United States
Department
of Agriculture

USDA

Economic
Research
Service

Economic
Research
Report
Number 55

March 2008

Price Trends Are Similar for Fruits, Vegetables, and Snack Foods

Fred Kuchler and Hayden Stewart

www.ers.usda.gov

Visit Our Website To Learn More!

You can find additional information about ERS publications, databases, and other products at our website.

www.ers.usda.gov

National Agricultural Library Cataloging Record:

Kuchler, Fred

Price trends are similar for fruits, vegetables, and snack foods. (Economic research report (United States. Dept. of Agriculture. Economic Research Service) ; no. 55)

1. Fruit—Prices—United States.
2. Vegetables—Prices—United States.
3. Snack foods—Prices—United States.
I. Stewart, Hayden.
II. United States. Dept. of Agriculture. Economic Research Service.
III. Title.

HD9220.U62

Photos: PhotoDisc and Comstock.

United States Department of Agriculture

Economic Research Report Number 55

March 2008

A Report from the Economic Research Service

www.ers.usda.gov

Price Trends Are Similar for Fruits, Vegetables, and Snack Foods

Fred Kuchler and Hayden Stewart

Abstract

An increase in the price of fruits and vegetables relative to less healthy foods could reduce consumers' incentives to purchase fruits and vegetables and result in less healthy diets. Whether such a change in relative prices and incentives has occurred in the United States is difficult to prove because of substantial quality improvements in many fresh fruits and vegetables. For commonly consumed fresh fruits and vegetables for which quality has remained fairly constant, analysis of price trends reveals a price decline similar to that of dessert and snack foods. This price trend evidence suggests that the price of a healthy diet has not changed relative to an unhealthy one, although a healthy diet might not include every fresh fruit or vegetable currently available.

Keywords: fresh fruit and vegetable prices, price trends, quality change

Acknowledgments

The authors thank Linda Calvin, Elise Golan, Ephraim Leibtag, Gary Lucier, James MacDonald, Abe Tegene, and Jay Variyam (Economic Research Service, U.S. Department of Agriculture). Thanks also to Mark Bowman (U.S. Bureau of Labor Statistics) and to Parke Wilde (Tufts University). Thanks to Angela Anderson and Tom McDonald for their editorial contributions.

Contents

Summary

An increase in the price of fruits and vegetables relative to less healthy foods could reduce consumers' incentives to purchase fruits and vegetables and result in less healthy diets. Whether such a change in relative prices and incentives has occurred in the United States is difficult to prove because of substantial quality improvements in many fresh fruits and vegetables. For commonly consumed fresh fruits and vegetables for which quality has remained fairly constant, analysis of price trends reveals a price decline similar to that of dessert and snack foods. This price trend evidence suggests that the price of a healthy diet has not changed relative to an unhealthy one, although a healthy diet might not include every fresh fruit or vegetable currently available.

What Is the Issue?

In theory, it should be easy to compare food prices from a time when Americans were thinner to current prices and demonstrate whether relative prices of healthy and less healthy foods have changed. In practice, an increase in the relative prices of fresh fruits and vegetables is difficult to prove. Standard price comparisons using Consumer Price Index (CPI) numbers suggest that prices of fresh fruits and vegetables have increased relative to prices of other foods. However, these numbers have been shown to overstate the rate of price increase for many types of foods, and especially for fresh fruits and vegetables. A primary reason is the difficulty in accounting for quality changes, like year-round availability and convenient pre-washed packaging. The question remains whether prices of fresh fruits and vegetables have increased over time, holding quality constant.

What Did the Study Find?

Bureau of Labor Statistics' (BLS) average food price data—not index numbers—reveal that, relative to dessert and snack foods, prices have remained stable for a variety of fresh fruits and vegetables that have not had substantial quality improvements and were commonly consumed in the 1980s. Inflation-adjusted price trends for these largely unchanged fruits and vegetables show patterns similar to those of the less healthful foods: prices for healthy and unhealthy foods declined at about the same rate relative to all other goods.

Specifically, from 1980-2006, inflation-adjusted prices of chocolate chip cookies, cola, ice cream, and potato chips fell by an average of 0.5-1.7 percent each year. During the same period, inflation-adjusted prices of Red Delicious apples, bananas, Iceberg lettuce, and dry beans fell by an average of 0.8-1.6 percent each year. Inflation-adjusted prices of cabbage, carrots, celery, cucumbers, and peppers fell by an average of 0.5-1.5 percent each year, over a slightly shorter period of time. These latter time series are somewhat shorter because BLS did not report prices for these foods for all years.

Rising price trends were observed for broccoli and field-grown tomatoes. These trends are not counter-examples, but reveal that the selection process

was not exclusive enough to screen out all foods that have undergone quality change. Unlike in 1980, today's consumer expenditures for broccoli are for partially or fully prepared products—washed and bagged florets and other cut products. Similarly, a technological improvement in the late 1980s changed the types of tomatoes grown and their sensory qualities.

The price trend evidence is specific to the foods examined. It neither indicates nor suggests that inflation-adjusted prices for all fresh fruits and vegetables are declining similarly. It does suggest that a wide class of unprepared fresh fruits and vegetables—those that have not been combined with labor-saving attributes and those that have long been available year-round—display declining prices along with prices of commonly consumed dessert and snack foods. The price trend evidence suggests that the price of a healthy diet has not changed relative to an unhealthy diet, although a healthy diet might not include every fresh fruit or vegetable currently available.

