Calculating Updated Consumer Baskets

For the updated data series, I created consumer baskets for fresh vegetables and fresh fruits to represent what households bought for at-home consumption in 1999 and 2003. The final baskets are an average of the 1999 and 2003 baskets.

Calculations for the updated baskets use data from the Consumer Expenditure (CE) Survey. The CE is administered by the Census Bureau for the BLS. These data are then used by BLS to calculate expenditure weights for the Consumer Price Index (see box, "Methodology for Calculating CPI"). Each year, in the diary section of the CE, households report their food expenditures for 2 weeks. For example, in 1999, households spent $148.51 for fresh vegetables, including $18.92 for lettuce, $26.91 for tomatoes, $28.35 for potatoes, and $74.33 for "other fresh vegetables," on average. Prior to 1999, diary sample sizes were around 5,000 households. Since then, they have numbered approximately 7,500.

Because the CE contains no information on prices or quantities purchased, I augmented the CE with ACNeilsen "Homescan" data.[5] ACNeilsen's consumer panel households keep a record of their purchases at retail foodstores using a scanner installed in their home. Upon returning from a shopping trip, panelists re-scan purchased items or manually enter information on products lacking a bar code. Thus, these data contain information on prices paid and quantities purchased of individual fresh fruits and fresh vegetables. The sample available for this study contains data for 7,200 households in 1999 and 8,833 households in 2003.

Consumer baskets were updated using both sets of data. For example, based on the ACNeilsen data, a representative household split its CE expenditures of $18.92 for lettuce into $11.73 for iceberg and $7.19 for romaine ("Iceberg" lettuce represents all purchases of head lettuce, which accounts for about 62 percent of the value of all lettuce purchased by the ACNeilsen households; "Romaine" represents all purchases of leafy lettuce.). Using ACNeilsen national average prices, I further estimated quantities purchased.[6] For example, since iceberg lettuce averaged $0.78/lb, I estimated that a representative household bought 15.04 lb with its $11.73.

A similar process was used to estimate purchased quantities of fresh potatoes, fresh tomatoes, and "other fresh vegetables." For selecting items to represent "other fresh vegetables," I first used the ACNeilsen data to rank foods with the potential for inclusion by expenditure share, then selected the top 12. I then divided the $74.33 spent by households in the CE on other fresh vegetables among the selected 12.[7] For example, since broccoli accounted for 7.46 percent of what panelists in the ACNeilsen sample spent on the 12 "other fresh vegetables," I allocated 7.46 percent of the $74.33 spent by households on other fresh vegetables in the CE to expenditures on broccoli, which totaled $5.55. Because the price of broccoli averaged $0.88 per pound at retail, I inferred that a representative household bought 6.3 pounds.

The estimated contents of the consumer basket are not unique, and alternative baskets could have been created. For instance, instead of choosing 12

[5]These data include a weight for matching the income and demographic characteristics of the sample with the characteristics of the population of the United States. I use that weight in all calculations.

[6]Prices were estimated as the ratio of expenditures to pounds purchased (also known as unit values).

[7]Despite expenditure ranking, some fresh fruits were excluded from the fresh fruit consumer basket because they were largely imported (including bananas, mango, limes, and pineapples), or because conversion factors were not available for calculating farm weights (blueberries).

items to represent "other fresh vegetables," it would have been equally reasonable to choose 10 or 14. Thus, to test the robustness of results, I experimented with consumer basket contents. In one experiment, asparagus was removed from the consumer basket while spinach was added in another. Estimates of the farm share changed by less than 1 percent whenever such changes were made.[8]

The consumer basket only contains whole vegetables, whereas food marketers now offer ready-to-eat items that have been prepared in various ways (cutting, chopping, etc.). To again gauge the robustness of results, I divided expenditures on broccoli and cauliflower into heads and florets, and expenditures on carrots into whole and ready-to-eat carrots (e.g., baby, cut, shredded, and peeled). In the ACNeilsen sample, florets and heads account for 44 percent and 56 percent, respectively, of expenditures on broccoli, so the $5.55 spent by a representative household on all broccoli was divided between each type according to these expenditure shares. Average prices for the two forms of broccoli were then calculated from the ACNeilsen data and used to infer quantities of florets and heads purchased at retail. The same procedures were followed for cauliflower florets and ready-to-eat carrots.

