

Holding Quality Constant: What Can We Learn About How Relative Prices Have Changed?

Consumers may place value on the increased variety of foods available as well as on the convenience of many of these foods. If we could net out the value of the improved quality, we would hold quality constant and price comparisons would still be meaningful. To remove the value of quality improvements from price comparisons, the price of the improved product would have to be adjusted downward by the value consumers place on the quality of the improvement. In practice, such a task is not trivial and, so far, most price statistics do not incorporate the notion.

Tracking changes in the prices of many different foods is an alternative to examining price indices. Our approach is to look at price trends for foods that have not undergone substantial quality change. Foods considered for selection must have been commonly consumed in the 1980s. A long time series on the price of each food must also be available. Since we chose foods that we hope did not change much, we cannot extrapolate our results to all food prices. The food prices we examine are not representative of all food prices. However, results will point to whether relative prices have changed.

BLS reports monthly retail prices going back to 1980 for many specific foods, such as Red Delicious apples and broccoli. This report uses a subset of the U.S. city average price series. An attractive feature of these data is that BLS maintains each price series as long as its probability-based sampling generates sufficient observations to report prices reliably. With long time series, researchers can also see how relative prices have changed over time and how consumers' ability and incentive to choose a healthy diet may have changed. Long time series reveal consumers' changing ability and incentive to alter dietary quality without being confounded by unusual or unique, shortrun events (like a freeze in California's Central Valley that leads to a temporary short supply of oranges and unusually high prices).

There are many reasons why the price trends we examine might display different patterns than the price indices. First, even if we interpret trends in price indices as conclusive evidence that Americans pay more annually for fresh fruits and vegetables, that the index for fresh fruits and vegetables has been rising means only that many fresh fruit and vegetable prices have been rising. The rising index does not necessarily mean that prices for all fresh fruits and vegetables are rising equally. Like any average, the index is composed of a diverse set of movements.

Second, we will be examining average price trends for foods with relatively less quality change than newer fresh fruit and vegetable products. More traditional foods embody a smaller quantity of marketing inputs than do the newer foods, which are likely to comprise a growing share of the CPI.

Another factor may be that BLS accounts differently for changes in the economy, such as the mix of retail outlets at which consumers shop, when calculating price indices and average price data. Many analysts have argued that the growth of "big box" retailers, like Wal-Mart, has dampened infla-

tionary price increases, but that effect is not fully incorporated in the CPI (see Reinsdorf, 1993; Leibtag, 2006). Using household purchase data, Leibtag (2006) shows that for a wide class of dairy foods, eggs, and butter/margarine, the CPI yielded larger estimates of price inflation than did average price data.⁴

Price Trends for Dessert and Snack Foods

Among the dessert and snack foods tracked by BLS, four met the requirements of a long time series (monthly prices from January 1980 through December 2006): chocolate chip cookies, potato chips, ice cream, and cola. Figures 2-5 show time plots of prices deflated by the consumer price index (CPI-U) along with corresponding linear trend lines.

All the trend lines fall, left to right, indicating that inflation-adjusted prices have declined. Relative to the entire bundle of all other goods consumers buy, desserts and snack foods have become less expensive. Table 3 shows how fast prices have fallen each year—average annual percentage changes in inflation-adjusted prices.⁵ For chocolate chip cookies, potato chips, ice cream, and cola, prices declined from 0.5-1.7 percent per year.⁶ Over the course of a year, a 1.5-percent decline in price might not have a major influence on potato chip consumption. Over 27 years, an annual average decrease of 1.5 percent implies that prices would be almost a third lower than at the outset.

Several foods display periods in which prices deviated substantially from long-term trends. Ice cream prices fell for many years and then rose rapidly during the 1990s. While it is difficult to call a decade-long rise in prices a short-run event, the long-run trend still gives the appearance of falling prices, just as it does for other dessert and snack foods.