Many innovative fresh fruit and vegetable products have been introduced in recent years. These newer products account for a growing share of produce sold by retailers. The growing availability of such products suggests that many consumers value these innovations. A remaining question is whether low-income households also share in the benefits provided by foods that are more convenient and more readily available.

How Was the Study Conducted?

The study used BLS U.S. city average food price data, deflating the monthly time series price data (1980-2006) by the CPI to construct inflation-adjusted price trends for 4 dessert and snack foods and 11 fresh fruits and vegetables. Identifying fresh fruits and vegetables that were largely the same product in 1980 and 2006 was accomplished by selecting foods with long, mostly uninterrupted, time series retail price data. Excluded from the study were foods with seasonal periods each year with no reported prices. The fresh fruits and vegetables included Iceberg lettuce, whole carrots, cabbage, celery, Red Delicious apples, bananas, dry beans, cucumbers, peppers, broccoli, and tomatoes. The desserts and snack foods included chocolate chip cookies, cola, ice cream, and potato chips.

Introduction

Dieticians routinely encourage consumers to eat more fruits, vegetables, and whole-grain foods and less sugared desserts and salty snacks. Regardless, recent statistics on obesity and dietary intake show that most Americans are not complying with this advice: the majority of Americans are overweight and approximately a third are obese (Hedley et al., 2004). To meet 2005 *Dietary Guidelines*, typical Americans would need to more than double their current intake of vegetables and whole-grain foods while reducing their intake of solid fats and added sugars by half (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2005).

Many variables influence diet choices. Individuals choose foods based on taste, convenience, family structure and traditions, age, health status, knowledge, and lifestyle. As long as household income and wealth place limits on what people can afford, food prices will also shape food choices. Some health researchers and policy advocates argue that what really motivates consumers to choose "unhealthy" foods and reject healthy alternatives are relative prices (Brownell and Horgen, 2004; Drewnowski and Darmon, 2005). Healthy foods, they say, are expensive, and unhealthy foods are cheap.

Americans, however, have not always been so overweight.[1] The incidence of overweight and obesity has increased sharply since 1980. If relative prices are responsible for Americans' weight gain, past relative prices must have been different. Here, we examine how prices for select foods have changed over the years. These foods include fresh fruits and vegetables, as well as foods that should be consumed in moderation, including snack foods.

[1]Obesity was relatively stable from 1960-1980, and has shown an upward trend since (Flegal et al., 2002). The most recent studies confirm a longrun upward trend in obesity (Hedley et al., 2004).

There is a major hurdle to definitively answering whether relative prices and incentives to choose a healthy diet have changed. When products do not change, but their prices do, relative price changes indicate that purchase incentives changed. But when product qualities change, price comparisons can be meaningless because the products being compared are different. Increases in food convenience and availability, as well as improvements in sensory properties, are all elements of what is here described as "quality." We first show evidence for the magnitude of quality changes in fresh fruits and vegetables.

The Consumer Price Index (CPI) is the standard tool used for tracking changes in relative prices. However, the CPI is widely believed to overstate the rate of inflation when used to examine price trends since the 1980s. The degree to which it actually accounts for quality change is among the reasons posited for this problem and remains an open research question.

Due in part to the ambiguity associated with CPI numbers, we examine longrun trends in the inflation-adjusted prices of individual food products, selecting those commonly consumed and exhibiting less quality change. We look for broad patterns across those foods. BLS provides price data on many foods every month of the year. To capture longrun trends, not just unique, shortrun events that might lead to temporarily high prices, we used city average monthly prices collected from 1980-2006.

The study builds on work by Alston, Sumner, and Vosti (2006), who examined trends in average prices paid for several foods and discussed the likelihood that quality improvements may confound any effort to compare how prices for different foods have changed. We examine the quality changes that have affected the mix of fresh fruits and vegetables sold at retail over the past several decades, consider problems associated with inferences drawn from the CPI, and then calculate and compare the annual average rate of price change for 15 foods.

Why Is It Difficult To Say Whether Relative Prices Have Changed?

Price comparisons for foods at different times would be meaningful and the issue of whether healthy and unhealthy food prices have diverged would be easily resolved if the foods being priced remained the same. Significant changes have occurred in the quality of foods sold (Davis and Stewart, 2003; Variyam, 2005).[2] New attributes are constantly being added to foods sold at retail, so many foods are not the same product from one year to the next.

[2]Annual new food product introductions ranged from 9,000-17,000 from 1990-2000 (Harris, 2002).

Consumers have more choices throughout the store. This is true for foods for which dieticians and nutritionists usually urge moderation, such as calorie-dense desserts and snack foods, as well as for foods usually recognized as healthy, such as fresh fruits and vegetables. Kaufman and others (2000) note that through the 1980s and 1990s, produce departments expanded in size. Produce departments took over larger shares of grocery store space, even as supermarkets became larger to accommodate additional departments such as service meat and seafood, prepared foods, and deli items. From 1987-97, produce departments nearly doubled the number of items sold (stockkeeping units), "…primarily to meet consumers' demands for added convenience, healthy diets, and gourmet and ethnic items." (p. 3)

Fruit and vegetable products that have only recently been offered for sale may be more expensive because they contain more value-added services. In fact, value added through transportation, processing, wholesaling, and retailing has grown to account for about three-fourths of the retail price of fruits and vegetables, on average, compared with about two-thirds in the early 1980s (Stewart, 2006). These services serve two purposes: increased convenience and variety.