Incorporating ready-to-eat broccoli, cauliflower, and carrots into the consumer basket for fresh vegetables had little impact on estimates. The inclusion of these items caused a less than 1-percent change in the farm share estimates.[9]

Finally, as noted earlier, the above procedures were repeated to create a basket of fresh vegetables representative of household purchases in 2003. A final basket was then constructed by averaging the contents of the baskets from the 2 separate years.[10]

Quantities of fresh vegetables and fresh fruits in the updated consumer baskets are shown in table 2. Compared with the 1982-84 baskets, but consistent with table 1, the updated baskets contain items now available for consumption in greater quantities, such as asparagus, broccoli, and romaine lettuce. The basket for fresh fruits adds kiwifruit, cherries, and plums.[11]

Farm Baskets Contain What is Needed to Produce Consumer Baskets

Estimates of farm share are based on a comparison of the retail price of consumer baskets with revenues received by farmers for the contents of a corresponding agricultural basket. The contents of these agricultural baskets are determined by estimating the amount of farm products marketers need to produce the consumer baskets. That is accomplished by multiplying retail quantities by conversion factors. For the case of fresh fruits and fresh vegetables, these conversion factors inflate the retail quantity by the amount necessary to compensate for waste and shrinkage that occurs as goods are prepared for presentation in retail stores.[12]

The agricultural baskets for fresh fruits and fresh vegetables behind the 1982-84 data series are shown in table 3, including the contents of the consumer baskets, the conversion factors, and corresponding quantities of

[8] Changes included adding and removing one or two items representing a household's expenditures on "other fresh vegetables." However, only items representing a small share of a typical household's expenditures were removed or added. For instance, the removal of both mushrooms and bell peppers from the consumer basket could impact the estimate of farm contribution. Of the items representing other fresh vegetables, mushrooms and bell peppers command the third and fourth largest shares, respectively, of household expenditures, on average.

[9] This suggests that marketing costs for additional preparation may be offset by reductions in other marketing costs, such as those for transportation. In fact, for broccoli and cauliflower, Reed et al. find that buying florets is less expensive per serving than buying heads. Servings include only edible portions, and more servings are obtained per pound of florets than per pound of heads.

[10] For fresh vegetables, the baskets for the 2 years were similar. For fresh fruits, there were differences in the amount of citrus fruit purchased in the 2 years, possibly due to high prices for citrus fruit in 1999. However, estimates of farm share were robust to whether the contents of the baskets from the separate years were averaged, or a basket based on only 1 of the 2 years was used.

[11] As they contain a greater number of items, the updated baskets are also closer to the consumer baskets behind the CPI (see box, "Methodology for Calculating CPI").

[12] Conversion factors for more highly processed foods are more complex and, generally speaking, involve more than one agricultural commodity. For example, to manufacture some dairy products, sugar is added to milk.

The Bureau of Labor Statistics (BLS) has developed its own procedures for creating the Consumer Price Index (CPI). When creating consumer baskets for the market basket data series, ERS researchers have sought to maximize the similarity between their baskets and those underlying the CPI. The CPI is used to update the cost of ERS consumer baskets at retail, which requires some correspondence between the two.

To calculate the CPI, the BLS collects prices at retail outlets. That process begins by dividing consumer products into one of 211 strata, called "entry level items" (ELI). For example, lettuce, potatoes, tomatoes, and "other fresh vegetables" are each one of 211 ELI. Goods are then priced at retail outlets across the country. Once an outlet has been selected for pricing a particular ELI, BLS assigns a probability of being sampled to every product at the outlet within the ELI. For instance, broccoli is among "other fresh vegetables." If an outlet had been selected for pricing other fresh vegetables, broccoli would be sampled with a probability equal to its share of that outlet's total sales of other fresh vegetables. Thus, all fresh vegetables are likely to be included in the consumer basket for fresh vegetables behind the CPI.

