AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

United States Department of Agriculture

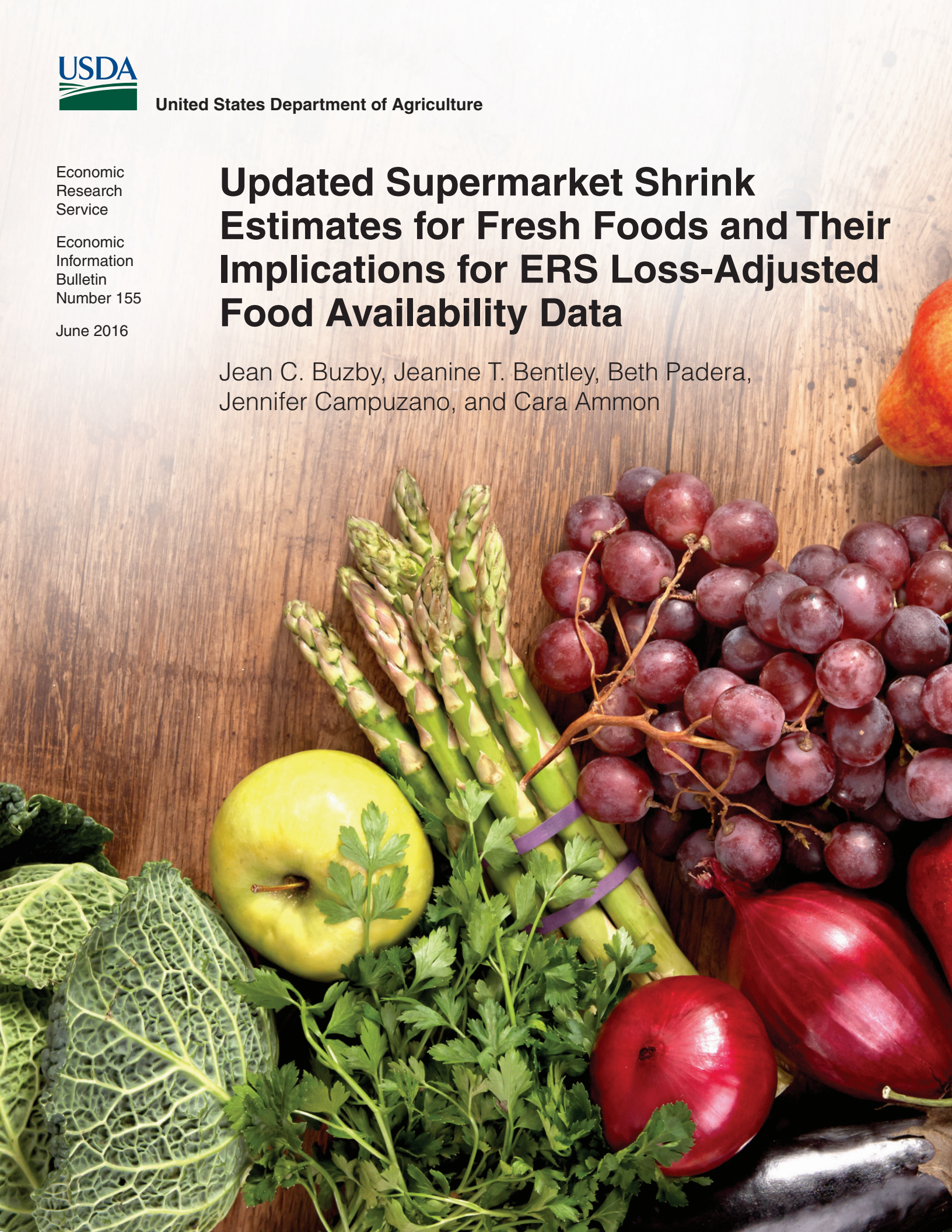
Economic Research Service

Economic Information Bulletin Number 155

June 2016

Updated Supermarket Shrink Estimates for Fresh Foods and Their Implications for ERS Loss-Adjusted Food Availability Data

Jean C. Buzby, Jeanine T. Bentley, Beth Padera, Jennifer Campuzano, and Cara Ammon



United States Department of Agriculture

Economic Research Service
www.ers.usda.gov

Access this report online:
www.ers.usda.gov/publications/eib-economic-information-bulletin/eib155

Download the charts contained in this report:

- Go to the report's index page www.ers.usda.gov/publications/eib-economic-information-bulletin/eib155
- Click on the bulleted item "Download eib155.zip"
- Open the chart you want, then save it to your computer

Recommended citation format for this publication:

Jean C. Buzby, Jeanine T. Bentley, Beth Padera, Jennifer Campuzano, and Cara Ammon. *Updated Supermarket Shrink Estimates for Fresh Foods and Their Implications for ERS Loss-Adjusted Food Availability Data.* EIB-155, U.S. Department of Agriculture, Economic Research Service, June 2016.

Cover images: Shutterstock.

Use of commercial and trade names does not imply approval or constitute endorsement by USDA.

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at How to File a Program Discrimination Complaint and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.

United States Department of Agriculture

Economic Research Service

Economic Information Bulletin Number 155

June 2016

Updated Supermarket Shrink Estimates for Fresh Foods and Their Implications for ERS Loss-Adjusted Food Availability Data

Jean C. Buzby, Jeanine T. Bentley, Beth Padera, Jennifer Campuzano, and Cara Ammon

Abstract

This study provides supermarket shrink estimates (percentages) for fresh fruit, vegetables, meat, poultry, and seafood in U.S. supermarkets in 2011 and 2012 by comparing supplier shipment data with point-of-sale data from one large national and four regional supermarket retailers. It also analyzes the consequences to the per capita food availability estimates if the new shrink estimates were to be incorporated into the Economic Research Service's Loss-Adjusted Food Availability (LAFA) data, replacing the current 2005-06 retail-level loss estimates. The updated estimates for fruits and vegetables were found to be generally close to the current loss assumptions, but there would be greater impacts for fresh meat, poultry, and seafood if the new estimates were to be used. For fresh meat, poultry, and seafood, data were available for case-ready items with a universal product code but not for random-weight items (i.e., loose items sold by weight). Adoption of the new estimates in LAFA would decrease per capita estimates of annual availability at the retail level in 2012 of fresh fruit by 4.7 pounds (4.3 percent), fresh vegetables by 1.7 pounds (1 percent), and fresh meat, poultry, and seafood by 12.4 pounds (7.3 percent). The 2005-06 shrink estimates for fresh meat, poultry, and seafood products were from interviews with executives and were not calculated by estimating the difference between supplier shipment and sales data for each item as was done for the other shrink estimates.

Keywords: Conversion factor, food availability, food loss, fruit, meat, poultry, retail, seafood, supermarket, vegetables

About the Authors

Jean C. Buzby and Jeanine T. Bentley are with USDA's Economic Research Service; Beth Padera was formerly with Nielsen Perishables Group, Inc.; Jennifer Campuzano is with Nielsen Perishables Group, Inc.; and Cara Ammon is with Beacon Research Solutions.

Acknowledgments

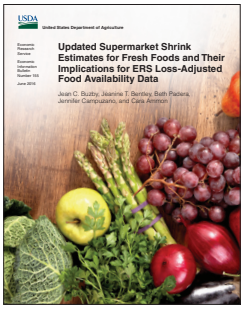
The authors thank Jay Variyam, Ephraim Leibtag, and Mark Denbaly of USDA, Economic Research Service (ERS) for their help with this report. The authors also thank Elise Golan of the USDA Office of the Chief Economist, Joanne Guthrie and Steve Martinez of ERS, Carlos Mena of Cranfield University in the United Kingdom, and Tina Saitone from OnPoint Analytics for their peer reviews of the report. Finally, the authors thank ERS editors Susmita Pendurthi and Courtney Knauth and designer Lori A. Fields.

Contents

United States Department of Agriculture

A report summary from the Economic Research Service

June 2016



Find the full report at *www.ers.usda.gov/publications/eib-economic-information-bulletin/eib155*

Updated Supermarket Shrink Estimates for Fresh Foods and Their Implications for ERS Loss-Adjusted Food Availability Data

Jean C. Buzby, Jeanine T. Bentley, Beth Padera, Jennifer Campuzano, and Cara Ammon

What Is the Issue?

In the past decade, advances in food technologies, food preparation practices, and procedures to safely transport, package, and market fresh foods, as well as changes in consumer demand and the supply of fresh foods, may have affected the supermarket shrink percentage for individual fresh commodities. Therefore, the 2005-06 supermarket shrink assumptions currently used as food-loss estimates for fresh foods at retail in the Loss-Adjusted Food Availability (LAFA) data series of USDA's Economic Research Service (ERS) need to be updated. Estimates of loss-adjusted food availability are popular proxies for actual consumption. Shrink is a term used in the food industry for wholesale and retail losses. Here, shrink is a proxy for food loss in handling and display that also captures some unknown amount of theft, accounting error, and other factors. If updated supermarket shrink estimates are adopted in LAFA, this would affect ERS estimates of the loss-adjusted amounts of fresh foods available for consumption in the United States.

What Did the Study Find?

In comparing the average shrink estimates for fresh items in 2011-12 with the 2005-06 averages from an earlier ERS study, the authors found that the 2011-12 shrink averages were higher by 1.2 percentage points for fresh fruits, roughly 2 percentage points for fresh vegetables, and 8.2 percentage points for fresh meat, poultry, and seafood. The average annual supermarket 2011-12 shrink rates for individual fresh fruits, vegetables, meat, poultry, and seafood at the retail level varied from 2.2 percent for sweet corn to 62.9 percent for turnip greens. Average fresh fruit shrink was in a narrower range: 4.1 percent for bananas to 43.1 percent for fresh papayas. Average shrink for fresh meat, poultry, and seafood ranged from 5.9 percent for turkey to 24.1 percent for shellfish.

Although individual supermarket shrink estimates in 2011-12 often varied considerably from the corresponding average estimates for 2005-06 in an earlier ERS study (Buzby et al., 2009)

ERS is a primary source of economic research and analysis from the U.S. Department of Agriculture, providing timely information on economic and policy issues related to agriculture, food, the environment, and rural America.

and were in general higher, the relative position of individual foods in terms of low or high shrink levels remained similar (i.e., weighted by commodity volume of sales). For example, estimated shrink for turnip and mustard greens was highest in both studies of all fresh vegetables. The average shrink estimate for total fresh fruit in 2011-12 (12.6 percent) was 1.2 percentage points higher than the 2005-06 average (11.4 percent). The average shrink estimate for total fresh vegetables in 2011-12 (11.6 percent) was roughly 2 percentage points higher than the 2005-06 average (9.7 percent). The difference between the two averages was much greater for fresh meat, poultry, and seafood, where the average shrink in 2011-12 (12.7 percent) was almost three times higher than the 2005-06 average (4.5 percent).

If ERS replaced the 2005-06 estimates currently used in the LAFA data series to represent retail food loss with the 2011-12 estimates, the impact on per capita availability estimates would vary relatively little among individual fresh fruits (a 1.6-pound decrease for apples to a 1-pound increase for bananas) and fresh vegetables (a 0.7-pound decrease for romaine and leaf lettuce to a 0.6-pound increase for onions), but more so with the fresh protein items (a 4.9-pound decrease for chicken in 2012 to a relatively small 0.01-pound increase in veal). Adopting the new shrink estimates would decrease LAFA loss-adjusted estimates of per capita retail availability in 2012 of fresh fruit by 4.7 pounds (4.3 percent), of fresh vegetables by 1.7 pounds (1 percent), and of combined fresh meat, poultry, and seafood by 12.4 pounds (7.3 percent). The new shrink estimates had relatively little impact on average food-loss rates for the fruit and vegetable groups in the LAFA data series or on total per capita estimates of the quantity of these food groups available for consumption at the retail level because the newer shrink estimates were generally close to the earlier loss assumptions, whereas the impacts for fresh meat, poultry, and seafood were relatively greater. However, dividing these annual changes in per capita estimates by 365 days results in very small daily per capita decreases—.01 pounds per day for fresh fruit, .005 pounds per day for fresh vegetables, and .03 pounds per day for fresh meat, poultry, and seafood. In short, even the relatively larger changes in availability for the meat, poultry, and fish group are not large when measured on a per capita per day basis.

How Was the Study Conducted?

ERS commissioned Nielsen Perishables Group to obtain 2011-12 shrink data for fresh fruits, vegetables, meat, poultry, and seafood for use as retail-level food-loss assumptions in the LAFA data series. The sample included 1 large national and 4 regional supermarket retailers from Nielson's proprietary database, which provided data from roughly 2,900 stores in 45 States and the District of Columbia. The sample did not include convenience stores, megastores, club stores, and mom-and-pop grocery stores. To identify a shrink percentage for each retailer, fresh commodity, and study year (2011 and 2012), the total supplier shipment data were paired with the corresponding total point-of-sale data (aggregated across all stores for each retailer in the sample).

Average shrink rates were then calculated for each commodity by weighting equally the estimates by those retailers providing estimates for that commodity. For fresh meat, poultry, and seafood, data were available for case-ready items with a universal product code (UPC, roughly two-thirds of that market) but not for random-weight items (i.e., loose items sold by weight, roughly one-third of that market)—unlike the fresh fruit and vegetable data, which included both UPC-coded and random-weight items. ERS then analyzed how the data on loss-adjusted food available for consumption would change if the new 2011-12 shrink estimates were adopted to replace the 2005-06 shrink estimates currently used in LAFA. It is important to note that the 2005-06 shrink estimates for fresh meat, poultry, and seafood products were from interviews with executives, rather than being calculated by estimating the difference between supplier shipment and sales data for each item, as was done for all fresh items in the current study and for fresh fruits and vegetables in the study that provided the 2005-06 estimates. The LAFA data series is considered *preliminary* because ERS continues to improve the underlying loss assumptions. The estimates presented in the study are a convenience sample and are not nationally representative.

Glossary

All commodity volume (ACV) – The term represents dollar sales of all items in the store (Kilts Center for Marketing, 2012).

Case-ready – In this report, case-ready meat, poultry, and seafood products are those prepared for sale prior to delivery to the store; that is, they are not butchered, trimmed, packaged, or labeled inhouse.

Channel – Refers to the type of retail outlet. For example, the *food channel* consists of supermarkets (e.g., Kroger), mass/supercenters (e.g., Walmart), club stores (e.g., Costco), and other retail stores selling food (e.g., convenience stores).