Changing Produce Quality: Fruits and Vegetables Are More Convenient To Eat

Grocery store freezer cases increasingly contain partially or nearly prepared foods. Many grocery stores offer completely prepared foods to take away and some have added restaurants. In effect, retailers are selling items better described as meals than as foods. They are bundling foods with kitchen work the consumer would otherwise have to do.

Many newer fresh fruit and vegetable products have grown in popularity and now account for a significant portion of what households spend on produce. Table 1 shows expenditure shares for three types of vegetables that are partially or fully prepared. Partially or fully prepared spinach (such as washed and bagged spinach products), for example, accounted for 65 percent of what households spent at supermarkets and other retail foodstores for fresh spinach in 2003. Only 35 percent of consumers' expenditures on fresh spinach went to traditional, bunch spinach in 2003. Similarly, florets, crowns, chips, and other cut products accounted for 52 percent of spending on broccoli. And, finally, baby carrots, sticks, and other types of peeled and cut carrots accounted for 69 percent of households' expenditures for fresh

Table 1

New products account for a significant share of household expenditures for fresh produce[1]

Vegetable	Partially or fully prepared products' share of total spending
Broccoli[2]	52%
Carrots[3]	69%
Spinach[4]	65%

[1]The panel is a sample of 8,833 U.S. households that reported all of their grocery purchases at retail stores, including a detailed product description and quantity purchased.
[2]Total broccoli expenditures include spending for traditional heads as well for florets, crowns, chips, and other cut products. Excluded are products mixed with other vegetables like carrots and cauliflower. Thus, the expenditure share is underestimated.
[3]Total carrot expenditures include spending for the traditional product—unpeeled carrots with tops—as well as spending for baby carrots, peeled carrots, and shredded carrots. Excluded are cut carrots mixed with other vegetables like broccoli and cauliflower. Thus, the expenditure share is underestimated.
[4]To estimate the percentage, we first calculated the ratio of spending on traditional, bunch spinach with stems to total spinach spending. We then subtracted this ratio from one. Total spinach expenditures include spending for the traditional product—bunch spinach with stems—as well as for newer, more convenient products like bagged and washed leaf spinach. Excluded from the calculations are leaf spinach products mixed with other vegetables in a bagged salad. Thus, the expenditure share is underestimated.

Source: Calculated from Nielsen Homescan panel, 2003.

carrots. Mass marketing of these partially or fully prepared products began in the early 1990s. Clearly, many Americans purchase (and can afford) fresh products that require less cutting, chopping, peeling, and washing than traditional products.

Prices of partially prepared or ready-to-eat vegetables may be more expensive than unprepared vegetables. The price difference can be as large as the value consumers assign to what would otherwise be their own kitchen work. The added cost of washing, peeling, chopping, cutting, mixing, and bagging is incurred by marketers and, presumably, passed on to consumers in the form of higher prices. It is also possible that costs for these services might rise at a different rate than costs for the underlying agricultural commodity. For example, if processing costs and other marketing services have risen faster than farm prices, it would follow that retail prices may rise faster for value-added food than for more traditional (less value-added) fruits and vegetables.

It would not be very informative to compare the average price of carrots in 1980 with current average prices because 69 percent of current expenditures are for carrots that include washing, chopping, and peeling services. On average, the old and the new product are distinctly different.

Changing Produce Quality: Fruits and Vegetables Come in Greater Year-Round Variety

Although less abrupt than the 1990s introduction of bagged fresh vegetables, the variety of fruits and vegetables available to consumers has been increasing. Fruit and vegetable choices have increased as seasons disappear from retail grocery stores. Fruit and vegetable production is seasonal, but

plant breeders have long sought to breed varieties that yield crops that can be marketed early when supplies are typically short and prices high. Their successes are incremental but numerous. Improvements in storage technology have also made it possible to extend marketing seasons, as inventories can be carried longer. Improvements in transportation technology have made it possible to move produce from where it is in season, domestically or overseas, to where it is not.

Table 2 shows monthly U.S. city average retail prices for strawberries (dollars per dry pint deflated by the Consumer Price Index for all urban consumers, CPI-U). As also noted by Alston, Sumner, and Vosti (2006), in the early 1980s, BLS surveyors found strawberries often enough to report prices for 3-5 months during the spring each year. Presumably, outside spring months, sellers could supply strawberries only at prices above what consumers were willing and able to pay. In recent years, prices were reported all 12 months. Having strawberries available 12 months a year rather than just 3 months is clearly a quality improvement. Expanding access to strawberries during seasons other than spring means nonspring prices have fallen from levels few could afford to prices that many willingly pay. Other fruits and vegetables have undergone the same transformation. Strawberries are one of the more recent to do so. Such increases in access diversify consumers' diets.

