E. COLI IN THE ROMAINE LETTUCE INDUSTRY: ECONOMIC IMPACTS FROM THE NOVEMBER 2018 OUTBREAK

KRISTIN KIESEL
RACHAEL E. GOODHUE
RICHARD J. Sexton
ASHLEY SPALDING

SUMMARY

Contact Kristin Kiesel for additional information: kiesel@ucdavis.edu

Kristin Kiesel is an Associate Professor of Teaching, Rachael Goodhue is Professor and Chair, Richard Sexton is Distinguished Professor, and Ashley Spalding is a Postdoctoral Scholar, all in the Department of Agricultural and Resource Economics at UC Davis. Kiesel, Goodhue, and Sexton are also members of the UC Giannini Foundation of Agricultural Economics.
A multi-state outbreak of E. coli infections is reported.

Health agencies in the U.S. and Canada issued a food safety advisory, warning consumers, retailers, and restaurants not to eat, sell, or serve any romaine lettuce or mixed salads containing romaine.

The CDC and FDA updated their advisories to specify avoidance of only romaine harvested from growing regions on California’s Central Coast.

The source of the outbreak was identified, and produce from Adam Bros. Farming Inc. in Santa Barbara County was recalled. The CDC and FDA further restricted the advisory to encompass only the Salinas-Watsonville and Santa Maria growing regions.

The CDC and FDA lifted the advisory for the final two regions, marking the end of the advisory.
DATA

Our analysis is facilitated by access to exceptionally good data on prices and sales within the leafy-greens supply chain. In addition to public data on spot-market prices and movement from the USDA-Agricultural Marketing Service (AMS), we acquired wholesale data from a cooperating processor that supplies both food-service and retail outlets, and retail scanner data from the Nielsen Company.

PRICE AND QUANTITY EFFECTS

Our analysis identifies two essential elements of damage to supply-chain actors from the incident and its aftermath--price effects caused by disruptions to both supply and demand, and quantity effects caused by the removal of romaine product from the supply chain and, later in the advisory period, from an inability to sell product due to reduced demand. Damages from non-salable product depend on where in the supply chain the product was located at the time of the advisory. Product that was harvested, processed, in transit, or on retail shelves or food-service refrigerators had incurred most or all production and handling costs, and its removal was particularly damaging to processors, retailers, and food-service operators. Romaine that was planted but not harvested and sold due to reduced demand also resulted in losses, but at a lesser amount per pound because harvesting, processing, and handling costs were not incurred.
Our methodology involved using econometric analysis to predict the path that markets for romaine and its close substitute leafy greens would have taken "but-for" the E. coli incident. These estimates provide our best assessment of what prices and sales would have been if the incident had not occurred. We then compare these but-for prices and quantities to the prices and quantities that actually did occur during the advisory period and aftermath for romaine and its substitutes and compute economic impacts from price changes and lost sales.

Increasingly, exchange in the leafy-greens industries is dominated by contracts. Spot markets comprise an estimated 10% of sales according to industry experts. Contract provisions vary. Product produced for the grocery retail channel generally has a fixed grower price and a fixed processor-retailer price for the various retail products. Contracts for production and sale to the food-service sector generally have more price flexibility based on price "triggers" built into the contracts. However, only spot sales were exposed fully to the forces of supply and demand in effect at the time.

**IMPACT ON PRICES**

Our analysis shows that spot market prices for romaine hearts and heads/leaf increased for the first several weeks of the advisory period compared to the but-for world. The effect turned negative around week 7 and remained negative for up to 12 weeks after the all-clear was issued. Growers and processors who had safe romaine to sell earned a premium in these early weeks, but eventually reduced demand due to the incident caused prices to fall. Figures 1 and 2 summarize our estimated price impacts for romaine hearts and romaine heads/leaf. Each blue dot represents our estimate of the price impact of the advisory for the indicated week. The blue line represents the 95% confidence bounds on the estimate.

![Figure 1. Average North American Spot Price Regression Estimates for Romaine Hearts](image1)

![Figure 2. Average North American Spot Price Regression Estimates for Romaine Leaf](image2)
The main spot market price effect detected for other leafy greens was for iceberg lettuce, which saw higher prices relative to the but-for world throughout most of the advisory period, as buyers sought to replace romaine with iceberg in salads.

Data from the cooperating processor indicate that it incurred higher acquisition costs in the range of 11%–30% for the retail channel throughout the advisory period and 12 weeks of aftermath. Acquisition costs for the processor were also substantially higher and variable in the food-service channel in the early weeks of the advisory—from 78% to 121% higher in weeks 2–4 of the advisory, but then stabilized and were little different from what we predict would have occurred in the but-for world. Given that grower prices are generally fixed in the retail channel, higher acquisition costs in that channel reflect plowing under of unsalable product or harvesting of product at sub-optimal times to accommodate the strictures of the advisory. Cost effects in the food-service channel reflect these same effects, as well as the implementation of price triggers in these contracts.

