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Food safety recall effects across meat products and regions ☆

Xia Shang [a], Glynn T. Tonsor [b,*]

[a] Department of Agricultural Economics, 332B Waters Hall, Kansas State University, Manhattan, KS 66506, United States
[b] Department of Agricultural Economics, 331A Waters Hall, Kansas State University, Manhattan, KS 66506, United States

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ABSTRACT

Food safety is one of the key issues for the international meat market. As a major meat exporter, few things facing the U.S. meat industry in recent years have garnered more attention than food safety events and policies. The impacts of Food Safety Inspection Services (FSIS) recalls on United States consumer meat demand are estimated using monthly grocery-scanner data identifying effects across products, geographic regions, and recall type. Results suggest beef *E. coli* recalls significantly reduce the demand for recalled ground beef contemporaneously among most, but not all, regions in the United States. Evidence of heterogeneity in demand impacts across regions and products is provided for the first time. Domestic and international implications for policy makers, industry leaders, and researchers are discussed.

1. Introduction

Food safety issues in meat industries are prevalent worldwide and are heavily debated in international trade discussions and throughout livestock industries. For example, the intractable beef hormone controversy between the U.S. and EU brought significant policy changes and compensation efforts on both sides. Among several core topics is the impact of food safety recall events and associated policies on consumer meat demand and hence design of effective food safety policies. Moreover, many such discussions occur at a finer level of specific pathogens and/or product type. While many valuable studies exist, research to-date has been limited by rather aggregated assessments leading to corresponding broad conclusions that likely over-simplify underlying heterogeneity that exist in recall events and subsequent consumer demand patterns. Specifically, most research considers consumers, meat products, and food safety recall types homogeneous when in fact region of residence, specific meat product type, and different pathogens likely result in a much more heterogeneous set of consumer demand reactions. This diverse pattern in turn has implications for effective food policy design and implementation that is limited in availability within the current literature.

Among meat contaminations, key pathogens include *E. coli* O157: H7, *Listeria monocytogenes*, *Salmonella*, and *Campylobacter jejuni* (Centers for Disease Control and Prevention, 2013). As a Class I health hazard which is categorized by the USDA Food Safety and Inspection Service (FSIS), *E. coli* O157: H7 is ranked as one of the top five pathogens contributing to domestically acquired foodborne illnesses in the U.S. resulting in hospitalization in 2011 (CDC, 2011). Scharff (2012) indicates the average economic cost per case of *E. coli* O157: H7 infection is $9606 (in 2010), which is substantially higher than the cost of infections of *Salmonella* ($4312) and other major foodborne illnesses. Some epidemiological studies also find *E. coli* O157: H7 infections have geographical and longitude patterns. For example, Sodha et al. (2014) discover that the isolation rate of *E. coli* O157: H7 infection is highest in northern states. However, most existing economics articles only consider the effects on the national level (Piggott and Marsh, 2004; Marsh et al., 2004; Moghadam et al., 2013; Tonsor et al.,

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* Corresponding author.
E-mail addresses: xshang@ksu.edu (X. Shang), gtonsor@ksu.edu (G.T. Tonsor).

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2010). It is possible that consumers in some parts of the country are more sensitive to recalls. Whether consumers residing in different regions across the U.S. have differential responses to food safety recalls is still an unanswered question leaving an economically important knowledge gap of direct policy relevance.

Recognition of this important and dynamic situation, along with improvement in both methods and data availability, provides the core motivation and logical structure of this article. The objectives of this study are (1) to provide a deeper assessment of how specific recall information impacts U.S. demand across meat products and residents in different geographic regions and (2) to outline corresponding policy implications.

The impacts of recall information are evaluated through a multi-regional modeling approach including total U.S. and eight separate regions facilitating regional comparisons. Combined, the multi-regional modeling approach, based upon monthly grocery-store scanner data, considering separate FSIS recall types, allows a much specific understanding of consumer responses to food safety events. These results provide empirical evidence for use in refined policy design with consideration of regions of residence, meat product, and recall type. Moreover, as a leading meat exporter, the relevant policies are vital for international market access of U.S. meat products. This research aides in refining and assessing aspects of these policies as well.

The next section summarizes insights available from existing literature and reveals knowledge gaps addressed here. The research methods and data utilized are then summarized succinctly with more details being available in a separate Appendix. We then present results, implications and concluding remarks with a collective goal of refining insight on how food safety events impact meat demand and hence food safety oriented policies.