Table 2

Average monthly retail prices for strawberries—U.S. city average ($1982-84)[1]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980				0.806	0.743	0.798						
1981			1.001	0.774	0.709	0.768	0.841					
1982			1.075	0.963	0.762	0.802	0.795					
1983				0.738	0.714	0.756	0.864					
1984			0.889	0.643	0.627	0.752	0.794	0.902				
1985			0.955	0.757	0.602	0.719	0.847					
1986			0.585	0.734	0.659	0.767	0.821	0.985				
1987				0.831	0.729	0.841	0.941	0.899				
1988			1.014	0.592	0.782	0.794	0.894	0.816	1.015			
1989			0.996	0.785	0.671	0.850	0.898	0.791	0.870			
1990		1.280	1.040	0.860	0.604	0.760	0.740	0.821	0.912			
1991		1.088	0.939	0.822	0.720	0.679	0.696	0.704	0.739	0.753		
1992		1.032	0.842	0.688	0.595	0.748	0.703	0.841	1.042	0.839		
1993		1.025	0.877	0.631	0.606	0.738	0.702	0.738	0.793	0.865		
1994		0.898	0.857	0.617	0.666	0.707	0.731	0.744	0.809	0.860		
1995		1.276	0.885	0.659	0.749	0.774	0.793	0.914	0.884	0.856		
1996	1.096	0.972	0.794	0.692	0.611	0.782	0.794	0.740	0.900	0.890		
1997		0.949	0.823	0.736	0.670	0.757	0.862	0.855	0.923		1.024	
1998	1.321	1.285	1.080	0.993	0.851	0.867	0.825	0.890	0.898	1.085		
1999		1.278	1.188	1.054	0.854	0.897	0.825	0.932	1.000	0.989	1.157	
2000	1.284	1.140	1.066	0.846	0.710	0.689	0.721	0.731	0.815	0.930		
2001		1.217	1.141	0.982	0.834	0.823	0.837	0.917	1.075	1.123	1.205	1.430
2002	1.411	1.202	1.086	0.863	0.849	0.863	0.858	0.938	1.035	1.039	1.227	
2003		1.176	1.016	0.959	0.914	0.854	0.966	0.997	1.072	1.214	1.306	
2004	1.340	1.252	1.133	0.884	0.884	0.974	0.860	0.959	0.971	1.362	1.668	1.893
2005	1.696	1.223	0.971	0.784	0.888	0.906	0.925	0.920	1.079	1.098	1.136	1.355
2006	1.216	0.997	0.909	0.848	0.856	0.813	0.864	0.885	0.995	1.192	1.147	1.437

[1]Prices (dollars per dry pint, per 12 oz.) have been adjusted for inflation using the CPI-U for all items. A blank cell indicates BLS did not provide a price in that month.

Source: U.S. Department of Labor, Bureau of Labor Statistics, U.S. city average price data and CPI-U.

It is meaningless to compare prices at different times when an unhealthy food with unchanging quality is compared to a fresh fruit or vegetable that has become available in formerly out-of-season months. Changing relative prices might indicate changing price incentives to choose a healthy diet or might indicate that better quality produce is being marketed. It is impossible to exclude either possibility.

Further, some price statistics mask the benefits consumers realize from reduced seasonality and give the impression that fruits and vegetables are becoming more expensive. For example, reducing seasonality could make the average annual strawberry price higher than it would be in the absence of quality increases. The pattern of prices in table 2 shows that, during the course of a year, the first and last reported strawberry prices are typically higher than spring prices. That is, retail prices for strawberries are typically higher at a season's margin than at the height of the season. The difference may reflect shorter supply at the margin as well as the increased cost of transportation.[3] Making strawberries available outside of spring months requires more attention to packaging, transporting fruit longer distances, and establishing new supply chains. All these changes add to the cost of making strawberries available at retail stores and raise retail prices.

Extending the marketing season means that tabulated average annual prices are higher than they otherwise would be if strawberries were available only in the spring. The price, however, is higher because consumers are eating foods that used to be largely unavailable. Rates of annual price inflation may also differ because strawberries at the season's margin embody more marketing inputs whose costs may rise independently of spring strawberry prices.

[3]For less fragile commodities, the difference could also include the cost of carrying inventories.

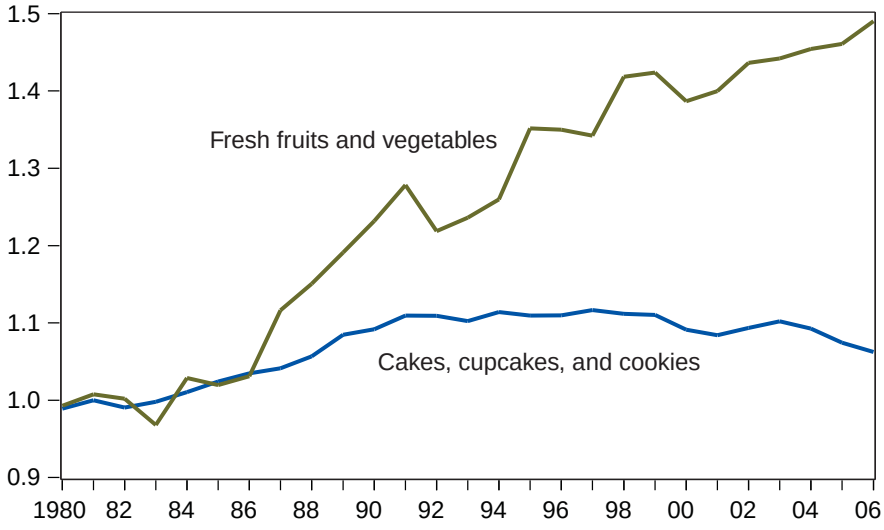
Price Indices May Not Adequately Account for Quality Change

The standard method for analyzing price trends examines movements in price indices. BLS constructs price indices, the CPI, and indices of a wide variety of goods precisely so price trends can be examined and changes in relative prices over time may be measured. One such index, the food and beverage price index, is built from a variety of food-related indices. These include the index for fresh fruits and vegetables, among others.