Price Trends for Fresh Fruits and Vegetables

The BLS also provides average prices for an extensive list of fruits and vegetables. We selected items for which a long time series of data are available and for which BLS has been reporting prices for each month of the year. Satisfying this condition implies that we will be looking at foods routinely consumed year-round (they take up significant grocery store shelf space and BLS easily finds them in grocery stores) and always compete for consumers' dollars. To that end, we eliminated from consideration price series so seasonal there were periods each year with no reported prices.

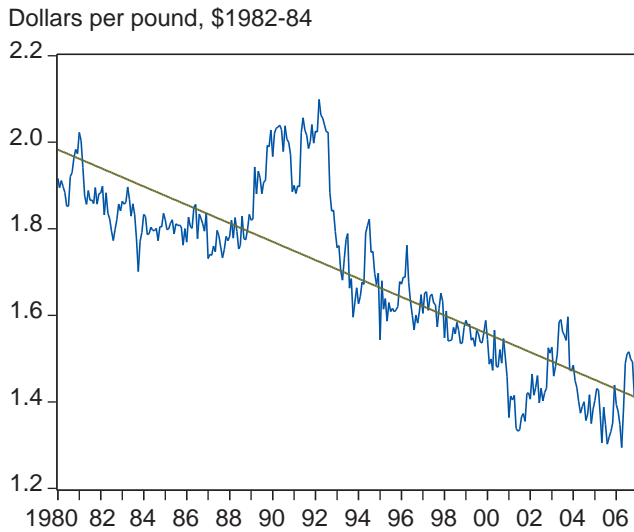
From among the fresh fruits and vegetables category for which this aspect of seasonality was long ago resolved, we further chose 11 items that researchers and health policy advocates might also consider "healthy." Our list includes apples, bananas, broccoli, cabbage, carrots, celery, cucumbers, dry beans, lettuce, peppers, and tomatoes. While the list includes one deep green vegetable, broccoli, we wanted to include other foods widely recognized as "healthy," such as romaine lettuce, also a deep green leafy vegetable. Unfortunately, the data on romaine lettuce were not sufficient. While our list might not include all the commodities dieticians and nutritionists point to first as being most "healthy," they are all clearly less calorie dense than the snack foods and desserts we examined. The fruits and vegetables compare favorably on their content of salt, refined sugar, fat, and cholesterol.

⁴Many of the price observations incorporated into BLS average price data are likely to come from nontraditional, "big box" outlets. It follows that a decrease (increase) in average prices over time does not necessarily mean that the same items are available at traditional retail outlets for less (more) money. But our concern is with prices consumers face, not with whether they have to switch the stores they patronize.

⁵The ordinary least squares regression $\ln P_t = \beta_0 + \beta_1 t + \varepsilon_t$, $\varepsilon_t \sim N(0, \sigma^2)$, where $\ln P_t$ is the natural logarithm of average monthly price (deflated by the CPI-U) at time t , was used to calculate the annual average percentage rate of price change. The average monthly rate of price change was calculated from the estimated coefficients as $\exp(\beta_1) - 1$ and the annual average percentage rate of price change was approximated as $12(\exp(\beta_1) - 1)$.