Food loss – Definitions of food loss and waste vary around the world. ERS defines food loss as the edible amount of food, postharvest, that is available for human consumption but that is not consumed, for whatever reason. This includes cooking loss and natural moisture loss; loss from mold, pests, or inadequate climate control; and food waste.

Loss-Adjusted Food Availability data – The ERS Loss-Adjusted Food Availability (LAFA) data series is derived by adjusting for food spoilage, plate waste, and other losses to more closely approximate actual intake. The LAFA data are recommended primarily for estimates of the per capita number of calories and food pattern equivalents of the five major food groups, plus the amounts of added sugars and sweeteners and added fats and oils (ERS, 2014b). ERS also uses the loss assumptions embedded in the LAFA data series to estimate the amount, dollar value, and calories of food loss at the retail and consumer levels in the United States (Buzby and Hyman, 2012; Buzby et al., 2011; Buzby et al., 2014; Hodges et al., 2010).

Modified atmosphere packaging (MAP) – Packaging that modifies the air inside the package in order to reduce or slow biological deterioration.

Ozone – Ozone is used as a disinfectant against a broad spectrum of spoilage microorganisms. It can be added to the water that comes into contact with fresh foods, such as during washing.

Point-of-sale data – In this report, point-of-sale data are scanner data of universal product code (UPC) barcodes or random-weight codes showing the amount in pounds of each commodity sold.

Random weight – In this report, the term refers to fresh products sold loose (not prepackaged) and by weight.

Retail level – In the LAFA data, this refers to the point along the chain extending from farm gate to fork for food sold at retail stores such as supermarkets.

Shipment data – These are data on supplier shipments to retailers—in essence, the product delivered to retail stores for sale to consumers.

Shrink/shrinkage – A term sometimes used for wholesale and retail losses (Paull et al., 1997). In this report, we define shrink as food loss plus product removed from stores by theft, accounting errors, and other factors.

Supermarket – Traditional grocers (e.g., Kroger) are referred to as supermarkets in this report.

Updated Supermarket Shrink Estimates for Fresh Foods and Their Implications for ERS Loss-Adjusted Food Availability Data

Introduction

In the United States, according to an estimate by the Economic Research Service of the U.S. Department of Agriculture (ERS/USDA), 43 billion of the 430 billion pounds of retail food available in 2010 went uneaten (10 percent), at an estimated total value of $46.7 billion (Buzby et al., 2014). ERS *food-loss* estimates represent the edible amount of food, postharvest, that is available for human consumption but is not consumed for any reason (including cooking loss; natural moisture loss; loss from mold, pests, or inadequate climate control; and food waste). *Shrinkage* (or *shrink*) is a term sometimes used for wholesale and retail losses (Paull et al., 1997). Shrink estimates are used here as proxies for food loss at the retail level for individual fresh commodities in the ERS Loss-Adjusted Food Availability (LAFA) data series. The primary purpose of the LAFA data is to provide estimates of the amounts of food available for consumption in the United States. These estimates are useful for monitoring the food quantities and nutritional intake of Americans over time.

There are various determinants of shrink at the retail level (that is, in supermarkets and other retail stores that sell food). Taking a broad view of all food and nonfood items sold in U.S. supermarkets, the Food Marketing Institute (FMI) and the Retail Control Group estimate that 64 percent of shrink in 2012 was caused by operational breakdowns and 35 percent by theft (Wheresmyshrink.com, 2012). The study covered 64 supermarket companies/chains in the United States (Kienzlen, 2015). The *operations category* (i.e., operation breakdowns) includes loss due to ordering inefficiencies, poor production planning (e.g., overproduction of fresh-cut fruit), product-handling errors, employee errors, poor rotation, scanning errors by cashiers, accounting errors, and damaged/unsaleable goods (e.g., crushed fresh fruit). The *theft category* includes loss due to shoplifting, cashier theft, general employee theft, and vendor theft (Wheresmyshrink.com, 2012). Typically, stolen items "are all high-ticket items that are also in demand—items like: razor blades, family planning items, high-end creams, tobacco, liquor, etc." (Kienzlen, 2015). The implication is that theft is not a notable issue for fresh fruit, vegetables, meat, poultry, and seafood relative to some other products sold in supermarkets. Kienzlen's study found, however, that shrink for meat departments was the highest by department, contributing to 18 percent of total-store shrink (the produce department contributed 16 percent). The shares of these estimates for food loss and for damaged/unsaleable fresh produce, meat, and seafood are not specified.

Food donations by retailers are not included in the supermarket shrink estimates because donations are usually written off either at cost or retail (per the company's accounting methods) on a different line on the company's' profit-and-loss statement (Kienzlen, 2015). Therefore, food donations are not

addressed in this study. Currently, food donations are not an explicit component of LAFA. ERS is interested in obtaining national data on the amounts of individual commodities donated by retailers, however, for use in the LAFA data series to improve measurement of food availability.

Changes in shrink over time can reflect changes in any of the above factors and changes in the availability and adoption of existing technologies to prevent or reduce product deterioration. For example, better inventory management systems, special waxes to slow wilting of susceptible produce, and advanced packaging technologies (such as ozonated water and modified-atmosphere technology) can help reduce fresh food shrink. However, packaging fresh fruits and vegetables can lead to higher levels of food loss if some items in the package are spoiled and cannot be removed, so that the entire package is thrown out (Mena et al., 2014). Shrink rates may also change over time with changes in consumer demand and supply and with new product introductions that expand food choices. Shrink may have also changed due to the economic climate, such as during the Great Recession in the United States (December 2007 to June 2009), but further research would be needed on this potential influence.

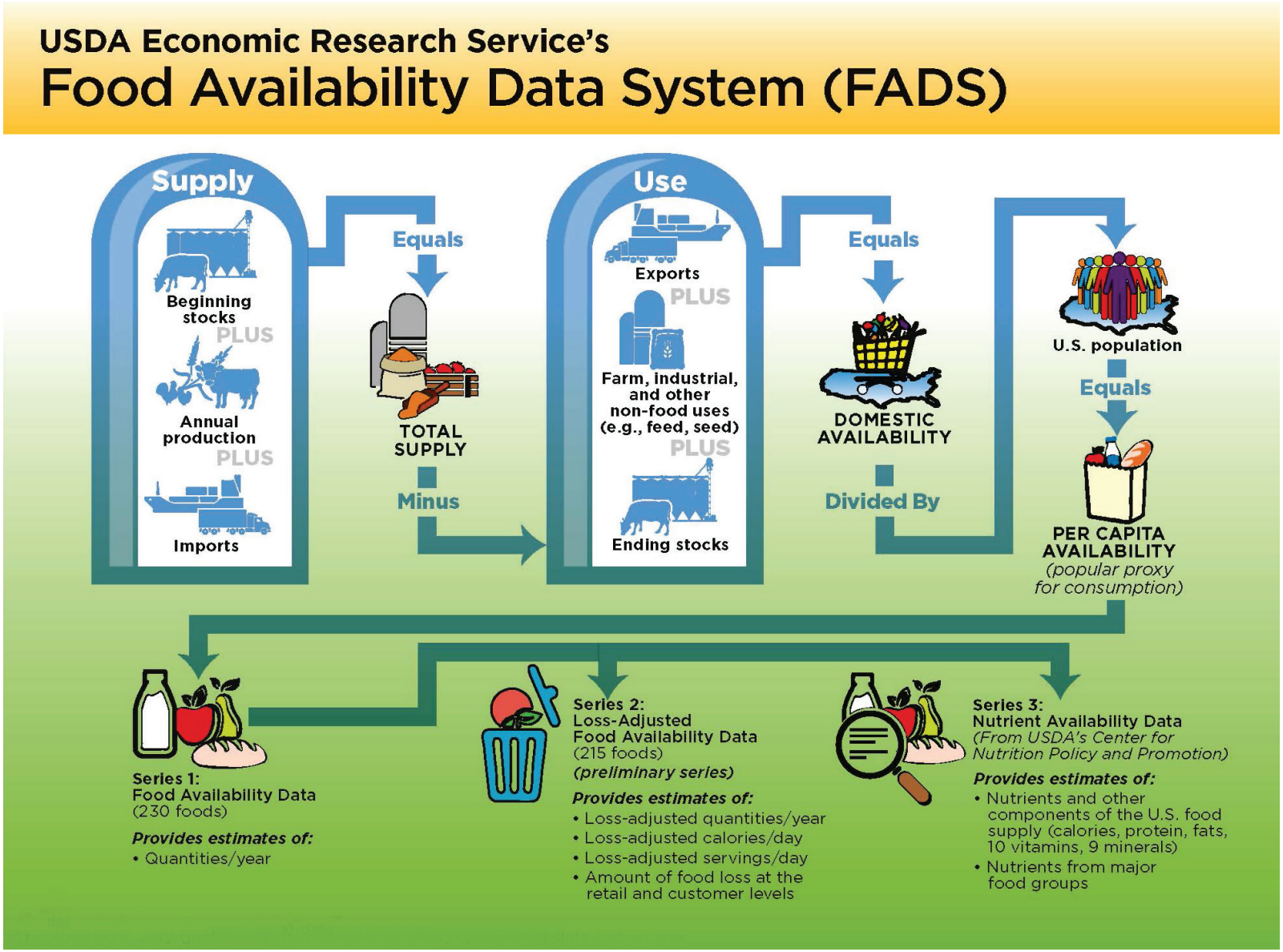
The primary goals of this report are (1) to provide shrink estimates (2011-12) for individual fresh fruit, vegetables, meat, poultry and seafood items at the retail or supermarket level in the United States and compare them with the currently used shrink estimates from 2005-06, and (2) to apply the new shrink estimates to the LAFA data as food-loss assumptions at the retail level to see how estimates of the food amounts available for consumption would change (e.g., in pounds per year or calories per day of fresh spinach, beef, or shellfish). Updated data can enable a more accurate measurement of the loss-adjusted fresh foods available for consumption at the retail level.

The LAFA Data Series

The foundation of the LAFA data is the Food Availability data series, which provides estimates of the supply of food for consumption in the United States (i.e., unadjusted for loss such as spoilage). For a given year and commodity, the supply of that commodity is the sum of production, imports, and beginning inventories. From this amount, ERS subtracts out exports, farm and industrial uses, and ending stocks to estimate the amount available for consumption. Another USDA agency, the National Agricultural Statistics Service (NASS), and the U.S. Census Bureau of the collect data on these components directly from producers and distributors, using techniques that vary by commodity. The food availability data are not collected from surveys of individual consumers, so the data provide an independent basis for examining food consumption trends. Per capita estimates are calculated by dividing the total annual availability for a commodity by the U.S. population for that year. Data for many of the commodities in the Food Availability data series extend back to 1909.

ERS manages and disseminates the Food Availability data series within the Food Availability Data System (FADS) posted on the ERS website (ERS, 2014a) (fig. 1). The data system is the only source of time-series data on the food available for human consumption in the United States. Accordingly, the information can be used to help monitor the potential of the food supply to meet the nutritional needs of Americans and to examine historical consumption trends.

Figure 1
ERS Food Availability Data System[1]



[1]The Nutrient Availability data series in FADS is outside the scope of this report.
Source: USDA, Economic Research Service.

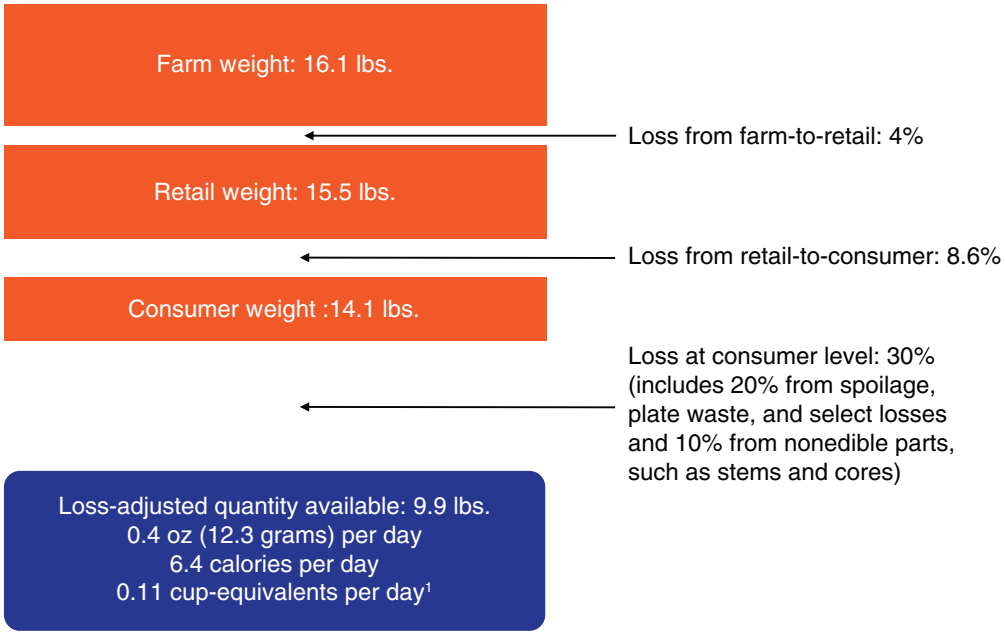
The Food Availability data overstate the amount of food actually eaten by including substantial quantities of food lost to human use through food loss, moisture loss, and spoilage beyond the farm gate in the marketing system, in foodservice outlets and restaurants, and in the home. Therefore, in the mid-1990s, ERS developed methods to adjust the availability data for spoilage and other losses and published the first ERS estimates of food loss at the retail and consumer levels (Kantor, 1998; Kantor et al., 1997). In connection with this capability, ERS created a second data series, now called the Loss-Adjusted Food Availability data (LAFA) series,[1] which refines the Food Availability data for around 215 commodities or foods in the data series for three general types of losses (fig. 2 provides an example for fresh apples):

1. Loss from primary (i.e., post-harvest/farm gate) to retail weight.

2. Loss at the retail level (e.g., in supermarkets, supercenters such as Walmart, and other retail outlets, including convenience stores and mom-and-pop grocery stores). This type of loss does not include losses in restaurants and other foodservice outlets.

3. Loss at the consumer level. This includes losses for food consumed at home and away from home (in restaurants, fast-food outlets, etc.) by consumers. It includes cooking loss and uneaten food such as plate waste from the edible share. For selected commodities (i.e., fresh fruits and vege-tables, eggs, and dried dates), it also removes the nonedible share of a food (e.g., apple cores, asparagus stalks, and eggshells).[2] Data on the nonedible share are from the National Nutrient Database for Standard Reference, compiled by USDA's Agricultural Research Service (ARS, 2012).