Based on the price data collected at retail stores, BLS next calculates a basic index for each of its 211 ELI in each of 38 parts of the country. That amounts to 8,018 basic indexes (38 x 211 = 8,018). For example, 38 of the 8,018 basic indexes are for lettuce, including one for the average price of lettuce in the Los Angeles suburbs. Since 1999, the BLS has used a geometric mean to average over food prices. This is designed to overcome a long standing criticism of the CPI that it provides an upper-bound estimate of the rate of inflation.

In a second stage, BLS creates aggregate indexes based on weighted averages of subsets of basic indexes. For example, a national index for lettuce can be created by taking a weighted average of each of the 38 geographic basic indexes for lettuce.

Finally, the CPI for fresh vegetables can be derived by averaging over national indexes for lettuce, potatoes, tomatoes, and other fresh vegetables. Weights are derived from the Consumer Expenditure (CE) Survey and reflect how much American households spend on each type of vegetable. For more information, see Bureau of Labor Statistics, Handbook of Methods.

agricultural goods. As noted above, waste may occur as commodities are shipped and prepared for presentation in retail stores. For example, ERS estimates that farmers must supply 1.031 pounds of carrots for marketers to provide 1 pound at retail. Some carrots may spoil and, perhaps, others may need trimming.

Tables 4 and 5 detail the updated agricultural baskets, based on the 1999-2003 consumer baskets, and the reported conversion factors to adjust for waste. These newer conversion factors are often smaller than the conversion factors behind the 1982-84 data series. For example, the conversion factor for corn on the cob has been reduced from 1.25 to 1.087. This reduction is consistent with improvements in the efficiency of supply chains to reduce waste that occurs as agricultural goods are shipped, processed, and stocked in retail foodstores. All else constant, the newer, smaller conversion factors reduce farm share estimates, since a smaller quantity of agricultural goods is needed to supply any given quantity of food at retail.

Table 3
Consumer and agricultural baskets for fresh vegetables and fresh fruits, 1982-84

	Retail quantity	Conversion factor	Farm quantity
	Pounds		*Pounds**
Fresh vegetables:			
Potatoes	81.4	1.042	84.8
Sweet potatoes	8.5	1.111	9.4
Head lettuce	30.3	1.076	32.6
Tomatoes	25.9	1.176	30.5
Carrots	20.2	1.031	20.8
Celery	20.2	1.075	21.7
Onions	49.2	1.064	52.3
Corn on the cob	14.9	1.250	18.6
Fresh fruits:			
Apples	41.7	1.064	44.4
Oranges	39.8	0.0135	0.5373[1]
Lemons	6.9	0.0140	0.0966[1]
Grapefruits	13.0	0.0131	0.1703[1]
Pears	5.0	1.088	5.4
Strawberries	3.4	1.149	3.9
Peaches	11.1	1.111	12.3
Cantaloupes	8.8	1.149	10.1
Grapes	14.7	1.178	17.3

*Farm quantities are in pounds except where otherwise noted.
[1] Quantity measured in boxes.
Source: USDA/Economic Research Service.

Table 4
Fresh vegetables: updated baskets and conversion factors

	Retail quantity	Conversion factor	Farm quantity
	Pounds		*Pounds*
Asparagus	2.00	1.099	2.19
Bell peppers	6.47	1.087	7.04
Broccoli	6.71	1.087	7.29
Cabbage	7.51	1.075	8.08
Carrots	21.11	1.031	21.76
Cauliflower	2.18	1.087	2.37
Celery	5.34	1.075	5.74
Corn on the cob	4.38	1.087	4.76
Cucumber	6.79	1.087	7.38
Iceberg lettuce	15.37	1.075	16.53
Agaricus mushrooms	3.12	1.064	3.32
Onions	24.22	1.064	25.77
Potatoes	82.92	1.042	86.37
Romaine lettuce	7.97	1.075	8.57
Sweet potatoes	4.67	1.111	5.19
Tomatoes	20.91	1.176	24.60

Source: USDA/Economic Research Service. Conversion factors available via the ERS food consumption (per capita) data system: http://www.ers.usda.gov/data/foodconsumption/.