BLS calculates the CPI from month-to-month movements in price changes for a sample of goods and services. This sample reflects the consumption sector of the U.S. economy and includes tens of thousands of items bought for day-to-day living. The importance of any particular good or service is proportional to the share of total consumer spending represented by that item. That is, monthly movements in the CPI are derived from weighted averages of monthly price changes of the sampled items. For example, frequently purchased fresh fruit and vegetable products, such as baby carrots and bagged spinach, are likely to be among items underlying the CPI. Over time, these products have accounted for a larger share of consumers' expenditures on fresh fruits and vegetables (starting from zero in the early 1990s). Price changes in these items would now have a greater effect on the CPI for fresh fruits and vegetables than in early years.

Two food-related indices are shown in figure 1, the index for fresh fruits and vegetables—generally recognized as healthy food—and the index for cakes, cupcakes, and cookies—recognized as foods that should be consumed in moderation. Both indices are presented relative to the CPI for all goods (for urban consumers). Displaying the indices relative to the CPI for all goods shows how prices for the two classes of foods have changed relative to everything else consumers purchase.

Figure 1
Consumer price index for fresh fruits and vegetables and consumer price index for cakes, cupcakes, and cookies (both relative to CPI-U for all items)



Source: BLS Consumer Price Index-All Urban Consumers data.

The line plots clearly show that, compared with all other goods purchased, Americans are paying relatively more for fresh fruits and vegetables now than they did 27 years ago. The indices were constructed so they would each equal 100 during the 1982-84 base period. Over the course of 27 years, the fresh fruits and vegetables index rose 49 percent. By contrast, the price index for cakes, cupcakes, and cookies increased until the early 1990s, and then decreased, leaving it 6 percent higher in 2006 than in 1980. In 2006, the fresh fruits and vegetables index stood 40 percent higher than the index for cakes, cupcakes, and cookies. The graph suggests that prices for healthy fresh fruits and vegetables are diverging from those for less healthy cakes, cupcakes, and cookies.

However, the CPI is widely believed to overstate the rate of inflation over much of the time period shown in figure 1. That is, prices have not risen as fast as the CPI suggests. The degree to which the CPI accounts for the value consumers place on quality improvements is among the reasons posited for this problem. Quality changes could be problematic for many food-related indices, such as that for cakes, cupcakes, and cookies. But, among foods, the fresh fruits and vegetables index is believed to be the component most likely to overstate price increases (see "Appendix: CPI Overstates the Rate of Increase in Food Prices, Especially for Fresh Fruits and Vegetables").

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 shortrun event, the longrun 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.

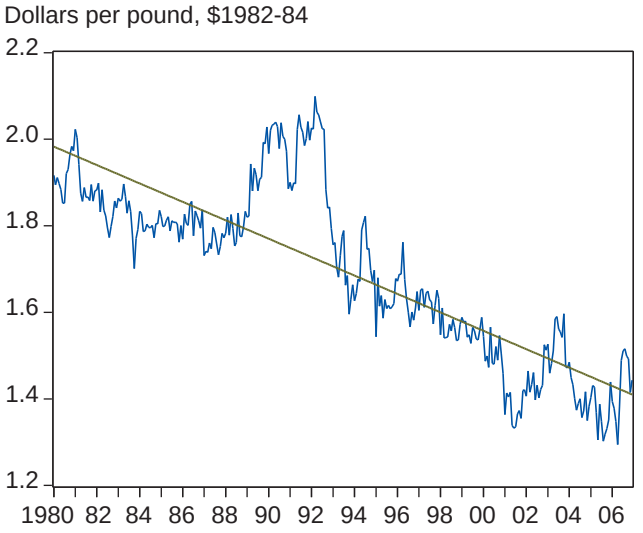
[4]Many of the price observations incorporated into BLS average price data are likely to come from nontraditional, "big box" outlets. It follows that a decrease (increase) in average prices over time does not necessarily mean that the same items are available at traditional retail outlets for less (more)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

[5]The 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 $12(\exp(\beta_1)-1)$.

[6]The 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 longrun 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

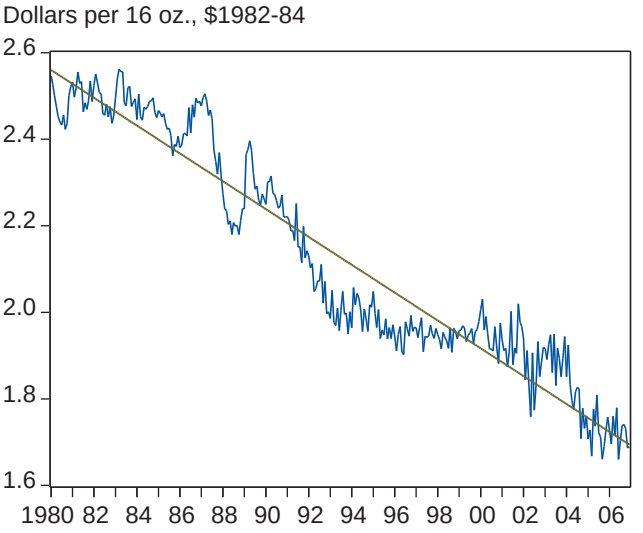
Chocolate chip cookies: inflation-adjusted prices and trendline