Figure 2
Loss-Adjusted Food Availability data for fresh apples, per capita, in 2010



[1]Food pattern equivalents can be thought of as servings needed to meet the Dietary Guidelines recommendations. See http://www.ars.usda.gov/Services/docs.htm?docid=23871 for details.
Source: USDA, Economic Research Service.

[1]The series was originally called the Food Guide Pyramid Servings data.

[2]What this means, in effect, is that for these commodities, the inedible share is included in the retail weight in LAFA but is then subtracted later at the consumer level.

Therefore, the primary purpose of LAFA is to provide loss-adjusted estimates of food availability as a proxy for actual consumption. In general, a second use of the LAFA data series by ERS is to estimate total food loss at the retail and consumer levels in the United States. This second purpose is not investigated further in this report.

The LAFA spreadsheets are posted on the ERS website and provide the loss assumptions currently used by ERS (ERS, 2014a). Each commodity in LAFA has a single spreadsheet (e.g., eggs, beef, and wheat flour) except for fruits and vegetables, which typically have separate spreadsheets for each type of fresh and processed item for which ERS has data. For example, apples have separate spreadsheets for fresh, frozen, dried, and canned apples, as well as a spreadsheet for apples made into juice. These loss estimates are sometimes called *conversion factors*, particularly when they involve a farm commodity's transformation into a consumer-ready product (e.g., fresh chicken carcass to boneless fresh chicken). In LAFA, the inedible shares for meat, poultry, and all processed forms of fruits and vegetables (other than dried dates, which have loss removed at the consumer level) are removed when converting the primary weight to the retail weight, so that these estimates at the retail level represent the edible portions. The seafood estimates are presented as edible meat weight (i.e., boneless equivalent weight) throughout the FADS.

One of the long-term goals for the ERS Food Availability Data System is to rigorously update the assumptions of the LAFA data so that the data series replaces the core Food Availability data series as the premier ERS estimate for food available for consumption over time. ERS aims to update the loss estimates in LAFA for each covered commodity for the most recent years of data available. The current ERS estimates of food loss for individual commodities are based on assumptions in the LAFA data series that are documented to varying degrees, ranging from little-to-no documentation for some of the estimates at the retail level (i.e., dairy products, grains, added fats and oils, added sugars and sweeteners, and processed fruits and vegetables) to well-documented estimates on the nonedible share for each food, using information from the Nutrient Database for Standard Reference published by ARS (ARS, 2012).

Over the last decade, the LAFA data series has been upgraded through a series of data initiatives (ERS, 2014b). The LAFA data series is considered as *preliminar*y because ERS continues to improve the underlying loss assumptions and to provide better documentation for the series. For example, the loss assumptions for fresh fruits, vegetables, meat, poultry, and seafood from the retail/institutional level (supermarkets and other retail outlets) to the consumer level in the LAFA data were previously updated with 2005-06 shrink estimates obtained through a study with the Perishables Group, Inc. (an independent consulting firm in the fresh food industry now doing business as Nielsen Perishables Group). Findings from this effort are documented in Buzby et al. (2009), and the 2005-06 loss estimates were adopted in the LAFA data series in February 2009 for the entire span of the data from 1970 to the most recent year available. For the current study, ERS obtained new data on retail-level shrink for 2011-12 in the United States from Nielsen Perishables Group.

Data Collection and Analysis

In 2014-15, Nielsen Perishables Group conducted the data collection and obtained updated estimates of retail shrink for individual fresh fruit, vegetables, meat, poultry, and seafood in the United States for 2011-12. ERS compared the new estimates with the 2005-06 estimates currently used in LAFA as a validation step and to obtain some perspective on changes over time. ERS then analyzed what would happen to ERS estimates of loss-adjusted food availability at the retail level in the United States, in terms of per capita pounds and calories, if ERS adopted the 2011-12 shrink estimates as food-loss assumptions in the LAFA data series to replace the 2005-06 estimates.

Commodities Studied

Nielsen Perishables Group aggregated retailer categories, as necessary, to match the individual fresh foods and commodities in the LAFA data series as closely as possible so that the new shrink estimates could be incorporated into the series. For example, data on all random-weight apples (such as Gala, Granny Smith, McIntosh, and Red and Golden Delicious) were combined with UPC-coded apples to match the ERS category for "fresh apples." UPC-coded apples included those packaged and sold in a bag or with "value added," such as by preslicing. As noted, data were used only for apples by themselves and did not include candy-coated or sliced apples mixed with other fruit. In each case, the goal was to have store purchases and sales aggregates that were consistent with the foods in the LAFA data. The result was that Nielsen Perishables Group provided new shrink estimates for each of the fresh fruits, vegetables, meat, poultry, and seafood items covered in the LAFA data (see box, "Fresh Food Commodities Covered in Nielsen Perishables Group Data and Analysis"), with a few exceptions.[3]

Nielsen Perishables Group did not include mixtures of commodities (e.g., fruit salad, leafy green salads with fruit and/or meat, and variety meat platters) in their calculations of quantitative data due to the lack of data on the share or weight of the different fresh items in each mixture. These mixtures vary widely from retailer to retailer, and composition shares of the various mixtures are not consistent. In addition, the authors did not collect data on mixtures because the primary purpose of this study was to obtain updated retail-level loss estimates for individual fresh commodities for use in the LAFA data series, which contains only the core BEGINindividual commodities; including mixtures could lead to double-counting of products.

[3]The exceptions were fresh raspberry and lima bean shrink, which were not estimated. Although the LAFA data series does not include goat meat, there is some goat meat included in the lamb sales estimates from Nielsen Perishables Group, although goat meat sales comprised less than 1 percent of lamb/goat meat.

Box 1

Fresh food commodities covered in Nielsen Perishables Group data and analysis

Fruit		Vegetables		Meat, poultry & seafood
Apples	Lemons	Artichokes	Kale	**Red meat**
Apricots	Limes	Asparagus	Romaine and leaf lettuce	Beef
Avocados	Mangoes	Bell peppers	Mushrooms	Veal
Bananas	Oranges	Broccoli	Mustard greens	Pork
Blueberries	Papayas	Brussels sprouts	Okra	Lamb/goat
Cantaloupe	Peaches	Cabbage	Onions	
Cherries	Pears	Carrots	Potatoes	**Poultry**
Cranberries	Pineapple	Cauliflower	Pumpkins	Chicken
Grapefruit	Plums	Collard greens	Radishes	Turkey
Grapes	Strawberries	Sweet Corn	Snap beans	
Honeydew	Tangerines	Cucumbers	Spinach	**Seafood**
Kiwi	Watermelon	Eggplant	Squash	Fish
		Escarole/endive	Sweet potatoes	Shellfish
		Garlic	Tomatoes	
		Head lettuce	Turnip greens	

Source: USDA, Economic Research Service and Nielsen Perishables Group.

Methodology To Update Data

The retail shrink estimates were derived by first matching total sales data with total shipment data for each retailer, covered commodity, and year and then by estimating the average shrink for each commodity across retailers providing estimates for that commodity (i.e., retailers did not provide data on all covered commodities). The 2011-12 shrink data for fresh food items are based on aggregates of actual records from all the stores in the sample for the individual fresh items covered in this study. Specifically, for a given retailer and year, the shrink percentage for each commodity was calculated as the total pounds (or other unit) of a product that came into the retailer's stores divided by the total pounds (or other appropriate unit) of that product that came into the stores but remained unsold (i.e., the "residual food loss," determined by subtracting sales from shipments received). This methodology yields actual, as opposed to estimated, shrink rates and provides some indication of shrink trends across fresh categories. The methodology currently offers the most accurate depiction possible of retail-level shrink for fresh items on a national level.

It is important to note that the 2011-12 data exclude store-processed, random-weight fresh meat, poultry, and seafood and include only case-ready products that are produced before delivery to the supermarkets and have a UPC. Although Nielsen Perishables Group had sales data for the random-weight items, the shipment data were more problematic, as a portion of the shipments were large carcasses or the entire animal/fish, which were difficult to convert into the boneless weight needed for this analysis. To put this lack of random-weight shipment data for fresh meat, poultry, and seafood into perspective, we used information from the 2010 National Meat Case Study as a comparison. This study found that for 124 retail supermarkets and 9 club stores in 51 metro markets across

31 States, the estimated share of case-ready (i.e., UPC-coded) meat and poultry was 66 percent in 2010 (the remainder would be random-weight product) (SealedAir/BCP/NPB, 2010).[4] This lack of detailed shipment data was also an issue for the 2005-06 estimates for meat, poultry, and seafood, and therefore the earlier study used data from a small sample of interviews with supermarket executives who likely considered both UPC-coded and random-weight products when providing estimates (see Buzby et al., 2009, p. 5). Without additional data, there is no way of knowing how much of the increase in the loss estimates in the meat category for 2011-12 from the 2005-06 estimates is attributable to the excluded random-weight meat items. This omission in the retailer calculations of random-weight meat, poultry, and seafood means that the updated shrink estimates provided in this report for these categories are not appropriate at this time for updating food loss estimates at the retail level in the LAFA data. Future research could determine if this random-weight data can be obtained through other data sources.

In order to be used in the analysis sample, data from each store under consideration had to have both weekly shipment data on a particular food commodity (e.g., pounds of fresh tomatoes from suppliers) and corresponding point-of-sale data on consumer purchases in the Nielsen Perishables Group's proprietary FreshFacts® point-of-sale database (e.g., scanner data showing the pounds of fresh tomatoes sold). Combined, these two types of information enabled Nielsen Perishables Group to aggregate the data across all stores for each retailer in the sample and match total shipment data to total sales data for each fresh commodity so that the amount (that is, the residual) and percentage of shrink could be calculated for each retailer for 2011 and 2012.

For each fresh food item and for each of the 2 years, Nielsen Perishables Group weighted equally each participating retailer's shrink estimate in the total average. For example, for those fresh commodities where all five retailers provide shrink estimates, each retailer's estimate comprised 20 percent of the final average for a given commodity and year. Nielsen Perishables Group chose this method to prevent any one retailer from having a disproportionate impact. For example, one participating retailer had a large number of stores and sold disproportionately more nonfood items than other participating retailers, meaning that it would not be appropriate to weight by total sales. The average shrink for each commodity for 2011-12 was then calculated. The appendix to the report, "Average Supermarket Shrink Estimates by Five U.S. Retailers, 2011-12," is provided to show that: (1) shrink estimates for some commodities were not provided by all five retailers in the study, (2) shrink estimates varied among retailers, and (3) some retailers reported zero shrink for some commodities (e.g., eggplant, garlic).

The shipment data and point-of-sale data were reported and aligned at the item level for each fresh commodity. For example, a 1-pound bag of fresh carrots would be identified by its UPC and its purchase by a particular store. Therefore, the data could be aggregated to the appropriate product level at a particular store and year, and a loss rate could be calculated. For example, "Fresh carrots" consist of UPC-coded baby carrots, shredded carrots, and 1-, 3-, and 5-pound bags of whole carrots, plus whole carrots sold by random weight.

[4]The 2010 National Meat Case Study found that in 2010 the following percentages were case-ready packages: 98 percent of turkey; 94 percent of chicken; 71 percent of ground beef; 60 percent of lamb; 58 percent of pork; 54 percent of veal; and 31 percent of beef. We could not identify national estimates for fish and seafood.

Retailer Point-of-Sale Data

Nielsen Perishables Group routinely collects point-of-sale data from approximately 18,000 stores and retail supermarkets across the United States and uses this information to develop its proprietary FreshFacts® point-of-sale database. Nielsen Perishables Group sales data track weight and package size attributes for produce, meat, poultry, and seafood, enabling reporting by weight. In comparison, the Census' County Business Patterns data (using the North American Industry Classification System (NAICS)[5] indicate that in 2012, there were an estimated 66,047 "supermarkets and other grocery (not convenience) stores" in the United States, 25,483 convenience stores, and 21,767 "specialty food stores" such as meat, fruit and vegetable, and baked goods stores and fish and seafood markets (Census, 2015). In the United States, the food channel (including grocery stores, mass/supercenters, and club stores) in total represents 90 percent of the dollar sales for the channels (types of retail outlets) where fresh food is sold.[6] The remaining 10 percent of fresh food sales are from the convenience, dollar, drug, and military channels and certain other retail chains.

Nielsen Perishables Group used a sample of supermarket retailers in the United States from its proprietary FreshFacts® point-of-sale database to estimate fresh commodity shrink at the retail level for 2011-12. Only stores from the food channel were included in order to best compare the data with the sample used in the 2005-06 food-loss analysis documented by Buzby et al. (2009). Specifically, this point-of-sale database includes retail census sales data for key grocery, club, and mass/supercenter store chains in the United States with $2 million or more annual all-commodity volume (ACV) sales per store. The ACV is a variable on a product's distribution that takes into account differences in the size of a store (Kilts Center for Marketing, 2012). The database does not include independent grocers, convenience stores, mom-and-pop grocers, and some retail chains, such as Whole Foods, Trader Joe's, Aldi, Costco, HEB, and Hy-Vee.[7] This may mean that the estimates shown here may be higher or lower than the estimates if all retail food outlets were included.

Retailer Shipment Data

For this study, Nielsen Perishables Group leveraged its existing business relationships to recruit a sample of retail chains in the United States to provide supplier shipment data on the specific fresh commodities covered in the study. Nielsen Perishables Group ensured a good cross-section of retailers by developing a sample of retail chains that included: (1) both large national and small regional chains, (2) retailers from all regions of the country, and (3) traditional supermarkets along with mass merchandisers/supercenters. Once Nielsen Perishables Group created the target list, the Nielsen staff member most in contact with each retailer made an initial e-mail request for study participation to retailer staff at the corporate level, typically to the vice presidents or directors of specific departments in the entire chain (i.e., produce, meat, or seafood). The e-mail explained the purpose of the study and invited the corporate officials to take part. The Nielsen Perishables Group then conducted phone interviews with those who chose to partici-

[5]The North American Industry Classification System (NAICS) is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy.

[6]Channel refers to the type of retail outlet. In general, examples of the "food channel" are supermarkets (e.g., Kroger), mass/supercenters (e.g., Walmart), and club stores (e.g., Costco).