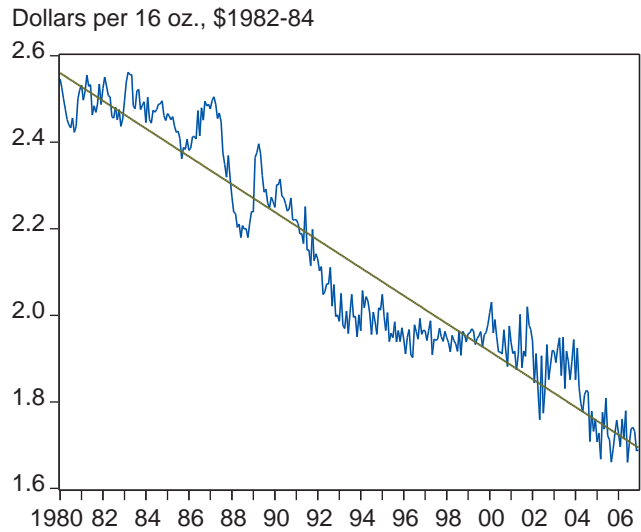
⁶The cola series is relatively short, beginning in July 1995 (138 observations, compared to 324 for the series beginning in 1980). However, Putnam and Allshouse (1999) provided annual price data for a similar series back to 1970 (carbonated soft drinks, excluding diet cola). Although their data are not monthly, they do allow us to examine long-run price trends, and we can examine the 1980-95 period, the period for which BLS provides monthly price data on chocolate chip cookies, potato chips, and ice cream, but not for cola. Deflating the average annual prices for carbonated soft drinks by the CPI-U (Base Period: 1982-84=100) reveals that prices fell at an annual rate of 1.8 percent from 1980 to 1995. That is, the calculated rate of decrease for the 1980-1995 period (derived from annual observations) is about the same as the calculated rate of decrease for the 1995-2006 period (derived from monthly observations).

Figure 2
Chocolate chip cookies:
inflation-adjusted prices and trendline



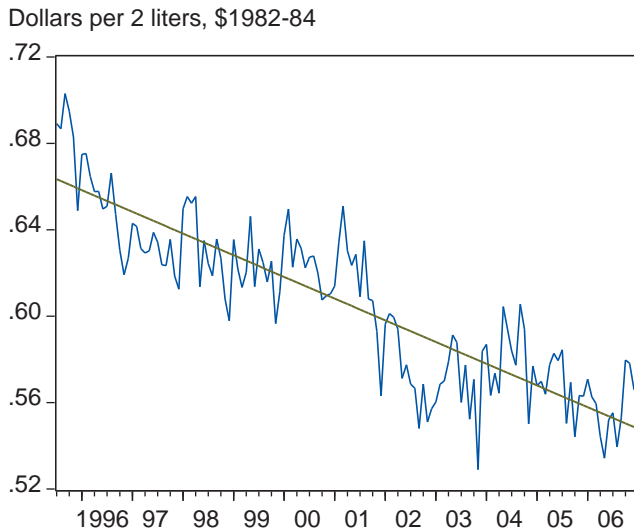
Source: BLS U.S. city average price data and CPI-U.

Figure 3
Potato chips:
inflation-adjusted prices and trendline



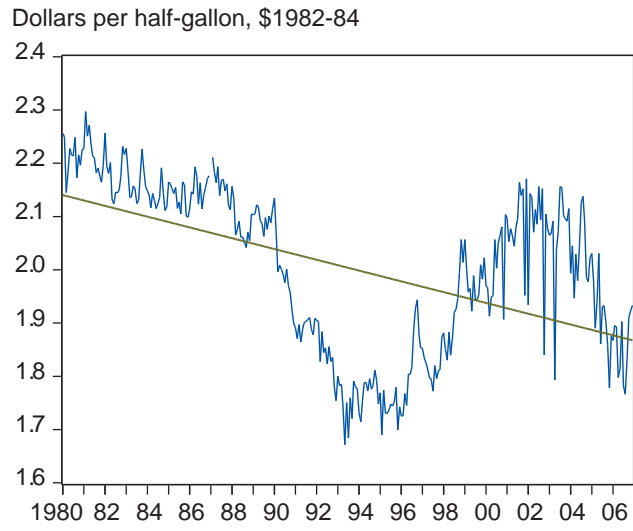
Source: BLS U.S. city average price data and CPI-U.

Figure 4
Cola (nondiet):
inflation-adjusted prices and trendline



Source: BLS U.S. city average price data and CPI-U. BLS began reporting cola prices in 1995.

Figure 5
Ice cream (prepackaged, bulk, regular):
inflation-adjusted prices and trendline



Source: BLS U.S. city average price data and CPI-U. Missing value reflects a month that BLS did not report an ice cream price.