Table 5
Fresh fruit: updated baskets and conversion factors

	Retail quantity	Conversion factor	Farm quantity
	Pounds		*Pounds**
Apples	34.07	1.042	35.49
Cantaloupe	11.25	1.087	12.23
Cherries	2.11	1.087	2.29
Grapefruit	15.07	1.031	15.54
Grapes	15.89	1.099	17.47
Honeydew melon	1.80	1.087	1.96
Kiwifruit	0.91	1.099	1.00
Lemons	6.01	1.042	6.27
Oranges	25.02	1.031	25.79
Peaches	8.87	1.064	9.43
Pears	3.87	1.053	4.07
Plums	2.46	1.053	2.59
Strawberries	8.27	1.087	8.99
Watermelon	19.75	1.111	21.95

Source: USDA/Economic Research Service. Conversion factors available via the ERS
food consumption (per capita) data system: http://www.ers.usda.gov/data/foodconsumption/.

Farm Share Calculated

Once the contents of the updated consumer and agricultural baskets have
been determined, the formal equation for farm contribution, FC, at time t is

(1)
$$FC_t = \frac{Q'_{ft}P_{ft}}{Q'_{rt}P_{rt}}$$

where Q_{rt} is the vector of food quantities bought at time t, P_{rt} is the vector
of unit retail prices for these foods, Q_{ft} is the corresponding vector of quan-
tities of agricultural goods, and P_{ft} is the vector of prices received by
farmers per unit for agricultural goods in Q_{ft}.

In contrast to equation 1, for the existing data series, researchers have
continued to work with baskets representing what households purchased in
1982-84. Since 1982-84, it has been assumed that $Q_{ft} = Q_f$ and $Q_{rt} = Q_r$, so
that equation 1 becomes

(2)
$$FC_t = \frac{Q'_f P_{ft}}{Q'_r P_{rt}}$$

Moreover, assuming consumer baskets are sufficiently similar to the baskets
used by the Bureau of Labor Statistics (BLS) to calculate the Consumer
Price Index (CPI),[13] equation 2 can be further expressed as

(3)
$$FC_t = \frac{Q'_f P_{ft}}{Q'_r P_{rt}} = \frac{Q'_f P_{ft}}{\left(\frac{Q'_r P_{rt}}{Q'_r P_{r0}}\right)(Q'_r P_{r0})}$$

[13]We recognize that our baskets are
not constructed in a manner identical
to how BLS constructs baskets used to
measure the CPI. For example, to
construct its basic indexes, BLS uses a
geometric mean to average over prices
charged for a much wider variety of
specific foods.

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where $\quad\quad\quad\quad\quad\quad\quad\quad Q'_r P_{r0}$

is the retail cost of the consumer basket in the base year of the CPI and

$$\left(\frac{Q'_r P_{rt}}{Q'_r P_{r0}} \right)$$

is the CPI in hundredths for the commodity at time t.[14] This representation of farm contribution is particularly convenient to implement. Researchers do not need to collect prices for individual foods at retail every year. Only the vector of current farm prices, P_{ft}, and the CPI for the food group are required to update the data series. The BLS publishes an annual CPI, including separate indices for major food groups such as fresh vegetables and fresh fruits.

For the current data series, ERS relies on farm prices reported by the National Agricultural Statistical Service (NASS), using an arithmetic mean of monthly NASS prices to calculate the farm value of market baskets. For instance, in 2004, the average price of a pound of fresh tomatoes at the farm gate ranged from a low of about $0.22 in June to a high of about $1.24 in November. High prices in November resulted from severe weather that interrupted tomato production in both Florida and California. The ERS price for fresh tomatoes used in estimating the farm value of the fresh vegetables market basket in 2004 was about $0.47 per pound, a simple average of the 12 prices reported by NASS for each month that year.