[7]These data were unavailable in this study. Future research could address whether some types of stores are expected to have larger and smaller shrink than others. In particular, future studies could analyze whether some types of stores are more or less efficient at specifics such as ordering, storage, product line management, etc.

pate. Participants typically shared their shipment figures for the covered commodities and years by sending a spreadsheet via e-mail. The supermarket retailers ultimately included in the data portion of this study were 1 large national and 4 regional food retail chains located in 45 States plus the District of Columbia and covering all 4 U.S. regions—East, South, Central, and West—to allow for a geographically representative sample. Nevertheless, the sample is a snapshot view of retail shrink; it is a convenience sample and is not nationally representative. Nielsen Perishables Group asked a total of seven retail chains to participate in the shipment data portion of the project, and five participated; thus, we had a 71-percent response rate. Because of Office of Policy Management (OPM) guidelines and restrictions on the number of firms/retailers we or our contractor can contact, we could not seek data from all retailers in the United States or all retailers with whom Nielsen Perishables Group has an association. That is, it is hard to get a true, national baseline of supermarket shrink because of data challenges.

For each store used in this study, Nielsen Perishables Group collected fresh fruit, vegetable, meat, poultry, and seafood supplier shipment data. If the complete 2-year timeframe was not available for a retailer, we used whatever data existed within this period. Three of the five retailers had complete data. The fourth retailer provided data for October 2011–September 2013, and the fifth provided data for September 2011–September 2013. Nielsen Perishables Group did not extrapolate the data to a full year, but rather used it "as is" to develop the averages (i.e., the data were divided into two 52-week periods to create the annual averages for 2011 and 2012).

The sample size was limited by the number of stores providing shipment data, not by the number of retail stores in the point-of-sale data. In combination, the 1 national chain and 4 regional chains in the study provide data for around 2,900 stores in 45 States plus the District of Columbia for estimating fresh fruit, vegetable, meat, poultry, and seafood shrink. The stores are not distributed evenly across States. We cannot divulge which States have more stores than others without providing clues about which stores we used. Walmart was not included in the sample. The stores in the study comprised roughly 16 percent of the approximately 18,000 stores in Nielsen Perishables Group's available universe. The Census' County Business Patterns data estimate (using NAICS) of 66,047 "supermarkets and other grocery (not convenience) stores" in the United States in 2012 suggests that our convenience sample of 2,900 stores represents 4.4 percent of U.S. supermarkets. This sample is much larger than the previous supermarket loss study sample, which provided the 2005-06 estimates. That study sample included over 600 retail stores from 6 national or regional chains in all 4 U.S. regions (East, South, Central, and West) (Buzby et al., 2009).

Data Quality

The shipment data were cleaned and validated for accuracy at the item level by each retailer. The data-input quality varied by retailer, as each had different internal ordering and accounting systems. Nielsen Perishables Group further cleaned and processed the data to meet internal data-quality standards across all retailer datasets included in the study. Weekly sales and procurement receipts for each study year (2011 and 2012) were aligned for each individual item sold, and anomalous data points (i.e., shrink levels above 80 percent or below zero) were identified and removed.[8] Outliers were primarily driven by the accuracy of the retailer's internal tracking systems for procurement and were found across all categories and retailers included in the study. Outliers can be attributed, for

[8]Eighty-percent shrink was chosen as a benchmark by Nielsen Perishables Group because it was a very high, unsustainable level of shrink for a retailer and would likely indicate missing or misreported data.

example, to procurement-receipt reporting discrepancies, longer-than-expected time in the supply chain, product repurposing in-store (e.g., cutting up fruit to remove blemishes and make fruit salad), or local store procurement outside of the main ordering process. Outliers were found across fruit and vegetable categories and varied by retailer.

Results

The results are provided in three sections for the three fresh food groups: (1) fruit, (2) vegetables, and (3) meat, poultry, and seafood. Each section is broken into two parts:

(a) *Updated Supermarket Data* provide new shrink estimates at the retail level for 2011-12 and are compared with the currently used shrink estimates for 2005-06.

(b) *Impact Assessment* provides an analysis of how the updated shrink estimates for 2011-12, if adopted in the LAFA data series to replace the currently used 2005-06 shrink estimates, would impact ERS estimates of the amount of loss-adjusted food available for consumption at the retail level for individual commodities in 2012.

It is important to note that the loss-adjusted estimates of food availability are at the retail level. Additional consumer-level losses (e.g., plate waste at home and away from home) are accounted for later in the LAFA data series to calculate final estimates of the total food loss at the retail and consumer levels in the United States and the amounts available for consumption.

The study compared shrink estimates for 2011 and 2012 as a validation of methods used. Widely varying estimates in 2011 and 2012 for a particular fresh food could suggest that there is greater year-to-year variability in the loss estimates than for other fresh foods. Fluctuations can be caused by many factors, such as crop size, weather events, and pest damage. We do not have enough information to determine whether trends have definitively changed over time. Widely varying estimates for a particular commodity between 2011 and 2012, for example, could mean that one of the estimates may be an outlier; if so, it should be considered more closely when deciding whether to use it to compute the 2011-12 average shrink estimates and whether to include it as an estimate of retail loss for that food in the LAFA data. However, 2 years of data are insufficient for firm conclusions about increases or decreases in loss estimates. Therefore, as a further validation step to ensure that the new estimates are reasonable, the study compared the average 2011-12 shrink estimates for each food group with the 2005-06 shrink data documented in Buzby et al. (2009), still used in the LAFA data series to represent food loss at the retail level as of the date of this publication.

Fresh Fruit

The estimated shrink for fresh fruit at the retail level was 13.3 percent in 2011 and 12.3 percent in 2012 (table 1). This 1-percentage-point difference is reasonable given year-to-year fluctuations in demand and supply of individual commodities. For the bulk of this report, ERS used the 2011-12 averages for individual fresh foods because they provide better snapshots of potential trends than using only 1 year of data. The averages for individual years of data in the last line of the table are weighted by commodity volume by Nielsen Perishables Group. The overall average supermarket loss for fresh fruit was 12.6 percent for 2011-12.

The average supermarket shrink rate during 2011-12 varied considerably across individual fresh commodities. Average fruit shrink ranged from 4.1 percent for bananas to 43.1 percent for fresh papayas. The second- and third-lowest average shrink estimates for fresh fruit in 2011-12 were lemons (5.1 percent) and grapes (8.7 percent).

Despite a large decline in shrink between 2011 and 2012 (24.5 percentage points), papayas remained the fresh fruit with the highest 2011-12 average shrink (43.1 percent). These estimates are in line

Table 1

Supermarket shrink estimates for fresh fruit[1]

Fruit	2005	2006	2005-06 percentage-point change	2005-06 average	2011	2012	2011-12 percentage-point change	2011-12 average	Percent difference between 2005-06 and 2011-12 estimates
	----- Percent -----		Number	---------- Percent ----------			Number	---------- Percent ----------	
Papayas	58.7	51.0	-7.7	54.9	54.8	30.3	-24.5	43.1	-21.4
Pineapples	16.8	12.5	-4.3	14.7	30.5	35.8	5.3	32.2	119.8
Apricots	37.5	32.6	-4.9	35.1	39.0	28.9	-10.1	30.0	-14.4
Watermelon	18.7	14.9	-3.8	16.8	23.3	27.7	4.4	25.4	51.2
Honeydew	20.9	24.6	3.7	22.8	33.8	18.5	-15.3	22.5	-1.1
Mangoes	21.2	7.7	-13.5	14.5	22.8	20.8	-2.0	21.1	46.0
Apples	9.5	7.8	-1.7	8.7	20.0	19.2	-0.8	19.2	122.0
Avocados	9.7	9.0	-0.7	9.4	25.0	17.2	-7.8	19.0	103.2
Grapefruit	12.9	12.8	-0.1	12.9	25.2	14.6	-10.6	18.8	46.3
Cantaloupe	11.1	13.3	2.2	12.2	18.4	17.9	-0.5	18.2	49.2
Peaches	14.8	9.1	-5.7	12.0	13.8	18.8	5.0	15.6	30.5
Plums	20.7	14.0	-6.7	17.4	16.4	13.6	-2.8	15.1	-13.0
Oranges	12.8	10.3	-2.5	11.6	13.1	15.4	2.3	14.8	28.1
Kiwi	15.7	9.6	-6.1	12.7	16.4	13.1	-3.3	14.7	16.2
Pears	19.7	15.4	-4.3	17.6	12.8	16.7	3.9	14.7	-16.2
Tangerines	19.5	21.4	1.9	20.5	16.9	14.3	-2.6	14.7	-28.1
Strawberries	10.0	9.5	-0.5	9.8	16.4	12.5	-3.9	14.2	45.6
Limes	10.9	5.7	-5.2	8.3	14.5	13.9	-0.6	14.0	68.7
Cranberries	7.1	4.8	-2.3	6.0	12.4	12.7	0.3	12.7	113.4
Cherries	2.8	4.9	2.1	3.9	8.0	10.3	2.3	10.3	167.5
Blueberries	5.9	4.6	-1.3	5.3	8.3	9.9	1.6	8.9	69.5
Grapes	8.1	7.1	-1.0	7.6	9.4	7.1	-2.3	8.7	14.5
Lemons	8.1	5.9	-2.2	7.0	8.3	4.9	-3.4	5.1	-27.1
Bananas	9.4	6.5	-2.9	8.0	4.1	4.1	0.0	4.1	-48.4
Average	10.7*	8.4*	-2.3**	11.4*	13.3*	12.3*	-1.0**	12.6*	38.4

* = Weighted averages calculated using category average sales contribution (%) to total fresh fruit for retailers included in the study.

** = Calculated percentage-point change.

[1]2005-06 data documented in Buzby et al. (2009).

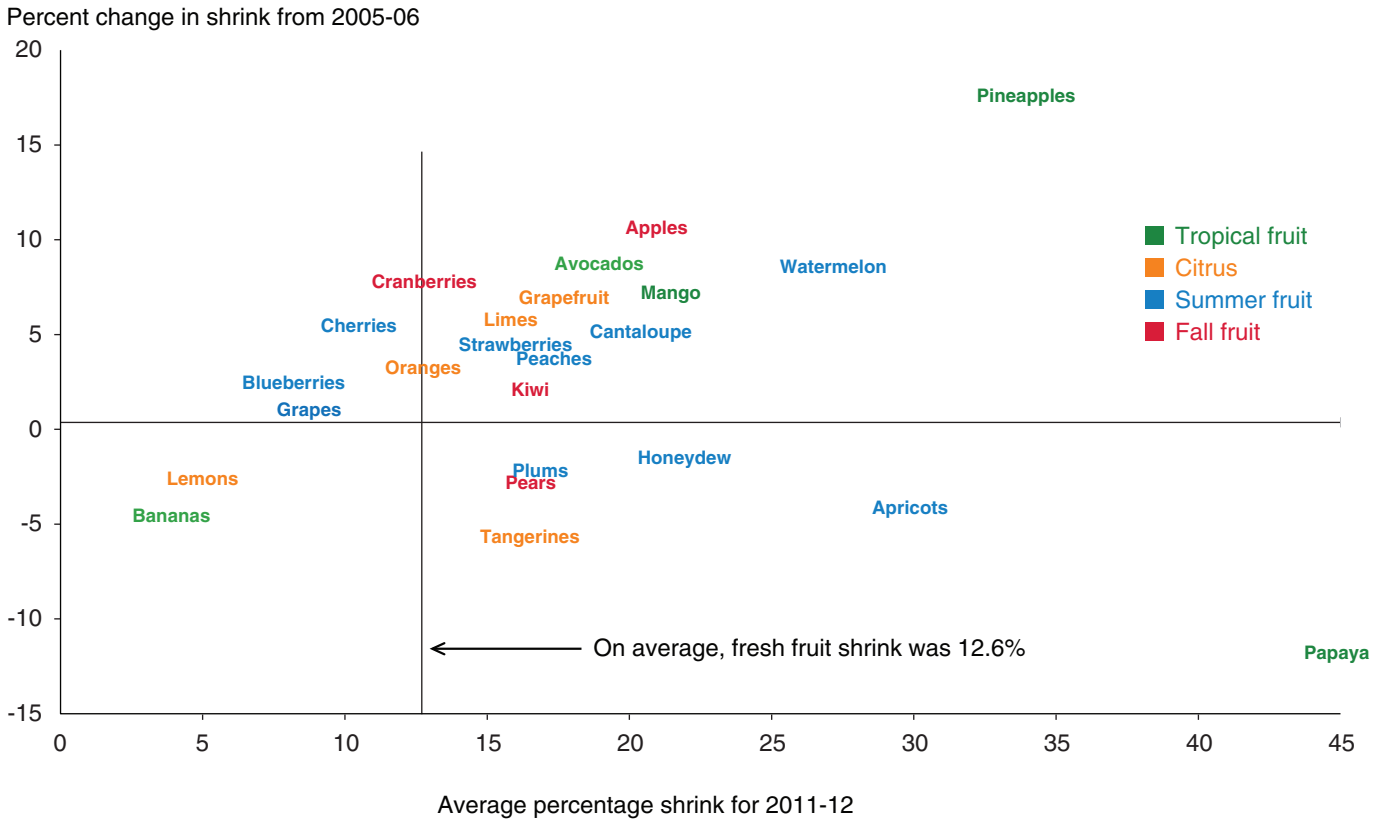
Source: USDA, Economic Research Service, adapted from Nielsen Perishables Group final report to ERS.

with the typical range of 10 to 50 percent for papaya shrink in the literature, with losses up to 80 percent for some shipments (Paull et al., 1997). Papayas also had the highest shrink among the fresh fruits in 2005-06. This high loss may be partly due to consumers' lack of knowledge of when papaya is ripe, how to prepare it, and how to use it as an ingredient. Lack of familiarity with the fruit may mean consumers are hesitant when deciding whether to purchase papayas at the supermarket, and that, as a result, the loss rate is higher. "Soft fruit" can be caused by crushing and bruising during handling, and when the papayas are low in calcium, they are particularly prone to such damage (Paull et al., 1997). Store policies that require the retail chain to carry a range of produce even when sales are minimal may also explain some papaya loss (Paull et al., 1997).

For 2011-12, the second- and third-highest average shrink occurred in pineapples (32.2 percent) and apricots (30 percent). The largest shrink percentage-point increases between 2011 and 2012 were for pineapples (5.3 percentage points) and peaches (5 percentage points). These increases do not suggest outliers in the new data. Peach quality often varies from year to year based on crop conditions, and increased peach shrink could be due to a lower quality crop in the second year.