Table 3
Long-term changes in retail dessert and snack food prices

Food item	Average annual percentage change in inflation-adjusted price
Chocolate chip cookies, 1980-2006	-1.3
Potato chips, 1980-2006	-1.5
Ice cream, 1980-2006	-0.5
Cola, 1995-2006	-1.7

Source: ERS calculations using BLS U.S. city average price data and CPI-U.

Table 4 shows average annual rates at which fruit and vegetable prices have been changing. The table is divided into three parts to reflect the evidence each commodity yields.

There are four commodities with long, uninterrupted time series that show inflation-adjusted prices declining at average annual rates similar to what we observed for snack foods and desserts. These include apples, bananas, lettuce, and dry beans (figs. 6-9). The price series for dry beans is, like the cola price series, somewhat shorter than others. The series gives the appearance of two distinct regimes: sharply declining prices through 2001 and trendless afterward. Nevertheless, when we compare prices from the 1990s with prices from the 2000s, it is obvious that recent prices are distinctly lower.

Other vegetable prices display the same pattern, although over a shorter time period. Inflation-adjusted prices for carrots, cabbage, celery, cucumbers, and peppers all show declining trends (figs. 10-14). Average rates of decline are comparable with other fruits and vegetables, as well as with snack foods and desserts. BLS, however, suspended reporting average prices for these five commodities in 2000.⁷ One likely explanation for this suspension was that, by 2000, expenditures for bagged carrots, bagged spinach, and prepared salads accounted for a large share of produce sales. BLS data collectors priced these newer products with greater frequency. Under BLS's sampling method, with probability proportional to share of sales, the reliability of the older series was increasingly difficult to maintain. BLS was shifting its survey resources to the most commonly consumed vegetables (and those taking more grocery store shelf space).⁸ The change in reporting reflects a large departure in consumer purchase patterns.

At first glance, broccoli and tomatoes appear to be counter-examples, displaying rising trends in inflation-adjusted prices (figs. 15-16).⁹ Rising prices appear to be systematic, not just high prices over a few months. However, the way in which commodities have been defined for government statistical purposes leads to the conclusion that they may not really be counter-examples.

Table 4

Long-term changes in retail produce prices

Food item	Average annual percentage change in inflation-adjusted (CPI-U) price
Apples (Red Delicious), 1980-2006	-1.1
Bananas, 1980-2006	-1.6
Lettuce (Iceberg), 1980-2006	-0.9
Dry beans (all types, sizes), 1995-2006	-0.8
Suspended price series	
Carrots (short trimmed and topped), 1980-2000	-0.9
Cabbage, 1980-2000	-0.7
Celery, 1980-2000	-1.5
Cucumbers, 1980-2000	-0.8
Peppers, 1980-2000	-0.5
Possible counter-examples	
Tomatoes (field-grown), 1980-2006	0.3
Broccoli, 1995-2006	1.4

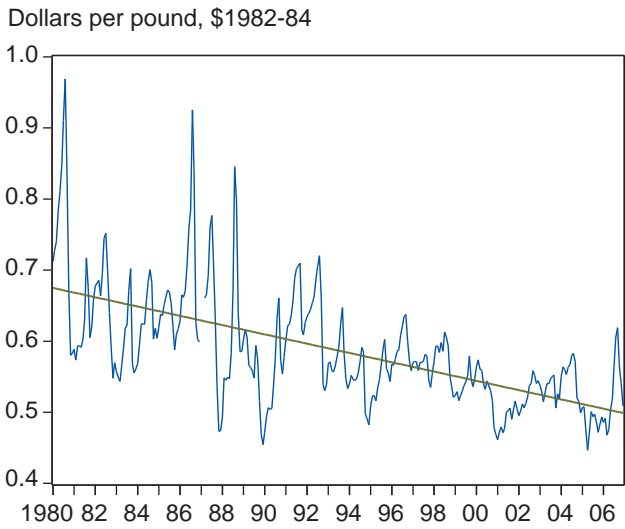
Source: ERS calculations using BLS U.S. city average price data and CPI-U.