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

Figure 3

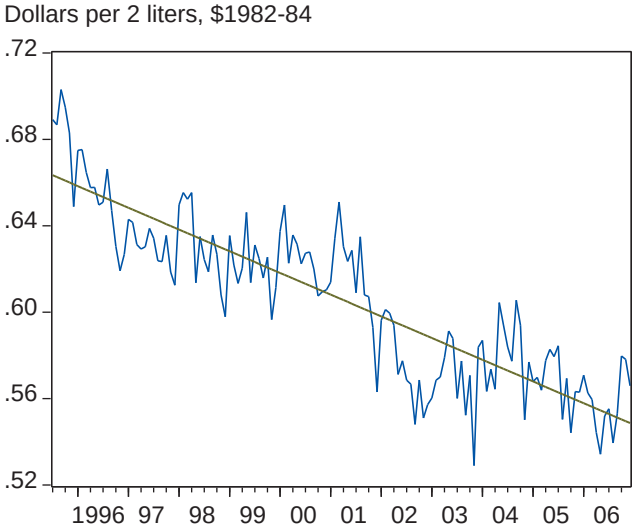
Potato chips: inflation-adjusted prices and trendline



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

Figure 4

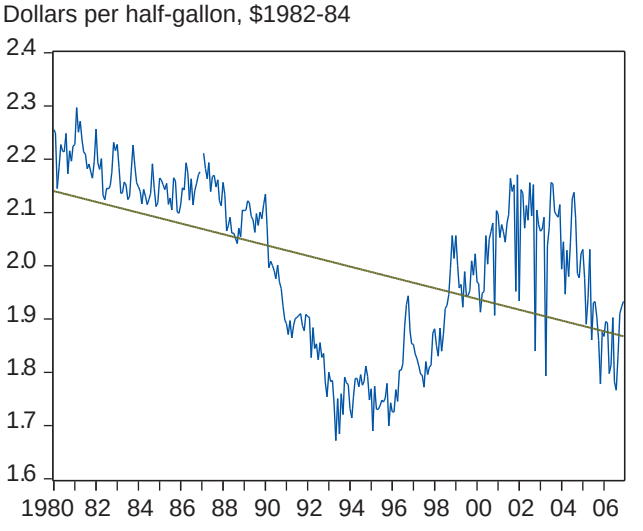
Cola (nondiet): inflation-adjusted prices and trendline



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.

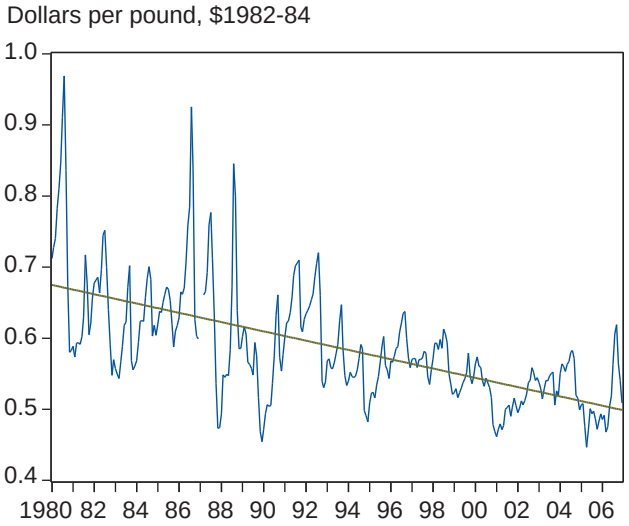
[7]BLS resumed publishing average prices for almost all of these foods in 2006.

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

[9]BLS 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

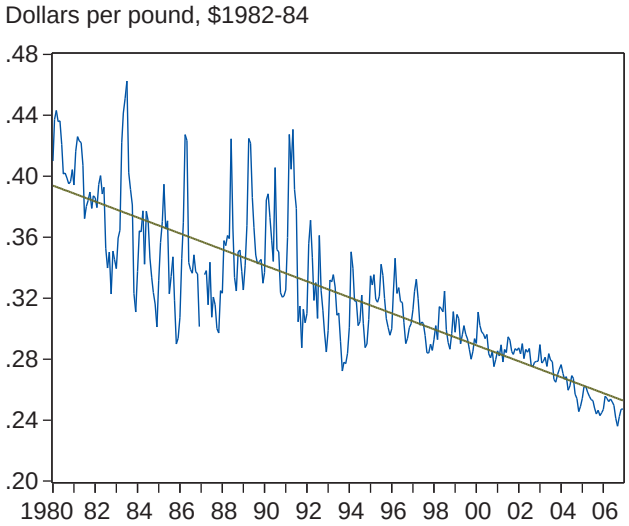
Apples (Red Delicious): inflation-adjusted prices and trendline



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

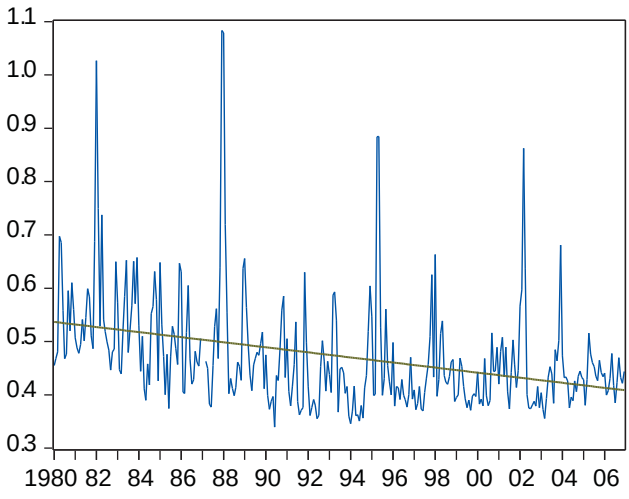
Bananas: inflation-adjusted prices and trendline