Another way to look at the data is graphically. In figure 3, the name of each fruit is located on its data point. The horizontal axis shows the relative size of the 2011-12 average percent shrink for each type of fruit, ranging from bananas on the far left to papaya on the far right. Data points can be easily compared to the vertical line representing the average fresh fruit loss of 12.6 percent. The vertical axis shows the percent change in each fruit's average shrink rate in 2011-12 from the rate in 2005-06. In other words, retail-level average food shrink rates for the fresh fruits shown above the zero-percent horizontal line increased in 2011-12 compared to 2005-06, while the average shrink rates for individual fresh fruits below the zero-percent horizontal line decreased from the earlier study. It is interesting that the shrink rates for most individual fresh fruits are above the average; we believe that the low shrink rates for highly popular bananas lowers the average to 12.6, which is weighted by commodity volume. Figure 3 uses colors to show the fruits in their tropical, citrus, summer, and fall categories, although no notable patterns emerged.

Figure 3
Average shrink increased for most fresh fruit categories between 2005-06 and 2011-12



Source: USDA, Economic Research Service, based on Nielsen Perishables Group data.

Estimated Fresh Fruit Availability

ERS used the 2011-12 estimated average supermarket shrink for each type of fresh fruit listed in the LAFA data to see how the newer estimates, if incorporated as retail-level loss assumptions in LAFA, would change the per capita estimates of the loss-adjusted food available for consumption at the retail level. As noted, this analysis uses the 2011-12 average shrink for each fresh food to reduce the impact of a single low-quality crop year or other factor on estimates of the food available for consumption in the LAFA data.

Table 2 provides a summary of what would happen to the estimates of each fresh fruit's availability at the retail level if ERS replaced the 2005-06 shrink estimates from Buzby et al. (2009), currently used in the LAFA data series as food loss at the retail level, with the 2011-12 shrink estimates from table 1. In essence, an increase in loss means a decrease in the amount of fresh fruit available for consumption.

Table 2 shows that if the 2011-12 shrink estimates for individual fresh fruit are adopted into the LAFA data series as loss estimates, there will be 4.7 fewer pounds of fresh fruit available for consumption at the retail level, per capita, in 2012. On a daily basis, this per capita 4.7-pound annual decrease is a small change, roughly 1/100 of a pound or about one less calorie per day.

The largest increase in annual per capita availability of fresh fruits between the two time periods was a 1-pound increase in bananas, America's most popular fresh fruit in 2012.[9] In other words, although bananas had the lowest average shrink of fresh fruit in 2011-12 (4.1 percent in table 1), they had the largest estimated change in food availability simply because they are one of the most important fresh fruits in the American diet.

Meanwhile, availability of pineapples, watermelon, and apples decreased by over a pound between the two time periods. Apples had the largest average decrease in 2011-12 (-1.6 pounds). Apples are one of America's favorite fruits (i.e., high-volume sales) and have a shrink rate toward the higher end of the range.

[9]As an aside, oranges were the top fruit in 2012 when both fresh and all processed versions are taken into account.

Table 2

A comparison of fresh fruit availability at the retail level using 2005-06 and 2011-12 food loss estimates

Commodity	Retail weight[1]	Pounds of commodity available at the consumer level		Difference in pounds between 2005-06 and 2011-12 estimates	Calories		Difference in calories between 2005-06 and 2011-12 estimates	
		2005-06 estimate	2011-12 estimate		2005-06 estimate	2011-12 estimate		
	Pounds				*Number/day*			*Percent*
Bananas	25.4	23.4	24.4	1.0	11.39	11.87	0.5	4.2
Tangerines	3.8	3.0	3.2	0.2	0.44	0.47	0.0	7.2
Pears	2.7	2.2	2.3	0.1	1.11	1.15	0.0	3.5
Lemons	3.7	3.4	3.5	0.1	0.11	0.11	0.0	2.0
Plums	0.6	0.5	0.5	0.0	0.19	0.19	0.0	2.7
Apricots	0.1	0.1	0.1	0.0	0.28	0.30	0.0	7.8
Honeydew	1.4	1.1	1.1	0.0	0.01	0.01	0.0	0.4
Kiwi	0.5	0.4	0.4	0.0	0.13	0.13	0.0	-2.3
Cranberries	0.1	0.1	0.1	0.0	0.02	0.02	0.0	-7.2
Blueberries	1.2	1.2	1.1	0.0	0.72	0.69	0.0	-3.9
Grapes	7.2	6.6	6.5	-0.1	3.57	3.52	0.0	-1.2
Cherries	1.4	1.3	1.2	-0.1	0.36	0.34	0.0	-6.6
Papaya	0.9	0.4	0.5	0.1	0.09	0.12	0.0	26.2
Peaches	3.7	3.3	3.1	-0.1	0.86	0.83	0.0	-4.2
Grapefruit	2.3	2.0	1.9	-0.1	0.24	0.22	0.0	-6.9
Limes	2.4	2.2	2.1	-0.1	0.33	0.31	0.0	-6.3
Mangoes	2.4	2.0	1.9	-0.2	0.91	0.84	-0.1	-7.7
Strawberries	7.2	6.5	6.2	-0.3	1.57	1.50	-0.1	-4.9
Oranges	10.4	9.2	8.8	-0.3	1.97	1.90	-0.1	-3.6
Cantaloupe	7.0	6.1	5.7	-0.4	0.21	0.19	0.0	-6.8
Avocados	5.0	4.6	4.1	-0.5	3.81	3.40	-0.4	-10.7
Pineapples	6.1	5.2	4.1	-1.1	0.45	0.36	-0.1	-20.6
Watermelon	13.3	11.1	9.9	-1.1	1.61	1.45	-0.2	-10.4
Apples	15.5	14.1	12.5	-1.6	6.42	5.68	-0.7	-11.6
Total	124.2	110.0	105.3	-4.7	36.81	35.60	-1.2	-3.3

[1]Retail weight from Economic Research Service Loss-Adjusted Food Availability (LAFA) data for 2012.

Source: USDA, Economic Research Service (USDA/ERS), based on Nielsen Perishables Group and USDA/ERS LAFA data.

Fresh Vegetables

Table 3 provides the 2011-12 estimates of average supermarket shrink for the different varieties of fresh vegetables in the LAFA data series. The estimated average shrink for vegetables in 2011-12 at the retail level was 11.6 percent, which was 1.9 percentage points higher than the 2-year average of 9.7 percent in 2005-06. The averages with an asterisk on the last line of table 3 for individual years are weighted by commodity volume by Nielsen Perishables Group.

As in 2005-06, sweet corn had the lowest average amount of shrink in 2011-12 of all fresh vegetables covered in this study (2.2 percent) (table 3). This may be attributed to its limited seasonal availability, generally from midsummer to the first frost. Consumers actively purchase corn during this limited season, which results in lower loss at the store level. Also, most fresh sweet corn is sold in its husk, which may protect the corn from damage and may keep any spoilage from being apparent until the husk is removed. New packaging innovations, such as special plastic wraps on dehusked corn, have increased the shelf life for sweet corn, as they have for some other vegetables. For example, tomato shrink likely declined due to improved clamshell packaging in addition to the introduction of varieties with improved shelf life.

Sweet potatoes had the second lowest average shrink estimate for 2011-12 (4.4 percent); they store well if certain temperature and humidity conditions are met. In general, the main environmental factor influencing produce quality is temperature (versus humidity or the concentration of surrounding gases) (Vigneault et al., 2009). Too high a temperature can accelerate water loss, premature softening, and shriveling and decrease internal produce quality, while too low a temperature can cause chilling injury or freeze damage (Vigneault et al., 2009).

The highest average shrink in 2011-12 among the fresh vegetables was for turnip greens (62.9 percent), followed by mustard greens (61.1 percent). Although the new average estimate for mustard greens in 2011-12 was similar to the 2005-06 average (63.7 percent), the average shrink for turnip greens rose 21.9 percentage points, from 41 percent in 2005-06 to 62.9 percent in 2011-12 (table 3). Cooking greens have gained in popularity with the current juicing trends and focus on healthy eating. According to Nielsen Perishables Group, retailers are increasing the amount of shelf space to display cooking greens, which can lead to higher shrink if the items are not handled optimally or are selling at a rate short of expectations. Other vegetables with high average shrink levels in 2011-12 included escarole/endive (47.4 percent), collard greens (43.8 percent), and okra (40.2 percent).

Leafy greens are more prone to moisture loss than many other types of produce, which likely contributes to higher shrink. A general lack of consumer knowledge about some of these products and their preparation may contribute to the high shrink estimates. In addition, the high shrink for fresh greens can be partly due to the lack of high-quality packaging; these products are typically sold in open bunches. In general, greens need to be refrigerated promptly in order to retain their moisture and stay fresh.

The fresh vegetables with the two largest shrink percentage-point increases between 2011 and 2012 were okra (17.9 percent) and artichokes (16.5 percent). The largest shrink decrease was for kale (6.5 percent). In figure 4, a graphic comparison of the 2011-12 vegetable shrink estimates with the 2005-06 estimates reported in Buzby et al. (2009) shows that vegetables in general increased in shrink. Many of the increases were slight, however, as evidenced by the location of the data points around the zero-percent horizontal line in the figure.

Figure 4 uses color to draw attention to four vegetable groups: greens, cooking vegetables, salad/snacking vegetables, and hard/winter vegetables. Overall, greens showed the highest shrink, as already noted. Turnip greens, romaine and leaf lettuce, and collard greens increased in shrink the most between 2005-06 and 2011-12, while shrinkage of mustard greens, endive/escarole, head lettuce, and kale declined. Shrink for the salad/snacking vegetables were near the 11.6 percent average loss but showed small increases. With the exception of okra, cooking-vegetable shrink was near or below average, with some strong declines in Brussels sprouts, cabbage, and broccoli.

Table 3

Supermarket shrink estimates for fresh vegetables[1]

Vegetables	2005	2006	2005-06 percentage-point change	2005-06 average	2011	2012	2011-12 percentage-point change	2011-12 average	Percent difference between 2005-06 and 2011-12 estimates
	---- Percent ----		*Number*	*---------- Percent ----------*			*Number*	*---------- Percent ----------*	
Turnip greens	39.1	42.9	3.8	41.0	61.7	63.9	2.2	62.9	53.4
Mustard greens	66.6	60.7	-5.9	63.7	60.4	61.6	1.2	61.1	-4.0
Escarole/endive	47.6	47.8	0.2	47.7	47.9	47.1	-0.8	47.4	-0.6
Collard greens	42.8	32.2	-10.6	37.5	42.5	44.2	1.7	43.8	16.8
Okra	22.9	25.9	3.0	24.4	35.6	53.5	17.9	40.2	64.8
Kale	42.1	36.3	-5.8	39.2	30.7	24.2	-6.5	26.6	-32.1
Squash	12.5	12.4	-0.1	12.5	24.0	22.9	-1.1	23.1	85.5
Radishes	22.4	19.6	-2.8	21.0	17.9	27.2	9.3	22.7	8.1
Snap beans	19.2	17.9	-1.3	18.6	19.2	23.9	4.7	21.9	18.1
Artichokes	19.8	18.8	-1.0	19.3	14.4	30.9	16.5	20.8	7.8
Eggplant	21.5	21.2	-0.3	21.4	18.1	22.9	4.8	20.6	-3.5
Romaine and leaf lettuce	14.6	13.3	-1.3	14.0	18.4	21.0	2.6	20.2	44.8
Spinach	14.4	14.4	0.0	14.4	15.1	20.2	5.1	18.2	26.4
Pumpkins	12.7	9.8	-2.9	11.3	16.5	21.9	5.4	18.0	60.0
Cauliflower	12.9	15.1	2.2	14.0	17.5	17.3	-0.2	17.3	23.6
Mushrooms	14.2	11.2	-3.0	12.7	19.7	16.5	-3.2	17.3	36.2
Asparagus	10.8	8.0	-2.8	9.4	12.3	17.0	4.7	15.8	68.1
Tomatoes	14.4	12.0	-2.4	13.2	11.9	14.7	2.8	14.5	9.8
Cucumbers	6.5	5.7	-0.8	6.1	12.2	12.1	-0.1	12.2	100.0
Bell peppers	9.7	5.8	-3.9	7.8	8.2	11.3	3.1	10.7	38.1
Celery	5.9	4.3	-1.6	5.1	6.3	10.0	3.7	8.5	66.7
Head lettuce	9.1	8.3	-0.8	8.7	9.0	6.4	-2.6	8.3	-4.6
Potatoes	7.4	5.6	-1.8	6.5	7.3	8.9	1.6	8.3	27.7
Cabbage	16.4	11.8	-4.6	14.1	7.0	7.9	0.9	7.4	-47.5
Carrots	6.2	4.1	-2.1	5.2	6.3	8.7	2.4	7.2	39.8
Broccoli	12.5	11.4	-1.1	12.0	7.0	6.5	-0.5	6.7	-43.9
Onions	12.0	7.5	-4.5	9.8	5.3	8.8	3.5	6.5	-33.3
Brussels sprouts	20.1	17.4	-2.7	18.8	6.1	5.6	-0.5	5.8	-69.1
Garlic	9.8	5.0	-4.8	7.4	1.7	6.1	4.4	5.1	-31.1
Sweet potatoes	0.6	0.6	0.0	0.6	5.3	4.3	-1.0	4.4	633.3
Sweet corn	15.2	13.2	-2.0	14.2	2.3	2.1	-0.2	2.2	-84.5
Average	10.3*	8.4*	-1.9**	9.7*	10.5*	12.2*	1.7**	11.6*	34.7

* = Weighted averages calculated using category average sales contribution % to total fresh vegetables for retailers included in the study.