⁷BLS resumed publishing average prices for almost all of these foods in 2006.

⁸BLS's primary goal is maintenance of the CPI and its major components, like the vegetable CPI, rather than individual food prices.

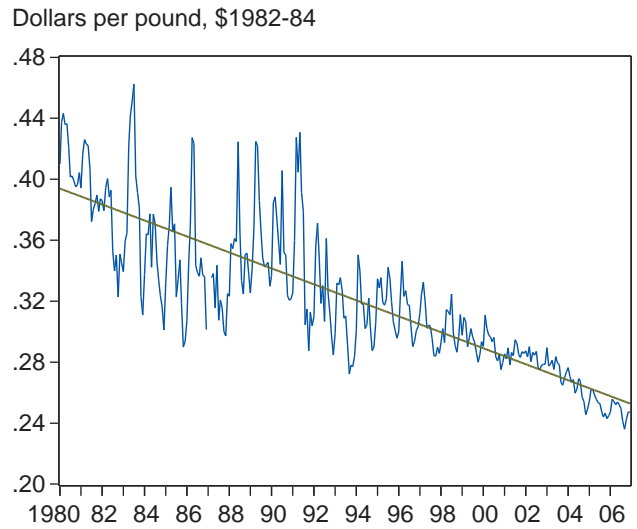
⁹BLS also reports a complete price series for grapefruit—monthly prices each month since January 1980. We excluded grapefruit from consideration because conclusions drawn from estimating a longrun trend depend on whether data from 2004-2006 are included. Including that period points to increasing prices, while excluding it points to falling prices. Perez and Pollack (2007) indicated the 2004-2005 period was unusual. They attribute a loss in citrus acreage in Florida over those years to the spread of citrus canker and major hurricanes that hit the State.

Figure 6
Apples (Red Delicious):
inflation-adjusted prices and trendline



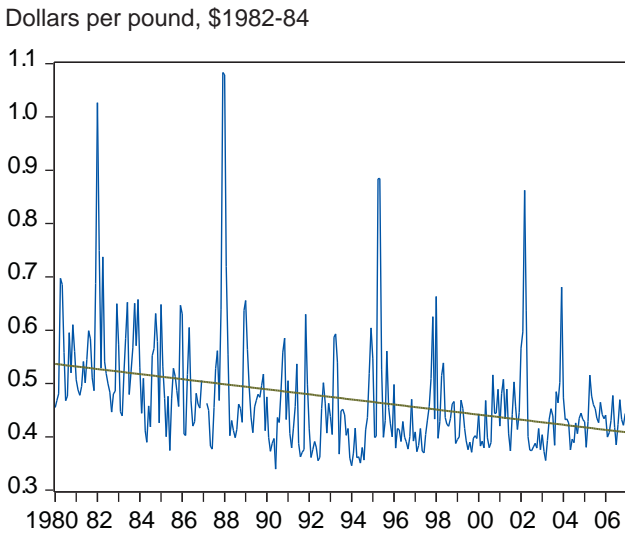
Source: BLS U.S. city average price data and CPI-U. Missing values reflect months that BLS did not report an apple price.