2. Summary of insights available in literature

Given increasing food safety concerns regarding contaminated meat products, a large body of research has been conducted to better understand the effects of food safety on meat demand worldwide. Significant research has broadly focused on safety issues such as evaluating how consumption changes in response to outbreaks of food safety incidents or scandals (McCluskey et al., 2005; Peterson and Chen, 2005; Ishida et al., 2010), examining the impact of negative food safety recalls and/or media information on meat demand (Burton and Young, 1996; Verbeke et al., 2000; Verbeke and Ward, 2001; Piggott and Marsh, 2004; Marsh et al., 2004; Mazzocchi, 2006; Tonsor et al., 2010), using choice experiments to analyze consumer willingness to pay (WTP) for food safety risk reductions (Buzby et al., 1998; Shogren et al., 1999), and quantifying determinants of food safety risk perceptions of consumers (Schroeder et al., 2007; Tonsor et al., 2009).

Most literature evaluating the effect of food safety information on U.S. demand utilizes per capita aggregate disappearance data from USDA (Piggott and Marsh, 2004; Marsh et al., 2004; Tonsor et al., 2010; Tonsor and Olynk, 2011). Aggregate disappearance data are limited in ability to assess heterogeneous preferences or product type and cannot represent the current market condition with much precision (Capps, 1989; Brester and Wohlgenant, 1993). In disappearance data, it is unclear where and how meat actually "disappears" into the market as some meat may be consumed or purchased by restaurants, food industries, or other commercial outfits as well as by consumers at grocery stores. Furthermore, aggregate beef data combines ground beef, muscle cuts (e.g. steaks and roasts), and other products masking underlying product-level information. This is important as certain pathogens are well-documented to be more associated with some product types. As an example, insights on *E. coli* O157: H7 contaminations on ground beef demand rather than aggregate beef demand are desired yet not obtainable using traditional disappearance data based analyses.

FSIS recalls have been used in demand models as proxies for food safety information received by consumers which represents the perceived level of food safety hazards in analyzing impacts on meat demand, prices, and financial markets (Marsh et al., 2004; Lusk and Schroeder, 2000; Thomsen and McKenzie, 2001; Tonsor et al., 2010; Moghadam et al., 2013; Jones and Davidson, 2014; Pozo and Schroeder, 2016). Furthermore, the prior literature typically "linearly aggregates" the number and type of FSIS issued recall events quarterly for beef, pork, and poultry to build measures of meat products recalls (Burton and Young, 1996; Kinnucan et al., 1997; Marsh et al., 2004; Tonsor et al., 2010). To make further statements concerning recall events, one must not only consider recalls by meat types, but also the specific source or pathogen (e.g. *E. coli* O157: H7 or *Salmonella*). To get at this, we separate beef recalls into beef *E. coli* recall and beef non-*E. coli* recall (e.g. *Listeria*, *Salmonella*, etc.), and aggregate the number of recall events monthly providing a more precise assessment both temporally and across recall type.

3. Data and research methods

The meat demand data utilized in this study were obtained from IRI (Information Resources, Inc) FreshLook Perishable Service from January 2009 through February 2014. This service provides scanner-based sales information on perishable items (including fresh meat products of central interest in this study) sold in the U.S. from over 15,000 grocery stores, 7000 mass merchandisers, and 800 club stores. This data includes measures of pounds (volume in lbs) and price (average retail price paid per pound). The dataset used in this study is derived from meat department reflecting approximately 82% of total U.S. sales that occur in the retail channel. The eight geographic regions are defined by IRI Freshlook Perishable Service based on InfoScan Standard Regions and the coverage of U.S. all-commodity volume (ACV) (Fig. 1).

This data offers significant advances in understanding the current meat market, which tracks the point-of-sale and random-weight sale from retail food stores.[1] What consumers actually paid for meat products can be reflected more accurately by volume-weighted prices provided by scanner data than the more commonly applied BLS (Bureau of Labor Statistics) summary of posted prices (Lensing and Purcell, 2006). In addition, the scanner data are available monthly, which allows for more accuracy in matching FSIS event dates (Taylor and Tonsor, 2013). Furthermore, the availability of scanner data for less aggregated product categories enables us to model impacts directly on ground beef demand consistent with the category's actual higher prevalence of *E. coli* recalls compared to other beef categories.

Generally, we have two fundamental model specifications focusing on different meat product levels which utilize two different datasets. The first approach has an emphasis of aggregated meat (beef, pork, chicken, and turkey) demand. The second approach separates beef products into ground beef and other beef to facilitate a focused assessment of ground beef demand. Here, pork and chicken are grouped into "other meat" by the assumption of weak separability to retain a four-product demand system. This approach is valuable given ground beef is a product most often involved in *E. coli* O157: H7 recalls and subject of food safety policies. The extension to gain finer insights on food safety policies

[1] Food safety recalls may also have different effects on restaurants and fast-food chains. Due to data limitations, the current study does not consider food-away-from-home (FAFH), which remains a good direction for future work.