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

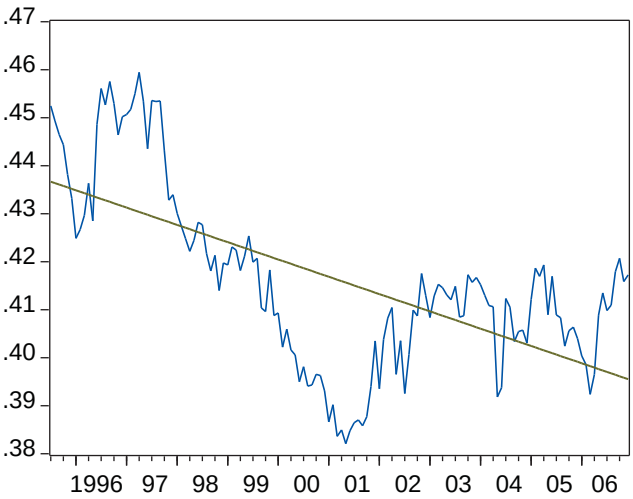
Lettuce (Iceberg): inflation-adjusted prices and trendline



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

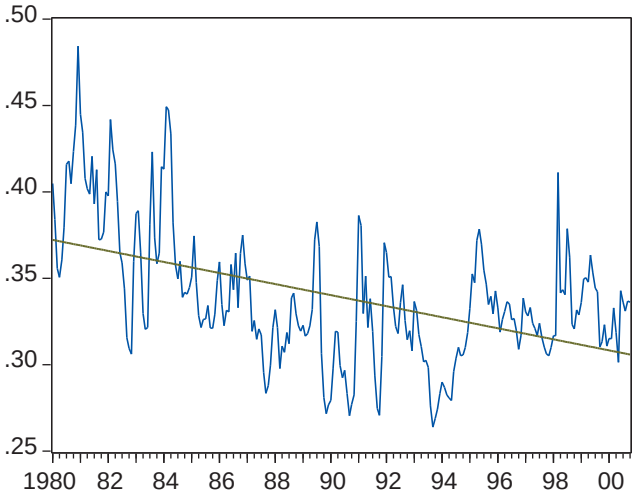


Source: BLS U.S. city average price data and CPI-U. BLS began reporting dry bean prices in 1995.

Figure 10

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

Dollars per pound, $1982-84

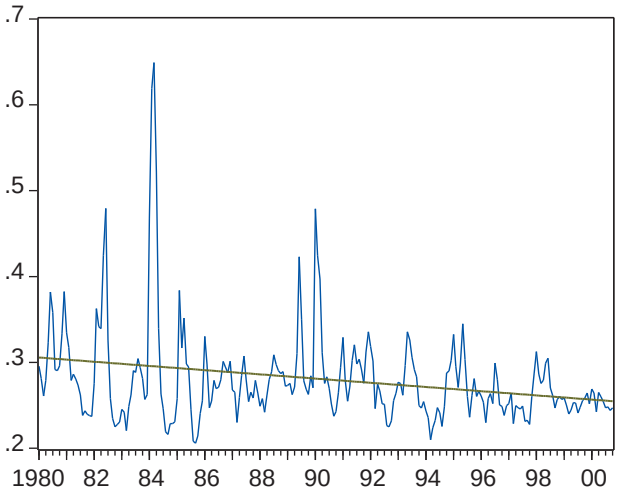


Source: BLS U.S. city average price data and CPI-U. BLS suspended reporting carrot prices in 2000.

Figure 11

Cabbage: inflation-adjusted prices and trendline

Dollars per pound, $1982-84

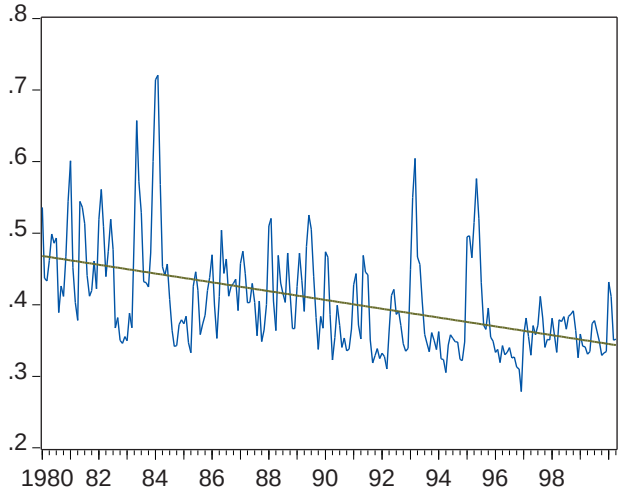


Source: BLS U.S. city average price data and CPI-U. BLS suspended reporting cabbage prices in 2000.

Figure 12

Celery: inflation-adjusted prices and trendline

Dollars per pound, $1982-84

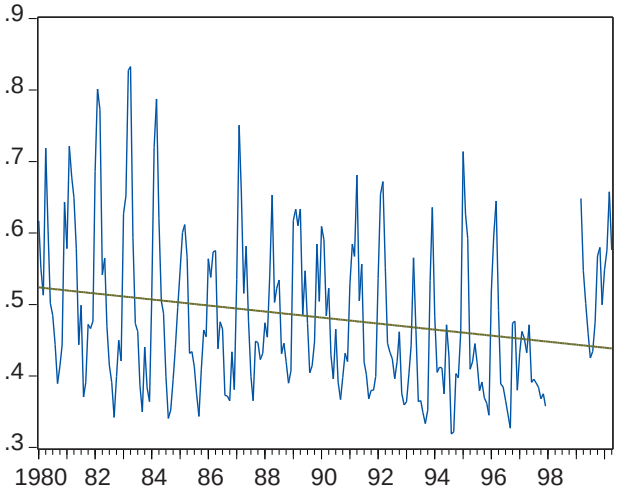


Source: BLS U.S. city average price data and CPI-U. BLS suspended reporting celery prices in 2000.