Figure 7
Bananas:
inflation-adjusted prices and trendline



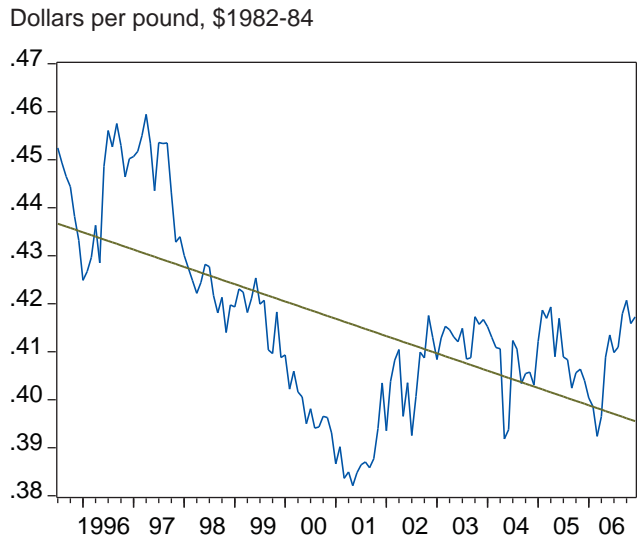
Source: BLS U.S. city average price data and CPI-U. Missing values reflect months that BLS did not report a banana price.

Figure 8
Lettuce (Iceberg):
inflation-adjusted prices and trendline



Source: BLS U.S. city average price data and CPI-U. Missing values reflect months that BLS did not report a lettuce price.

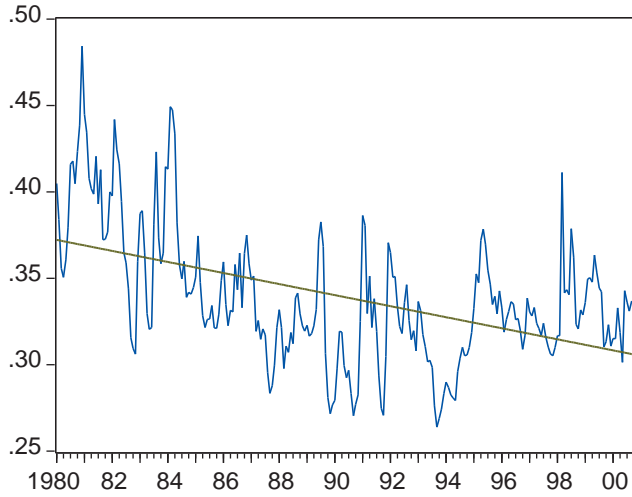
Figure 9
Dry beans (all types and sizes):
inflation-adjusted prices and trendline



Source: BLS U.S. city average price data and CPI-U. BLS began reporting dry bean prices in 1995.

Figure 10
**Carrots (short trimmed and topped):
inflation-adjusted prices and trendline**

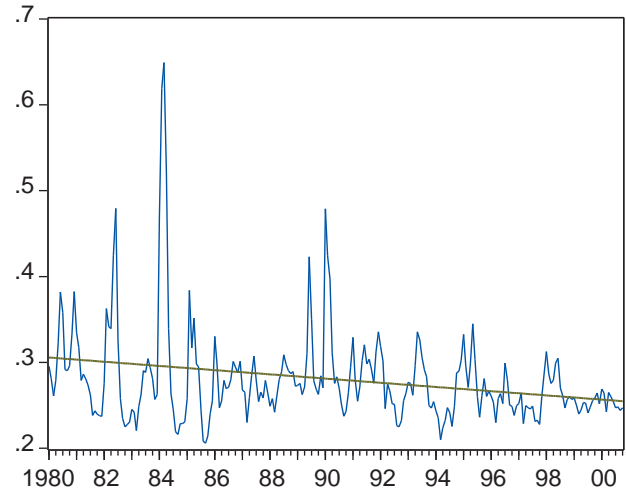
Dollars per pound, \$1982-84



Source: BLS U.S. city average price data and CPI-U. BLS suspended reporting carrot prices in 2000.