Prices received by processors for romaine in the food-service channel increased in the range of 24% to 41% in the early weeks of the advisory, but then were modestly lower than but-for prices in subsequent weeks including the aftermath period, reflecting reduced demand for romaine. Prices received for the main romaine-based bagged salads (hearts, blends, kits, and premium classics) changed relatively little in most cases, reflecting the fixed-price basis of processor-retailer contracts. However, we detected a significant and persistent decrease in the price for romaine hearts throughout most of the 12 weeks of the aftermath period. Hearts is a romaine product that is easily identified by consumers, and it may have suffered the most severe demand impacts due to the incident and advisory.
Our analysis also detected little movement in prices charged to retail consumers for romaine-based salads, an unsurprising result given that most retailers as a strategy prefer to keep stable consumer prices and that prices paid by retailers for leafy greens were themselves relatively stable. However, we found one notable exception: romaine hearts were more expensive by several percent throughout most of the advisory period relative to prediction in the but-for setting, but then its price did not fall in the post-advisory period, despite retailers' acquisition costs being lower.

**IMPACT ON QUANTITIES**

We also utilized econometric models to predict the decrease in sales volumes caused by the advisory and aftermath relative to the but-for world. We considered the USDA-AMS movement data to be unreliable as a source of sales data because spot sales are idiosyncratic, depending on market conditions. We were, however, able to study sales data for food service provided by the cooperating processor and for retail based on the Nielsen data.

Sales to food service decreased 72% in the first week of the advisory, with smaller decreases relative to prediction occurring for the remainder of the advisory period and for 10 weeks thereafter in the aftermath period. Retail sales were reduced most dramatically in week 2 of the advisory period—e.g., down 91% for salad blends and 96% for romaine hearts. (Week 1 reductions were somewhat less because the advisory was issued midweek relative to Nielsen’s recording period.) These early sales reductions were due to retailers having to remove romaine products from their shelves. Sales of bagged salads containing romaine, however, remained low relative to the but-for prediction throughout the advisory period and through 11 weeks in the aftermath of the all clear being issued. Across the advisory and aftermath period, we estimate that retail sales were down 25% for romaine hearts, with similar decreases for salad products containing romaine.
**INDUSTRY DAMAGES**

**GROWERS**

Due to the nature of contracting for leafy greens, growers were largely insulated from the economic fallout caused by the incident. Only spot sellers were fully exposed, and we estimate their losses at $650,000. Contract sellers actually gained slightly (about $600,000) because prices for food-service sales rose on average due to the incident.

**PROCESSORS/HANDLERS**

Processors and shippers were hit hardest by the incident. We estimate that this group lost $20.6 million due to having to pull harvested product from the supply chain and another $37.3 million from product under their control that could not be harvested or sold due to the advisory and reduced demand for romaine. We estimate that processors actually gained a few million dollars on net from price changes precipitated by the incident, but in total, across the various impacts, lost $52.7 million.

**GROCERY RETAILERS**

Grocery retailers lost $18.3 million due to having to pull product that was under their control from shelves and distribution channels. Retailers lost another $7.3 million due to price changes for their purchases and sales, for a total estimated loss of $25.7 million.

**FOOD SERVICE OPERATORS**

Food service operators experienced little net loss based on our analysis. These firms lost $3.6 million from inability to sell product under their control when the advisory was issued, but gained about $2.4 million from reduced acquisition costs, resulting in an estimated net loss of only $1.2 million.
SOCIETAL DAMAGES

The net loss to society from the E. coli incident involves more than the leafy-green supply-chain participants. It also involves consumers who were unable to access romaine products during the early weeks of the incident and in the later weeks due to fears regarding product safety. Losses were also incurred by suppliers of inputs, such as labor and materials, to the industry who lost employment and sales due to the incident.

Our estimates indicate a total social loss in the range from $280 to $350 million depending on various price elasticities considered. Most of the damage from the incident occurred in the early weeks of the advisory as figure 3 illustrates. However, damages from reduced sales continued to be experienced for up to 12 weeks after the all-clear had been issued by government agencies.

The entire Fall 2018 incident was traced to a single farm but resulted in widespread unavailability of romaine products, fears among some consumers about the safety of eating romaine, and significant economic losses incurred by a wide range of participants in the leafy-greens industries and beyond. The magnitude and breadth of losses from this single incident indicated the importance for the industry to adopt universal food-safety standards that can either prevent or, at worst, sharply reduce the likelihood of such incidents occurring in the future.