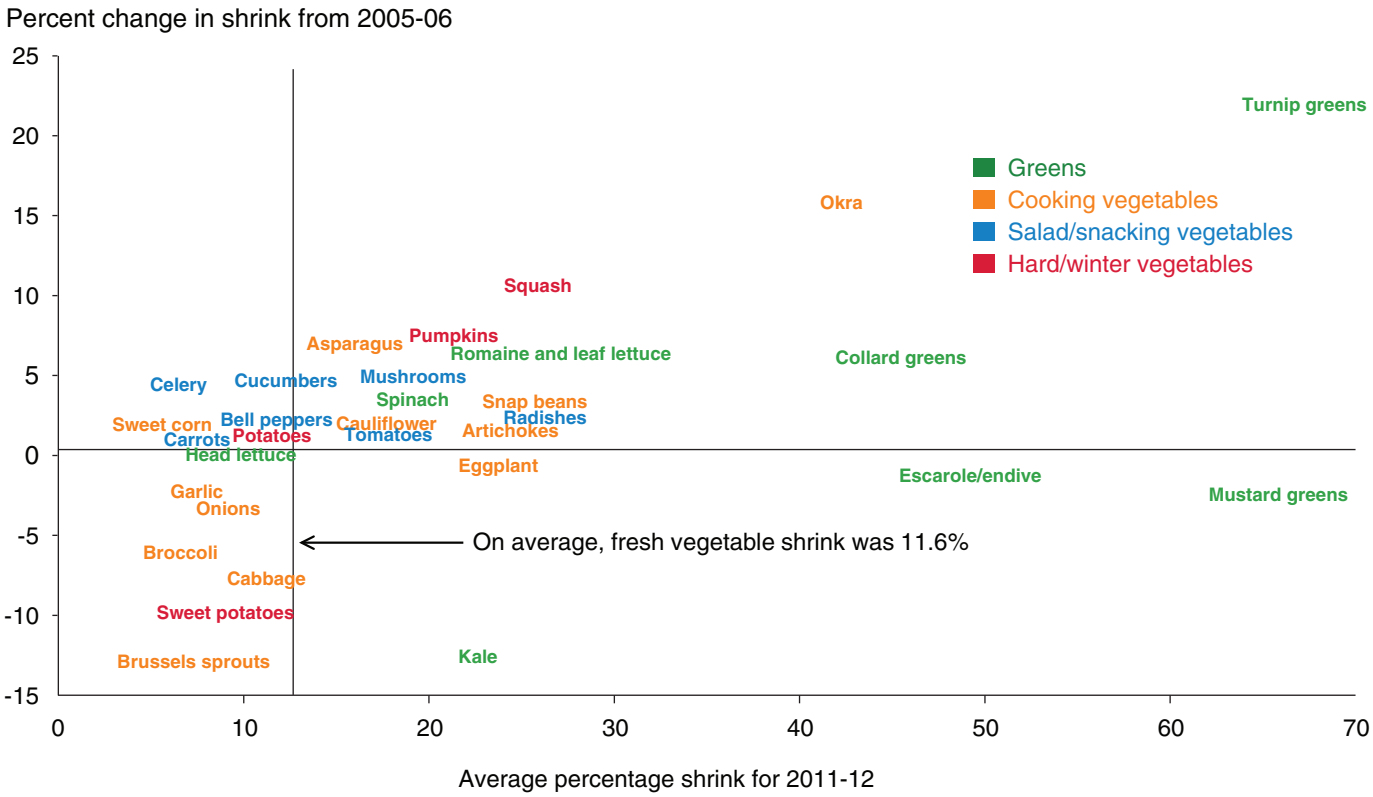
** = Calculated percentage-point change.

[1]2005-06 data documented in Buzby et al. (2009).

Source: USDA, Economic Research Service (USDA/ERS), adapted from Nielsen Perishables Group final report to USDA/ERS.

Figure 4

Greens showed higher shrink than other fresh vegetables



Source: USDA, Economic Research Service, based on Nielsen Perishables Group data.

Estimated Fresh Vegetable Availability

If ERS adopts the 2011-12 supermarket shrink estimates for fresh vegetables in the LAFA data, the total estimated fresh vegetable loss at the retail level will decrease by 1.7 pounds per capita in 2012. This amount is small on a per day basis (roughly 5/1,000th of a pound) or on a calorie per day basis (1/2-calorie) (table 4).

If the new vegetable shrink estimates are adopted in LAFA as loss estimates at the retail level, the greatest increase in per capita availability estimates will be for onions, cabbage, and sweet corn. In the analysis, none of the fresh vegetables had more than a 1-pound per capita increase or decrease in availability at the retail level over the course of a year. Many of the small changes were due to the relatively small baseline of a particular vegetable's annual availability for consumption. Of the 31 vegetables in the LAFA data in 2012, 10 had per capita availability of less than 1 pound and another 8 had availability of between 1 and 5 pounds. Vegetable consumption in the United States is centered on a handful of the most popular vegetables such as potatoes, onions, tomatoes, bell peppers, and head lettuce and other salad lettuces such as leaf and romaine.

Table 4

A comparison of fresh vegetable availability at the retail level using 2005-06 and 2011-12 food-loss estimates

Commodity	Retail weight[1]	Pounds of commodity available at the consumer level		Difference in pounds between 2005-06 and 2011-12 estimates	Calories		Difference in calories between 2005-06 and 2011-12 estimates	
		2005-06 estimate	2011-12 estimate		2005-06 estimate	2011-12 estimate		
	Pounds				*Number/day*			*Percent*
Onions	18.6	16.8	17.4	0.6	4.11	4.26	0.2	3.7
Cabbage	6.3	5.4	5.8	0.4	0.88	0.95	0.1	7.8
Sweet corn	8.0	6.9	7.8	1.0	0.33	0.37	0.0	14.0
Broccoli	5.8	5.1	5.4	0.3	1.06	1.12	0.1	6.0
Head lettuce	13.2	12.1	12.1	0.1	1.15	1.15	0.0	0.4
Brussels sprouts	0.3	0.3	0.3	0.0	0.12	0.14	0.0	16.0
Garlic	1.9	1.7	1.8	0.0	1.41	1.44	0.0	2.5
Kale	0.3	0.2	0.2	0.0	0.03	0.04	0.0	20.7
Mustard greens	0.4	0.1	0.2	0.0	0.03	0.03	0.0	6.8
Eggplant	0.8	0.6	0.6	0.0	0.10	0.10	0.0	0.8
Escarole/endive	0.3	0.1	0.1	0.0	0.02	0.02	0.0	0.6
Radishes	0.4	0.3	0.3	0.0	0.03	0.03	0.0	-2.2
Artichokes	1.4	1.1	1.1	0.0	0.14	0.14	0.0	-1.9
Cauliflower	1.1	0.9	0.9	0.0	0.09	0.08	0.0	-3.9
Spinach	1.4	1.2	1.1	-0.1	0.21	0.20	0.0	-4.4
Collard greens	0.8	0.5	0.5	-0.1	0.04	0.03	0.0	-10.0
Okra	0.4	0.3	0.2	-0.1	0.07	0.06	0.0	-20.9
Snap beans	1.8	1.5	1.4	-0.1	0.37	0.35	0.0	-4.1
Turnip greens	0.4	0.2	0.1	-0.1	0.03	0.02	0.0	-37.2
Asparagus	1.3	1.2	1.1	-0.1	0.10	0.10	0.0	-7.0
Mushrooms	2.6	2.3	2.1	-0.1	0.47	0.44	0.0	-5.3
Sweet potatoes	6.6	6.5	6.3	-0.2	2.53	2.43	-0.1	-3.8
Carrots	7.6	7.2	7.0	-0.2	2.00	1.95	0.0	-2.2
Celery	5.5	5.3	5.1	-0.2	0.45	0.44	0.0	-3.6
Tomatoes	17.3	15.1	14.8	-0.2	2.79	2.75	0.0	-1.5
Bell peppers	10.7	9.9	9.6	-0.3	1.07	1.03	0.0	-3.2
Pumpkins	4.7	4.2	3.9	-0.3	0.01	0.01	0.0	-7.6
Cucumbers	7.1	6.6	6.2	-0.4	0.40	0.37	0.0	-6.5
Squash	4.3	3.7	3.3	-0.5	0.43	0.38	-0.1	-12.1
Potatoes	34.1	31.9	31.3	-0.6	20.52	20.12	-0.4	-2.0
Romaine and leaf lettuce	10.7	9.2	8.6	-0.7	1.07	0.99	-0.1	-7.3
Total	176.2	158.5	156.8	-1.7	42.06	41.57	-0.5	-1.2

[1]Retail weight from USDA, Economic Research Service Loss-Adjusted Food Availability (LAFA) data for 2012.

Source: USDA, Economic Research Service, based on Nielsen Perishables Group and LAFA data.

Fresh Meat, Poultry, and Seafood

Table 5 shows how the shrink rates for individual types of fresh meat, poultry, and seafood at the retail level varied during 2011-12. Average shrink ranged from 5.9 percent for turkey to 24.1 percent for shellfish. Combined meat and poultry had a 1.9-percentage-point increase in shrink between 2011 (10.2 percent) and 2012 (12.1 percent). Combined fish and shellfish shrinkage had a 4.6-percentage-point decrease between 2011 (24.6 percent) and 2012 (20 percent). Comparisons across the two time periods should be treated with caution, however. One caveat is that the fresh meat, poultry, and seafood estimates for 2011-12 are for UPC-coded items only. As previously mentioned, the 2010 National Meat Case Study found that 66 percent of meat and poultry were case-ready (i.e., UPC-coded) in 2010 (SealedAir/BCP/NPB, 2010). A second caveat is that the 2005-06 shrink data for fresh meat, poultry, and seafood were from interviews with supermarket executives, who likely included both UPC-coded and random-weight items when providing shrink estimates.

Table 5

Supermarket shrink estimates for fresh meat, poultry and seafood[1,2]

Meat/poultry/ seafood	2005	2006	2005-06 percentage-point change	2005-06 average	2011	2012	2011-12 percentage-point change	2011-12 average	Percent difference between 2005-06 and 2011-12 estimates
	--- Percent ---		*Number*	*---------- Percent ----------*			*Number*	*---------- Percent ----------*	
Meat and poultry									
Veal	23.0	27.8	4.8	25.4	11.7	30.2	18.5	23.3	-8.3
Lamb/goat[3]	14.0	10.6	-3.4	12.3	15.2	18.8	3.6	18.7	52.0
Chicken	3.7	4.2	0.5	4.0	10.9	12.8	1.9	12.6	219.0
Beef	4.3	4.4	0.1	4.4	11.0	13.0	2.0	11.2	157.5
Pork	4.1	4.6	0.5	4.4	5.8	10.1	4.3	8.9	104.6
Turkey	3.4	3.5	0.1	3.5	9.3	5.8	-3.5	5.9	71.0
Average	4.3*	4.5*	0.4	NA	10.2*	12.1*	1.9**	11.0*	99.3
Fish and shellfish									
Shellfish	9.4	9.2	-0.2	9.3	26.0	21.4	-4.6	24.1	159.1
Fish	8.8	8.6	-0.2	8.7	23.3	18.8	-4.5	21.3	144.8
Average	9.1*	8.9*	-0.2	NA[3]	24.6*	20.0*	-4.6**	22.6*	152.0
Total average	NA	NA	0.3	4.5*	12.3*	13.2*	0.9**	12.7*	112.5

* = Weighted averages calculated using category average sales contribution % to total fresh meat/seafood for retailers included in the study.

** = Calculated percentage-point change.

NA = Not available.

[1]Numbers may not total due to rounding.

[2]2005-06 data documented in Buzby et al. (2009).

[3]A small portion of goat was included in the Nielsen Perishables Group (NPG) data for lamb, although goat is not included in the Loss-Adjusted Food Availability data. The NPG data estimates that goat made up 0.93 percent of this category.

Source: USDA, Economic Research Service (USDA/ERS), adapted from Nielsen Perishables Group final report to USDA/ERS.

Veal had the highest 2011-12 average shrink rate (23.3 percent) in the fresh meat, poultry, and seafood group. Historically, veal has had higher shrink than other proteins, but it represents a small percentage of the overall meat category in dollar and volume terms. According to Neilson Perishables Group's discussions with retailers documented in Buzby et al. (2009), in 2007, some of the retailers saw veal as an item that they must offer to consumers to enhance variety in the meat department, even though relatively few consumers purchased it. Veal also had the highest percentage-point increase (18.5 points) in shrink between 2011 (11.7 percent) and 2012 (30.2 percent) of the fresh meat, poultry, and seafood items in the LAFA data.

Lamb/goat continues to be one of the highest shrink categories; its shrink increased 3.6 percentage points, from 15.2 percent in 2011 to 18.8 percent in 2012. The previous study found that (1) retailers believed they must offer lamb to consumers, as they do veal, (2) that consumers are often unclear about how to prepare lamb and therefore decide not to purchase it, (3) that lamb is more likely than other meats to remain unsold by its expiration date, (4) that fewer lamb products are typically available to consumers, compared with other meats, and (5) that, as with other meats, some consumers forgo purchasing lamb if the desired cut is not available (Buzby et al., 2009).

The new supermarket shrink estimates for beef were 11 percent in 2011 and 13 percent in 2012, roughly three times higher than the 4.3 percent in 2005 to 4.4 percent in 2006 (Buzby et al., 2009). As noted, comparison between the two studies for these items should be treated with caution.

More broadly, Buzby et al. (2009) also found that increased shrink for protein foods can be attributed to several factors, including the growth in the variety of products available in supermarkets over the few years prior to the 2007 study. As consumers looked for new flavors, different cuts, and more convenient options (e.g., chicken presented as thin slices of tenders or boneless breasts), the number of unique meat products carried by a retailer increased. This requires more effort by stores to manage inventory of perishable products and shelf space. As mentioned, we believe one likely explanation for the 2011-12 shrink estimates for fresh meat, poultry, and seafood being higher than the 2005-06 estimates is that the 2011-12 estimates were from supplier shipment and sales data for UPC-coded products (only) and the 2005-06 estimates were from interviews with meat and seafood executives, who likely considered both UPC-coded and random-weight products when providing their estimates. It is not possible to ascertain the impact of the differences due to the sources of data for the two study periods. In addition, it is not possible to determine the impact of the exclusion of random-weight meat, poultry, and seafood on the 2011-12 shrink estimates or on food availability estimates for these products. The exclusion of random-weight items could explain some of the greater shrink in 2011-12 compared with 2005-06, but the size of the impact is not clear.