Figure 11
**Cabbage:
inflation-adjusted prices and trendline**

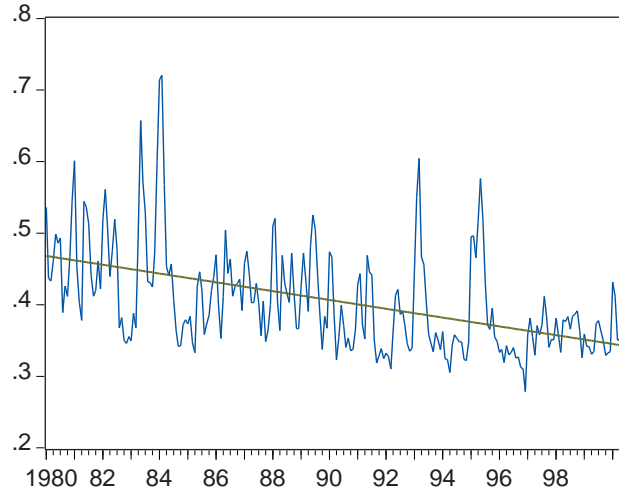
Dollars per pound, \$1982-84



Source: BLS U.S. city average price data and CPI-U. BLS suspended reporting cabbage prices in 2000.

Figure 12
Celery: inflation-adjusted prices and trendline

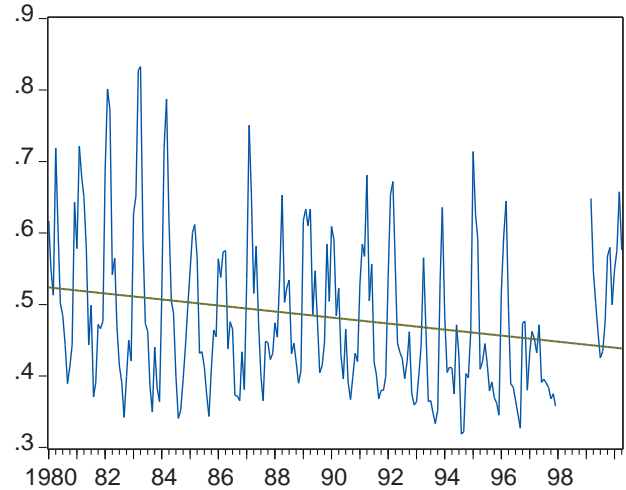
Dollars per pound, \$1982-84



Source: BLS U.S. city average price data and CPI-U. BLS suspended reporting celery prices in 2000.

Figure 13
Cucumbers: inflation-adjusted prices and trendline

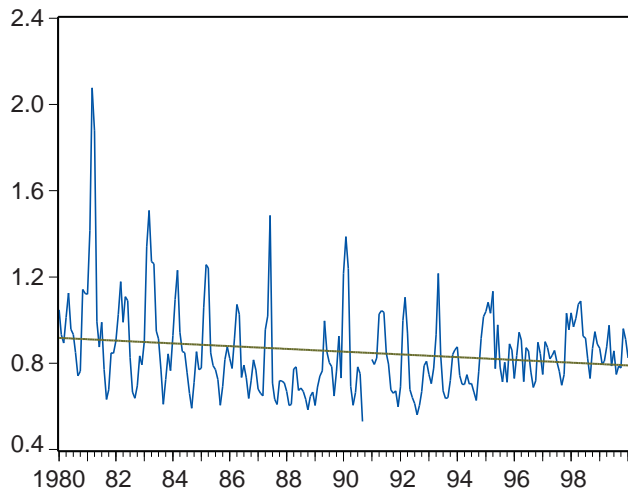
Dollars per pound, \$1982-84



Source: BLS U.S. city average price data and CPI-U. BLS suspended reporting celery prices in 2000. Missing values reflect months in which BLS did not report a cucumber price.

