow disease and dioxin in the food supply, consumer confidence in the government's ability to control and monitor GM foods had almost the same effect on consumers' willingness to purchase GM foods in both countries. But, Italians were more sensitive to potential risks than Americans. Changes in perceived risks had a relatively larger effect on purchasing decisions for Italians than for Americans.

These findings point to the possibility that news about bird flu detections might lead to a smaller response by U.S. consumers. Even if the quantity (and distribution over time) of news in the United States about bird flu was similar to that in Italy, the differences in risk perceptions and risk preferences could make the U.S. response much smaller than the Italian response. Americans might not perceive so large a health risk as did Italians, and Americans might not be as concerned with risks as Italians.

With any detection of bird flu in the United States, public health authorities are likely to comment publicly on the threat posed to consumers. For example, suppose bird flu were detected in wild birds and public health authorities knew that the infected birds constituted isolated cases and were not part of a wave of infected birds. Knowing that the infected wild birds were unlikely to contaminate commercial flocks, authorities could assume that the possibility of infected commercial poultry entering the food supply chain is remote. Thus, it is likely that public health authorities would tell consumers that the risk of the detection to humans is negligible.

A detection of HPAI H5N1 in the United States is likely to generate extensive media coverage for a while; the news would be about a potentially fatal illness. But, if consumers are told that the risk is negligible and their prior assessment is that the risk is negligible, there would be no reason for consumers to change risk perceptions if they believe public health authorities are credible. News of HPAI H5N1 outbreaks would not be news from a risk perspective.

With no substantial changes in risk perceptions, there would be no reason for consumers to change their food choices. The findings of Harrison et al. reinforce that conclusion. If their findings hold for all types of foodborne health risks, one should expect the U.S. response to bird flu news to be small. Under the assumption that food choices of Italian consumers are more influenced by changing risk perceptions than are those of U.S. consumers, the U.S. response should be smaller.

Further, this scenario shares attributes with the response to the 2003 BSE announcements in the United States. Survey evidence indicates that prior to the announcements, consumers generally treated human health risks of BSE as negligible. When government agencies announced BSE detections, they also emphasized the risk was negligible (Kuchler and Tegene, 2006). The impact of bird flu news on consumers' risk perceptions may be nearly identical to impacts of BSE announcements if consumers respond similarly to government agency announcements regarding negligible bird flu risk. Reductions in beef consumption following BSE announcements were short-lived.

If the risk posed by bird flu is not negligible,[12] the Italian response to HPAI H5N1 discovered in wild birds would not offer much guidance in estimating a U.S. response. In this case, risk and risk perceptions would change. Consumer behavior would be more difficult to predict. Consumer response toward familiar health risks is difficult to forecast, especially in the short run. An unfamiliar risk raises the uncertainty about behavior, and even the limited available evidence does not all point to the same outcomes.

In the short run, the range of possible consumer responses is wide. News about *E. coli* (STEC 0157) contamination of spinach shut down the spinach industry during 2006. And the fatality rate for *E. coli* (STEC 0157) is less than 1 per 1,000 cases (USDA, ERS, 2006), orders of magnitude less than the fatality rate for bird flu. On the other hand, pathogens in the food supply are numerous despite a wide range of private and public sector actions designed to reduce contamination (Mead et al., 1999). Cases like the spinach contamination are extreme and unusual.

[12]Bird flu poses human health risks if the virus is in the food supply or if it mutates to a form that is easily transmissible among people. The latter hazard bears no relation to chicken consumption and is not considered here.

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