NASS data further reflect prices received by farmers for commodities of average quality. For example, if citrus growers export their highest quality products, then NASS prices may overstate what farmers earn for the commodities they sell in the United States. Of course, farmers are likely to receive higher prices for higher quality products, and lower prices for products of below-average quality.[15]

The existing market basket data series for fresh fruits and fresh vegetables are reproduced in table 6. Estimates of the farm contribution for fresh vegetables in 2004 demonstrate how equation 3 is used to create these data. To begin, the denominator is estimated at $256 based on two pieces of information: first, the CPI for fresh vegetables was 261.2 in 2004; second, the value of the fresh vegetables at retail in the first column of table 3 had been previously estimated at $98.01 in 1982-84.[16] Next, the numerator in equation 3 is estimated at $48.77 by multiplying the quantities in the top part of the third column of table 3 by the appropriate vector of 2004 farm prices.[17] The ratio—or share—is ($48.77/$256) = 19 percent.

Farm Share Calculated for the Updated Data Series

The updated data series is based on different consumer baskets, and uses updated, often smaller, conversion factors to determine the contents of the corresponding agricultural baskets. In addition, I treat 2001 as the base year for the new data series and, in lieu of monthly average prices, use season-average prices.

[14]The CPI is reported by BLS in hundredths. For example, if the value of a CPI were 200, then we would understand prices to have doubled since the base year. To estimate the cost in current dollars of a product given its base-year price and this CPI, a researcher would multiply the base-year price by 2, not by 200.

[15]A parallel assumption exists regarding retail prices. For example, both BLS and ACNeilsen average prices may overstate (understate) prices paid by American consumers for foods of domestic origin, if these foods tend to command a lower (higher) price than foods of imported origin.

[16]Those years currently serve as the base years for the CPI as well as for the ERS market basket data series.

[17]Prices per pound were $0.0704 for potatoes, $0.3041 for sweet potatoes, $0.1708 for lettuce, $0.468 for tomatoes, $0.2103 for carrots, $0.1559 for celery, $0.1585 for onions, and $0.2168 for corn on the cob. These are based on monthly prices published by NASS in *Agricultural Prices,* with the exception of sweet potatoes, which are for cured Louisiana Beauregard as reported in *Fruit and Vegetable Market News*. All prices except potato prices are f.o.b. shipping point, which may include marketing services such as washing and sorting.

Table 6
USDA market basket data series for fresh vegetables and fresh fruits[1]

| | Fresh vegetables | | | | | Fresh fruits | | | |
Year	Retail cost[2,3]	Farm value[2,4]	Farm-retail spread[2,5]	Farm share		Retail cost[2,3]	Farm value[2,4]	Farm-retail spread[2,5]	Farm share
1982	94	95	94	34		100	106	97	33
1983	98	97	98	34		94	80	100	27
1984	108	108	108	34		107	114	103	34
1985	104	93	109	31		118	111	122	30
1986	108	90	117	28		120	104	128	27
1987	122	110	128	31		136	114	146	26
1988	129	106	141	28		145	117	159	25
1989	143	123	153	29		155	109	176	22
1990	151	124	165	28		175	128	196	23
1991	154	111	177	24		200	173	213	27
1992	158	121	177	26		190	122	221	20
1993	168	127	190	26		196	135	224	22
1994	172	118	200	23		209	119	250	18
1995	193	130	226	23		227	136	269	19
1996	189	113	228	20		243	152	285	20
1997	195	119	234	21		245	137	295	18
1998	216	125	263	20		258	141	312	17
1999	209	118	256	19		294	154	359	17
2000	219	121	270	19		284	141	350	16
2001	231	130	282	19		292	146	359	16
2002	245	146	297	20		298	154	364	16
2003	251	150	302	20		309	163	376	17
2004	261	147	320	19		319	201	373	20

[1] Calculated for a market basket of foods bought at retail in a base period, currently 1982-84.

[2] Indices relative to the 1982-84 base.

[3] For fresh vegetables, the retail cost index is the BLS-estimated CPI for fresh vegetables. For fresh fruits, BLS estimates of the CPI are adjusted to remove the effect of changes in the price of bananas, which are not included in the consumer basket since they are not commonly grown in the United States.

[4] A measure of the absolute value of the farm contribution. For fresh vegetables, for example, the value of goods in the agricultural basket is estimated to have been $33.28 in 1982 and $48.77 in 2004, so the farm value index in 2004 was estimated as ($48.77/$33.28) x100 = 146.53.