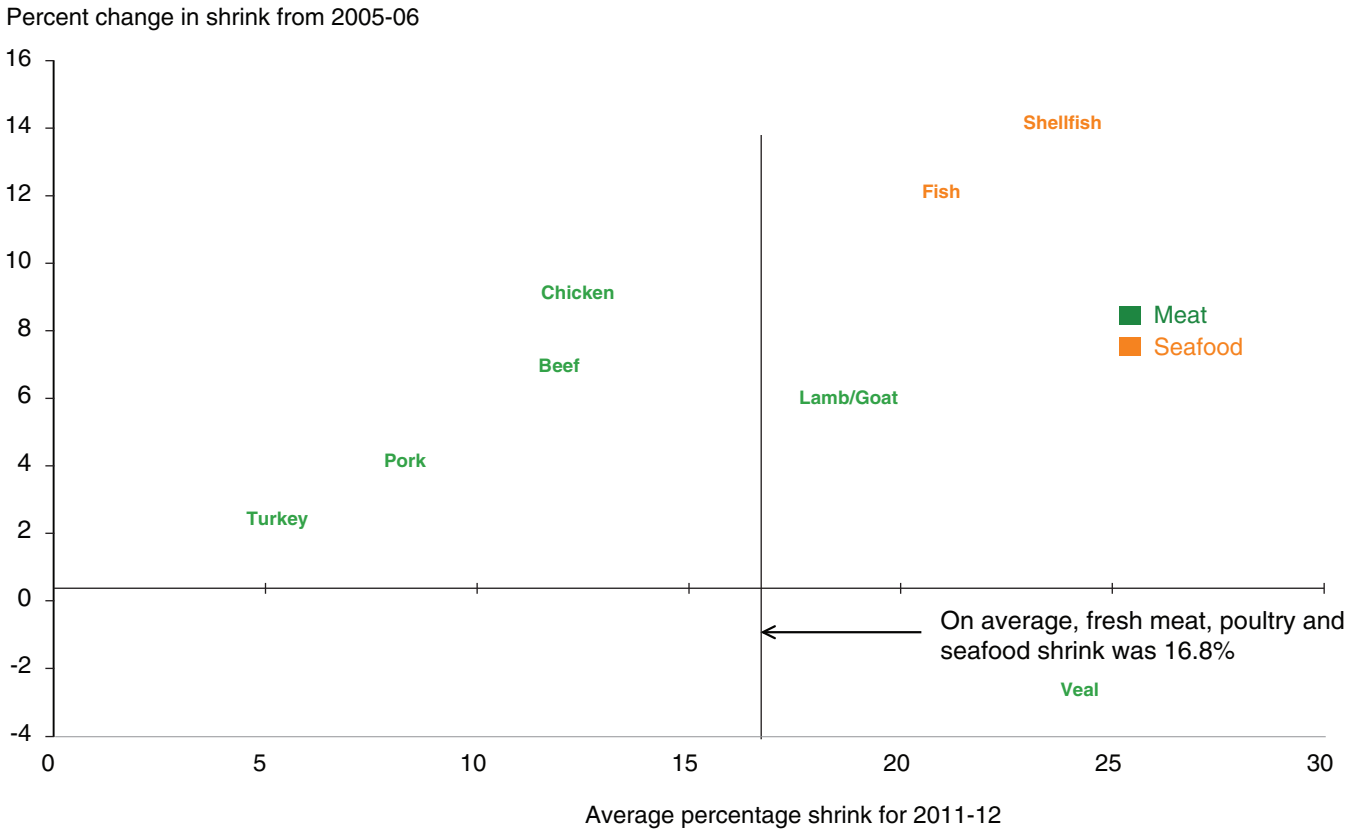
In the meat, poultry, and seafood group, turkey has the smallest 2011-12 average shrink (5.9 percent). Turkey is often shipped frozen and is displayed and sold in partially frozen form, increasing shelf life.

Average fish and shellfish shrink decreased from 24.6 percent in 2011 to 20 percent in 2012, with estimates more than double the average loss of 9.1 percent in 2005 and 8.9 percent in 2006. Again, these increases may be because the 2005-06 data were from interviews with executives, while the 2011-12 estimates are derived from store sales and shipment data for UPC-coded items and do not include data for random-weight items. We hypothesize that the 2005-06 data from the interviews may have underestimated shrink.

The horizontal axis of figure 5 shows the relative position of the different kinds of meat, poultry, and seafood in terms of average shrink in 2011-12, with shrink ranging from low for turkey to high for shellfish and veal. The vertical axis shows how the 2011-12 shrink estimates for individual meat, poultry, and seafood compared against the 2005-06 average weighted by commodity volume. That is, shrink for meat, poultry, and seafood items above the zero-percent line increased in 2011-12 above 2005-06 levels, and veal's shrink rate decreased from 2005-06. Shellfish, fish, and lamb/goat are not only high-shrink areas but are also increasing in shrink.

Figure 5

All fresh meat, poultry, and seafood items increased in supermarket shrink except for veal



Source: USDA, Economic Research Service, based on Nielsen Perishables Group data.

Estimated Fresh Meat, Poultry, and Seafood Availability

If the new supermarket shrink estimates for fresh meat, poultry, and seafood were incorporated in the LAFA data to replace the currently used food loss estimates from 2005-06, per capita availability of these commodities combined at the retail level would decrease by 12.4 pounds per year (table 6) or about 15.3 grams per day. This translates into about 30 fewer calories per day.

In the fresh meat, poultry, and seafood category, the greatest change in per capita consumption for an individual commodity was for chicken. In the past decade, chicken passed beef as the number-one meat in per capita availability in the Food Availability data.[10] The relatively high shrink estimates for lamb and veal had little impact on the per capita availability estimates for those meats because they are not high-volume items. That is, the changes for lamb and veal were smallest of the protein items on a pound-per-capita basis, partly due to their relatively low annual volume.

Table 6
A comparison of fresh meat, poultry, and seafood availability at the retail level using 2005-06 and 2011-12 food-loss estimates

Commodity	Retail weight[1]	Pounds of commodity available at the consumer level		Difference in pounds between 2005-06 and 2011-12 estimates	Calories		Difference in calories between 2005-06 and 2011-12 estimates	
		2005-06 estimate	2011-12 estimate		2005-06 estimate	2011-12 estimate		
	Pounds				*Number/day*			*Percent*
Veal	0.3	0.2	0.2	0.0	0.46	0.47	0.0	2.9
Lamb/goat	0.6	0.5	0.5	0.0	1.66	1.54	-0.1	-7.2
Turkey	12.6	12.2	11.9	-0.3	20.09	19.60	-0.5	-2.5
Fish	5.5	5.1	4.4	-0.7	5.46	4.71	-0.8	-13.8
Shellfish	4.9	4.5	3.7	-0.7	2.93	2.45	-0.5	-16.3
Pork	42.6	40.7	38.8	-1.9	97.52	92.91	-4.6	-4.7
Beef	54.5	52.2	48.4	-3.8	157.40	145.97	-11.4	-7.3
Chicken	56.6	54.4	49.5	-4.9	133.74	121.73	-12.0	-9.0
Total	177.7	169.7	157.3	-12.4	419.26	389.37	-29.9	-7.1

[1]Boneless-equivalent or edible weight at the retail level from USDA, Economic Research Service Loss-Adjusted Food Availability (LAFA) data for 2012.
Source: USDA, Economic Research Service, based on Nielsen Perishables Group and LAFA data.

[10]See "Per capita availability of chicken higher than that of beef," http://www.ers.usda.gov/data-products/chart-gallery/detail.aspx?chartId=40060&ref=collection&embed=True&widgetId=39734. In the Loss-Adjusted Food Availability data, chicken surpassed beef in 2004.

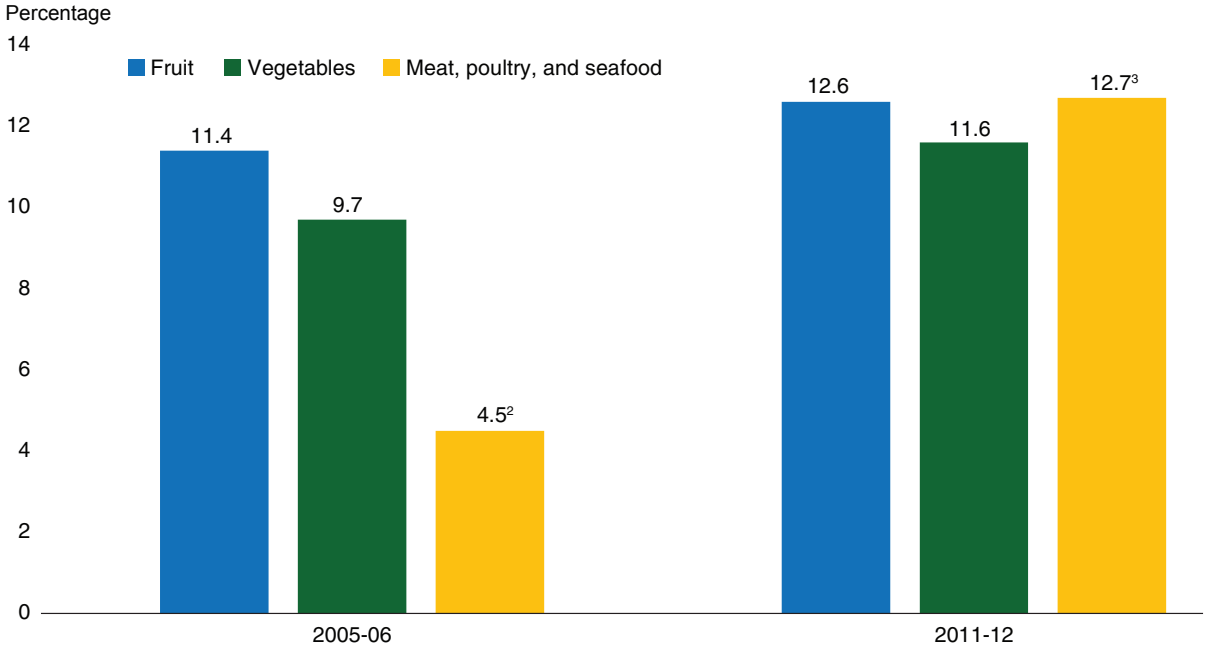
Conclusions

Contributions to the Literature

The current study contributes to the literature on food loss in several ways. The analysis provided 2011-12 average shrink estimates for individual fresh fruit, vegetables, meat, poultry, and seafood in retail stores in the United States. One caveat is that we obtained a snapshot of retail shrink and used a convenience sample. Therefore, it is not clear how accurate the new estimates are compared to the old ones or how nationally representative these estimates are (e.g., store coverage did not sample mom-and-pop stores, and shrink for random-weight meat, poultry, and seafood products could not be calculated). (Figure 6 provides averages weighted by commodity volume by the Nielsen Perishables Group). Most important, this study provides more recent data from a much larger sample than the sample used in the 2005-06 estimates (i.e., 2,900 versus 600 stores). The new shrink estimates for 2011-12 for individual fresh fruits and vegetables were generally close to, but higher than, the 2005-06 shrink estimates currently used as loss assumptions in the LAFA data series.

Several factors support the hypothesis that supermarket shrink might have increased since 2005-06 for fresh fruit and vegetables. U.S. retailers are now typically carrying a greater assortment of fresh produce in abundant displays, sometimes far more than is sold, and they are struggling to find trained labor to tend these fresh commodities in the store. Further, retailers have become better at tracking shrink due to improved inventory control technologies. Thus, the 2005-06 estimates might be understated. On the other hand, there are also reasons to think that shrink might be decreasing over time, such as through improved packaging technologies and new transportation efficiencies.

Figure 6
Average percent shrink for fresh fruit, vegetables, and meat, poultry, and seafood in retail stores, 2005-06 and 2011-12[1]



[1]Shrink includes food loss, reductions due to theft and accounting errors, and other factors.
[2]The 2005-06 estimates for meat, poultry, and seafood shrink were from interviews with executives, whereas the rest of the data were from comparing supplier shipment data with sales data.
[3]The 2011-12 estimates for fresh meat, poultry, and seafood compared supplier shipment data with sales data for UPC-coded items only. That is, random-weight items were not included as they were for the fresh fruit and vegetable items.
Source: USDA, Economic Reseach Service (USDA/ERS), adapted from Nielsen Perishables Group final report to USDA/ERS.

There were larger increases in general for individual fresh meat, poultry, and seafood shrink estimates between 2005-06 and 2011-12, and thus there was a larger increase in the average percent of shrink for this food group when weighted by the Nielsen Perishables Group by volume (fig. 6). ERS is not considering adopting the 2011-12 shrink estimates for fresh meat, poultry, and seafood as food loss assumptions at the retail level in the LAFA data series at this time for three reasons.

First and most important, as discussed above, the 2011-12 shrink estimates for fresh meat, poultry, and seafood are only for UPC-coded items, as Nielsen Perishables Group was unable to estimate retail shrink for random-weight fresh meat, poultry, and seafood in the current study.[11] As we noted, according to the 2010 National Meat Case Study, case-ready (i.e., UPC-coded) fresh meat and poultry accounted for an estimated 66 percent of packages (SealedAir/BCP/NPB, 2010). Therefore, we have less confidence in the shrink estimates for these products than we do for the updated shrink estimates for fresh fruits and vegetables, where we have data for both UPC-coded and random-weight items. If data are available, future research could investigate whether random-weight meat, poultry, and seafood products have larger errors in estimation than the UPC-coded items, due to the variation in processing/butchering them into retail cuts (e.g., from slabs of beef in the supermarket meat departments). It is not clear how the 2011-12 shrink estimates for these items would differ if we had been able to include random-weight items. ERS plans to conduct future research to determine if there are other data sources available that could fill the data void for shrink estimates for random-weight, fresh meat, poultry, and seafood in retail stores. If ERS is able to obtain such data, the next step would be to combine the data with the data for UPC-coded fresh meat, poultry, and seafood items obtained in this study, and then to determine if the combined data would be appropriate for updating the current retail-level loss estimates for these foods in the LAFA data series.

Second, without further information, we have no reason to believe that adoption of the 2011-12 shrink estimates for UPC-coded fresh meat, poultry, and seafood would improve the LAFA estimates of the availability of these foods compared to the 2005-06 estimates now used in the LAFA data series. The 2005-06 shrink estimates were from a small sample of interviews with food company executives, who likely considered both UPC-coded and random-weight items when providing their estimates. The fact that the 2011-12 data for these items were calculated by comparing supplier shipment data with sales data for UPC-coded items (only) makes the comparison of estimates for fresh meat, poultry, and seafood less precise than that for fresh fruits and vegetables, which spanned both UPC-coded and random-weight items.