Figure 14
Peppers (sweet):
inflation-adjusted prices and trendline

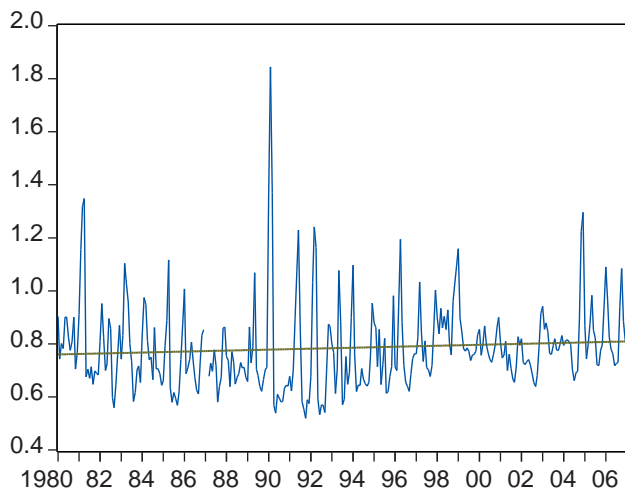
Dollars per pound, \$1982-84



Source: BLS U.S. city average price data and CPI-U. BLS suspended reporting pepper prices in 2000. Missing values reflect months in which BLS did not report a pepper price.

Figure 15
Tomatoes (field grown):
inflation-adjusted prices and trendline

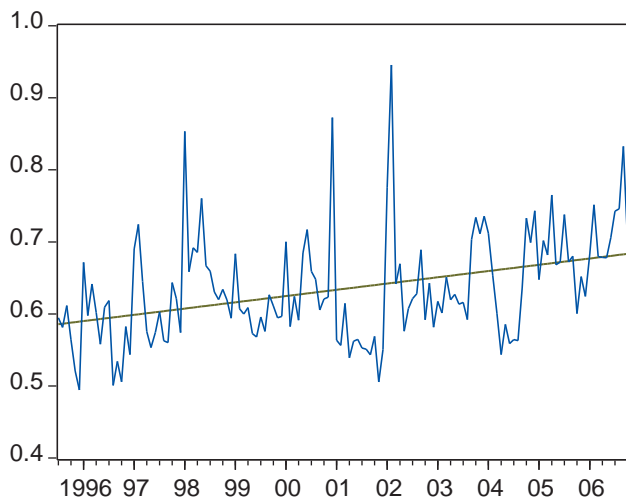
Dollars per pound, \$1982-84



Source: BLS U.S. city average price data and CPI-U. Missing values reflect months in which BLS did not report a tomato price.

Figure 16
Broccoli:
inflation-adjusted prices and trendline

Dollars per pound, \$1982-84



Source: BLS U.S. city average price data and CPI-U. BLS began reporting broccoli prices in 1995.

There are limits to BLS's commodity definitions. Unlike the definitions BLS uses for apples (Red Delicious) or lettuce (Iceberg), broccoli and tomatoes allow for a wide range of possibilities. For broccoli, prices reported by BLS include head broccoli (with stems), crowns, and bags of washed florets. As shown in table 1, with increasing demands for prepared foods, the current mix of products has shifted away from just heads and toward crowns and florets.

For tomatoes, Cook and Calvin (2005) found that vine ripe and mature green tomatoes shifted in importance, with vine ripe becoming the preferred round field tomato in retail channels and mature green being used in food service. They described the market history as follows:

Vine ripe tomatoes were not always strong competition for mature green tomatoes in the retail sector. Before the early 1990s, vine ripe tomatoes had poor shelf-life characteristics, compared with mature green tomatoes. In the late 1980s, a California firm and a few Mexican firms in Sinaloa began growing extended shelf life (ESL) vine ripe tomatoes. These new vine ripe tomatoes had better color than mature green tomatoes and held up just as well, a major improvement over the softer, older varieties. (p. 53)

Over the entire 1980-2006 period, inflation-adjusted prices for tomatoes increased, on average, at an annual rate of 0.3 percent. The shift may not be visually obvious in the tomato price trendline. But, when we allow for a change in the late 1980s, statistics reveal the shift. Inflation-adjusted tomato prices from January 1980 through December 1988 declined at an annual rate of 2.1 percent. From January 1989 through December 2006, prices increased at an annual rate of 0.8 percent. It is possible that tomato prices were generally declining until consumers were offered a product with better sensory qualities, and the quality change was responsible for the upward price trend.