[5] A measure of the absolute difference between the cost of a consumer basket at retail and a corresponding agricultural basket at the farm gate. For fresh vegetables, for example, the spread between the value of the consumer basket at retail and the farm value of agricultural goods was $256-$48.77 = $207.23 in 2004. This compares with $98.01-$33.28 = $64.73 in 1982. The value of the farm-retail spread index in 2004 is then estimated to be ($207.23/$64.73) x100 = 320.15.

Source: USDA/Economic Research Service. Market basket data series: http://www.ers.usda.gov/Briefing/FoodPriceSpreads/.

For 2001 (the base year), I value the consumer baskets at what households in the Consumer Expenditure (CE) Survey sample spent on the food group, on average, in that year. For fresh vegetables, that was $162. For the cost of this same basket at retail in other years, it is necessary to scale that year's CPI for fresh vegetables by its 2001 value. This scaling is necessary because 1982-84 remains the base period for the CPI as reported by BLS. For example, since the CPI for fresh vegetables was 261.2 in 2004, compared with 230.6 in 2001, I estimate the price of the fresh vegetables market basket in 2004 to be

$$(\$162)\left(\frac{261.2}{230.6}\right) = \$183.50$$

at retail.[18]

Season-average prices are also used to estimate the value of agricultural baskets in lieu of monthly-average prices. Season-average prices are the mean of prices received by farmers, weighted by quantity marketed, not by

[18]The CPI can be scaled about the base year of 2001 by dividing its value in other years by its value in 2001. However, for fresh fruits, bananas are among the entry level items which BLS uses to construct the fresh fruit CPI, while bananas are excluded from the consumer basket. To improve the correspondence between the CPI and the consumer basket, I first estimate the cost of the consumer basket for fresh fruits in 2001 and other years, using the same process described for fresh vegetables, as if bananas were included in the basket. Next, I use the CPI for bananas and expenditures on bananas in 2001 by CE households to estimate the contribution of bananas to the basket in the first part. The difference is taken to be the cost of the consumer basket for fresh fruits at retail.

month. These prices may be less than monthly-average prices if, in any given month, farm prices tend to be inversely related to the amount marketed. For example, as reported by Lucier and Jerardo, the season-average price for fresh tomatoes in 2004 was $0.372 per pound, compared with the arithmetic mean of monthly prices reported by NASS, about $0.47, that is currently being used. As with the smaller conversion factors, using season-average prices could lower estimates of farm shares, if all else were constant.[19]

Farm share estimates based on the updated data series are shown in table 7. To illustrate how these data are calculated using the updated baskets, season-average prices, equation 3, and the CPI by food group, consider how farm contribution is calculated for fresh vegetables for 2004. To begin, as described earlier, the denominator in equation 3 is estimated at

$$(\$162)\left(\frac{261.2}{230.6}\right) = \$183.50$$

For the numerator, I value the farm commodities in table 4 using season-average prices provided by Lucier and Jerardo. For 2004, that value is $43.10. The 2004 farm contribution for fresh vegetables is then $43.10/$183.50 = 23.5 percent.

[19]Season-average prices have also been adjusted to remove marketing services embodied in f.o.b. shipping point prices (see footnote 17).

Table 7
Farm value shares for fresh vegetables and fresh fruits based on market baskets representative of what American households bought for at-home consumption between 1999 and 2003

Year	Fresh vegetables[1]	Fresh fruits[2]
	Percent	
1997	29.7	30.0
1998	27.7	28.2
1999	26.1	28.8
2000	25.5	25.7
2001	27.4	27.9
2002	26.5	29.1
2003	26.1	28.0
2004	23.5	26.6

[1] Calculated using the quantities in table 4. Farm prices are from Lucier and Jerardo.
[2] Calculated using the quantities in table 5. Farm prices for melons are from Lucier and Jerardo. Fruit prices are from Perez and Pollack. Farm prices for grapefruit based on an 85-pound box from Florida. Prices for lemons based on a 76-pound box from Arizona. Prices for oranges based on a 75-pound box of California Navels.
Source: USDA/Economic Research Service.