Third, we have less confidence in our assumption that shrink equals food loss for the fresh meat, poultry, and seafood items than in this assumption for the fresh fruit and vegetable items. It is likely that certain components of supermarket shrink, such as theft, have more of a role in the loss of relatively higher valued fresh meat, poultry, and seafood than in the loss of fresh fruits and vegetables. It is possible that the theft component of shrink increased for some fresh foods following the recent recession (particularly for fresh meat, poultry, and seafood), meaning that the food loss for these items could have stayed the same or decreased despite the overall increases in shrink during the two study periods. More research and better data are needed to test this supposition. Despite these limitations, the shrink data for UPC-coded fresh meat, poultry, and seafood in U.S. supermarkets make a contribution to the literature, especially as there is very little in the peer-reviewed literature on this topic.

[11]Although Nielsen Perishables Group had sales data for these items, the shipment data were more problematic, as a portion of the shipments was large parts of carcasses or the entire animal/fish, difficult to convert into the boneless weight needed for this analysis.

In addition to providing 2011-12 average shrink estimates for individual fresh fruit, vegetables, meat, poultry, and seafood in U.S. retail stores, the current study contributed to the literature on supermarket shrink and food-loss through an analysis of how these updated shrink estimates, if incorporated as retail food-loss estimates in the LAFA data series, would impact ERS estimates of the amount and calories of fresh foods available for consumption at the retail level. The study found that the new shrink estimates had little impact on per capita food availability for individual fresh fruit and vegetables in the LAFA data series but had a relatively greater impact for individual fresh meat, poultry, and seafood items. Further research is needed to update the other food items at the retail level in the LAFA data, namely fruits and vegetables in forms other than fresh (e.g., canned, frozen, dried, dehydrated, and juice), as well as grains, dairy, added sugars and sweeteners, and added fats and oils.

Looking Ahead

ERS is interested in broadening its understanding of retail food loss for each of the 215 commodities in the LAFA data system, particularly the extent of theft in retail stores for each covered commodity and the extent to which specific commodities are donated by retailers to feed the hungry. Nationally representative data are lacking for both theft and donations for each of the 215 commodities. For example, the Business for Social Responsibility group (BSR) performed an analysis of food waste in the United States among food manufacturers, retailers, and wholesalers for the Food Waste Reduction Alliance12 and estimated that 3.8 billion pounds were generated by retailers, but the study did not provide the percentage of food waste in total food available for sale and the data were not broken down by commodity (BSR, 2013). If ERS were able to obtain nationally representative data on theft and food donations for each of the 215 commodities in the LAFA data series, these data could potentially be incorporated into the LAFA data series to improve the food availability and food loss estimates. At this point, ERS has identified very few peer-reviewed articles on supermarket shrink in the United States or on its theft component.

ERS previously contracted with the National Academies of Science (NAS) Committee on National Statistics (CNSTAT) of the National Research Council (NRC) and the Food and Nutrition Board (FNB) of the Institute of Medicine (IOM) to develop a joint workshop, which was held in April 2014. The goal of this workshop was to advance knowledge and understanding of the measurement and technical aspects of the data supporting the ERS Food Availability (FA) and the Loss-Adjusted Food Availability (LAFA) data series so that these series—and subsequent food availability and food loss estimates—could be maintained and improved. A workshop summary provides greater detail on the findings (NRC and IOM, 2015). One limitation mentioned at the workshop was that these series do not take into account the amount of food donated at different points along the farm-gate-to-fork chain to food banks and other charitable organizations to feed hungry people or the transfers of unsold food to thrift outlets for sale at lower prices (unsaleables). Again, the implication is that without directly including food donations (along with theft) in the LAFA data, estimates of the loss-adjusted food available for consumption may be understated, and the embedded loss estimates (i.e., the 2005-06 shrink estimates from Buzby et al. (2009) in the LAFA series) may be overstated.

[12]The Food Waste Reduction Alliance is an industry-wide effort led by the Grocery Manufacturers Association (GMA), the Food Marketing Institute (FMI), and the National Restaurant Association (NRA).

As a followup to this workshop, NAS developed and hosted an expert meeting for ERS titled "Data on Food Donations and Food Sold through Thrift or Discount Stores" on March 6, 2015. This meeting explored data on the amount of edible food in the United States that travels through these pathways and ultimately gets eaten and therefore should not be counted as food loss. Participants at the meeting shared samples of their current data on the amount of food donated to feed hungry people or sold at thrift or discount stores and illuminated how these sectors of the economy work. A summary of this expert meeting is being prepared, which will help ERS develop research plans for improving data on fresh food shrink, loss, and waste and on the influence of food donations, theft, and other causes of shrink in retail stores on food availability and food loss.

References

Business for Social Responsibility (BSR). 2013. *Analysis of U.S. Food Waste Among Food Manufacturers, Retailers, and Wholesalers*http://www.foodwastealliance.org/wp-content/uploads/2013/06/FWRA_BSR_Tier2_FINAL.pdf.

Buzby, J.C., J.T. Bentley, B. Padera, C. Ammon, and J. Campuzano. 2015. "Estimated Fresh Produce Shrink and Food Loss in U.S. Supermarkets," *Agriculture* 5(3):626-48. http://www.mdpi.com/2077-0472/5/3/626.

Buzby, J.C., and J. Hyman. 2012. "Total and Per Capita Value of Food Loss in the United States," *Food Policy* 37(5):561-70. http://www.sciencedirect.com/science/article/pii/S0306919212000693).

Buzby, J.C., J. Hyman, H. Stewart, and H.F. Wells. 2011. "The Value of Retail- and Consumer-Level Fruit and Vegetable Losses in the United States," *Journal of Consumer Affairs* 12(4):492-515. http://onlinelibrary.wiley.com/doi/10.1111/j.1745-6606.2011.01214.x/epdf.

Buzby, J.C., H.F. Wells, and J. Hyman. 2014. *The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States*, EIB-121, U.S. Department of Agriculture, Economic Research Service. http://www.ers.usda.gov/publications/eib-economic-information-bulletin/eib121.aspx.

Buzby, J.C., H.F. Wells, B. Axtman, and J. Mickey. 2009. *Supermarket Loss Estimates for Fresh Fruit, Vegetables, Meat, Poultry, and Seafood and Their Use in the ERS Loss-Adjusted Food Availability Data*, EIB-44, U.S. Department of Agriculture, Economic Research Service. http://www.ers.usda.gov/publications/eib-economic-information-bulletin/eib44.aspx.

Hodges, R.J., J.C. Buzby, and B. Bennett. 2010. "Postharvest Losses and Waste in Developed and Developing Countries: Opportunities to Improve Resource Use," *Journal of Agricultural Science* 149(S1):1-9. http://journals.cambridge.org/download.php?file=%2FAGS%2FAGS149_S1%2FS002185961000936a.pdf&code=6b06d3a8e0285b0c2cf84720c13bb8d5.

Kantor, L.S. 1998. *A Dietary Assessment of the U.S. Food Supply: Comparing Per Capita Food Consumption with Food Guide Pyramid Serving Recommendations*, AER-772, U.S. Department of Agriculture, www.ers.usda.gov/publications/aer772.

Kantor, L.S., K. Lipton, A. Manchester, and V. Oliveira. 1997. *Estimating and Addressing America's Food Losses*, U.S. Department of Agriculture, Economic Research Service, *FoodReview* 20(1):2-12. www.ers.usda.gov/publications/foodreview/jan1997/jan97a.pdf.

Kienzlen, M. April 8, 2015. Whereismyshrink.com. Personal communication (by e-mail and phone) with J.C. Buzby.

Kilts Center for Marketing. November 5, 2012. "Nielsen Data Seminar: An Introduction to Scanner Data," University of Chicago, Booth School of Business. http://research.chicagobooth.edu/marketing/docs/Kilts_Center_Nielsen_Presentation-2012.pdf.

Mena, C., L.A. Terry, A. Williams, and L. Ellram. 2014. "Causes of Waste across Multi-Tier Supply Networks: Cases in the UK Food Sector," *International Journal of Production Economics* 152(2014):144-58.

The National Academies, National Research Council (NRC) and Institute of Medicine (IOM). 2015. "Data and Research to Improve the U.S. Food Availability System and Estimates of Food Loss." N.J. Kirkendall, Rapporteur.

Paull, R.E., W. Nishijima, M. Reyes, and C. Cavaletto. 1997. "Postharvest Handling and Losses During Marketing of Papaya (Carica papaya L.)," *Postharvest Biology and Technology* 11(3):165-79.

SealedAir/BCP/NPB 2010. A Snapshot of Today's Retail Meat Case: 2010 National Meat Case Study Executive Summary, Sealed Air's Cryovac Food Packaging, T.B.C.P.B., and the National Pork Board (NPB), ed. (Duncan, S.C.)

U.S. Department of Agriculture, Agricultural Research Service (ARS), Food Surveys Research Group. 2012. USDA Food and Nutrient Database for Dietary Studies *(FNDDS) 4.1.*

U.S. Department of Agriculture, Economic Research Service (ERS). 2014a. Food Availability (Per Capita) Data System. http://www.ers.usda.gov/data-products/food-availability-%28per-capita%29-data-system.aspx.

U.S. Department of Agriculture, Economic Research Service (ERS). 2014b. *Loss-Adjusted Food Availability Documentation*. http://www.ers.usda.gov/data-products/food-availability-%28per-capita%29-data-system/loss-adjusted-food-availability-documentation.aspx

U.S. Department of Commerce, U.S. Census Bureau. 2015. *County Business Patterns.*

Vigneault, C., J. Thompson, S. Wu, K.P.C. Hui, and D.I. LeBlanc. 2009. "Transportation of Fresh Horticultural Produce," *Postharvest Technologies for Horticultural Crops* 2:1-24.

Wheresmyshrink.com. 2012. *Where's My Shrink: Executive Summary*, http://wheresmyshrink.com/executivesummary.html.

Appendix

Appendix table 1

Average supermarkets shrink estimates by five U.S. retailers, 2011-12

Commodity	RETAILER 1	RETAILER 2	RETAILER 3	RETAILER 4	RETAILER 5
			Percent		
Fruit	19.4	11.1	20.5	15.2	20.2
Apples	13.0	8.0	27.4	27.9	19.5
Apricots	NA	22.9	28.5	NA	38.7
Avocados	22.6	6.0	14.4	NA	33.1
Bananas	5.4	2.7	NA	4.1	NA
Blueberries	10.9	4.7	NA	NA	10.9
Cantaloupe	16.6	9.7	NA	19.6	26.7
Cherries	8.5	5.0	NA	12.1	15.6
Cranberries	12.8	8.5	NA	NA	16.9
Grapefruit	21.2	10.3	24.7	NA	19.0
Grapes	9.1	7.8	12.7	NA	5.3
Honeydew	26.1	12.3	34.5	NA	17.0
Kiwi	11.7	12.2	15.3	19.7	
Lemons	8.4	6.3	0.0	6.7	4.0
Limes	25.1	8.1	10.1	8.2	18.7
Mango	21.7	15.2	NA	NA	26.3
Oranges	15.2	9.2	25.6	NA	9.2
Papaya	62.5	40.9	NA	NA	25.8
Peaches	18.9	12.9	NA	NA	14.9
Pears	27.1	10.1	15.2	17.7	3.5
Pineapples	25.7	6.2	47.8	NA	48.9
Plums	23.6	6.5	NA	NA	NA
Strawberries	12.2	9.6	20.3	NA	14.8
Tangerines	22.3	16.4	1.2	0.0	33.7
Watermelon	24.7	13.6	30.3	36.4	22.1
Meat	7.9	12.0	17.0	12.0	15.4
Beef	8.7	6.9	29.7	4.0	6.9
Chicken	8.7	6.1	5.4	18.9	24.0
Lamb/goat	3.3	30.4	NA	29.5	11.5
Pork	11.7	6.5	11.0	3.8	11.6
Turkey	7.0	2.2	3.2	6.8	10.3
Veal	NA	20.1	35.9	9.1	27.8
Seafood	21.6	10.9	25.1	17.1	32.3
Fish	27.0	10.9	23.8	16.2	28.9
Shellfish	16.2	NA	26.4	18.0	35.8

Continued—

Appendix table 1

Average supermarkets shrink estimates by five U.S. retailers, 2011-12—continued

Commodity	RETAILER 1	RETAILER 2	RETAILER 3	RETAILER 4	RETAILER 5
Vegetables	20.1	19.5	18.7	21.7	17.7
Artichokes	NA	30.7	11.0	NA	NA
Asparagus	23.0	6.3	NA	NA	18.0
Bell peppers	13.3	10.2	11.5	0.0	18.6
Broccoli	15.5	2.5	0.0	9.0	NA
Brussels sprouts	NA	5.8	NA	NA	NA
Cabbage	11.1	9.8	2.9	6.0	NA
Carrots	5.6	2.2	6.8	14.9	6.5
Cauliflower	19.7	14.9	NA	NA	NA
Celery	8.0	2.3	11.1	9.1	12.1
Collard greens	25.0	49.9	46.6	NA	53.6
Cucumbers	6.5	7.0	3.2	21.3	22.9
Eggplant	NA	25.0	13.9	23.0	NA
Escarole/endive	NA	50.8	46.0	45.3	NA
Garlic	3.1	0.0	0.0	0.0	22.3
Head lettuce	7.3	9.2	8.4	NA	NA
Kale	30.4	23.0	53.1	13.7	12.7
Mushrooms	21.7	11.5	12.5	22.8	18.2
Mustard greens	58.5	80.6	41.7	63.7	NA
Okra	49.9	57.6	NA	13.0	NA
Onions	10.1	6.1	6.9	NA	2.8
Potatoes	7.4	9.1	9.8	15.4	0.0
Pumpkins	25.9	18.8	0.0	25.8	19.3
Radishes	30.3	21.7	3.9	31.9	25.8
Romaine and leaf lettuce	21.8	13.2	26.7	NA	19.1
Snap beans	NA	18.5	24.6	22.7	NA
Spinach	NA	9.8	19.6	25.1	NA
Squash	26.0	9.6	17.7	30.4	31.9
Sweet corn	0.0	4.4	NA	NA	NA
Sweet potatoes	8.7	4.4	NA	NA	0.0
Tomatoes	17.4	9.6	13.8	NA	17.0
Turnip greens	57.0	79.0	75.1	40.6	NA

NA = Not available.

Source: USDA, Economic Research Service (USDA/ERS). Data provided by the Perishables Group to USDA/ERS March 7, 2016.