Figure 13

Cucumbers: inflation-adjusted prices and trendline

Dollars per pound, $1982-84

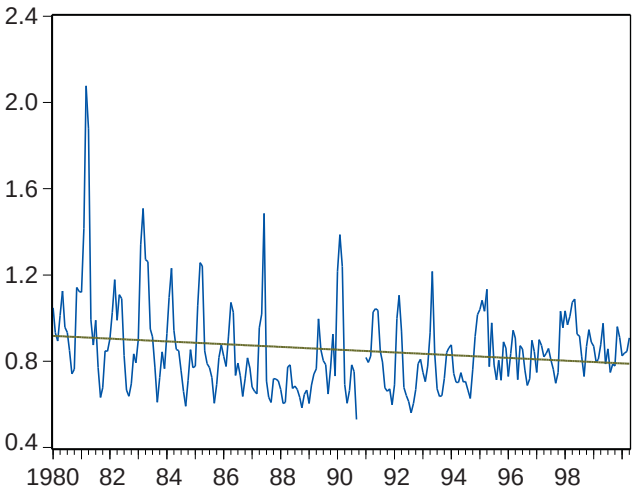


Source: BLS U.S. city average price data and CPI-U. BLS suspended reporting celery prices in 2000. Missing values reflect months in which BLS did not report a cucumber price.

Figure 14

Peppers (sweet): inflation-adjusted prices and trendline

Dollars per pound, $1982-84

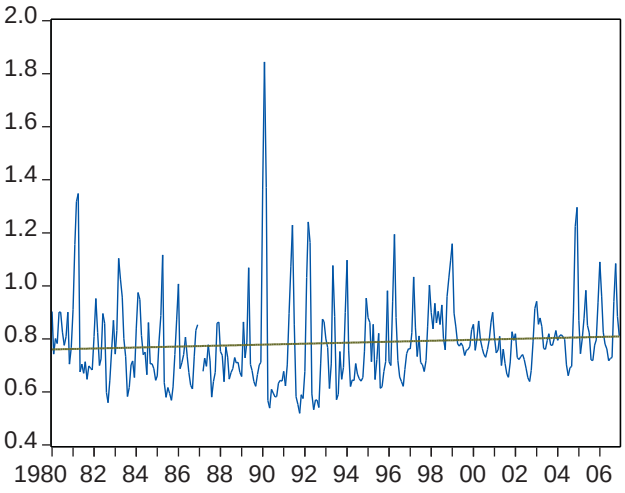


Source: BLS U.S. city average price data and CPI-U. BLS suspended reporting pepper prices in 2000. Missing values reflect months in which BLS did not report a pepper price.

Figure 15

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

Dollars per pound, $1982-84

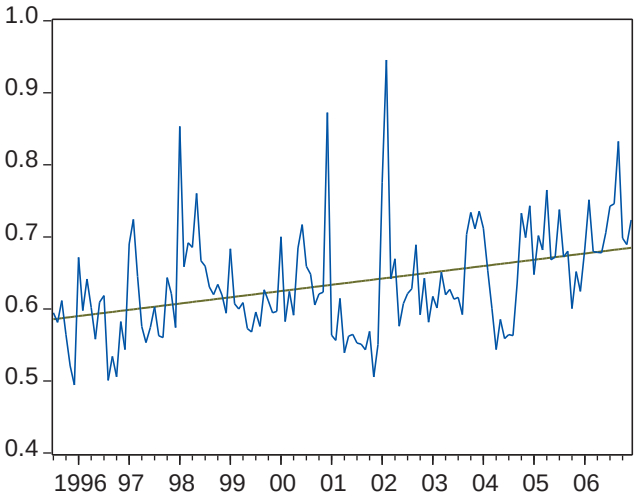


Source: BLS U.S. city average price data and CPI-U. Missing values reflect months in which BLS did not report a tomato price.

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.

Conclusions

Food attributes change over time, making price comparisons at different times difficult to interpret. Thus, to definitively answer whether changing relative prices of healthy and unhealthy foods are responsible for Americans' current weight problems is an impossible task. For commonly consumed fresh fruits and vegetables for which quality has remained fairly constant, analysis of price trends reveals price declines similar to those of dessert and snack foods.

A healthy diet might include only a subset of fresh fruits and vegetables. A healthy diet could conceivably be composed of fresh fruits and vegetables that are not partially or fully prepared. Such a diet might include fruits and vegetables that have been on the market for many years, without changes in seasonal availability. In effect, a healthy diet might be exactly what was available to consumers years ago, without changes in quality. Thus, the price trend evidence suggests that the price of a healthy diet has not changed relative to an unhealthy one, although a healthy diet might not include every fresh fruit or vegetable currently available.

Fresh fruits and vegetables that have undergone substantial quality change account for a growing share of produce sold by retailers. That limits our results, but also points to the widespread benefits of quality change. Product innovations have widespread benefits if the new products remain on the market. Most product innovations fail the test of the market and disappear quietly. Bagged, washed, and cut broccoli florets have met the test of the market: many consumers are willing to pay for the services embodied in these products and do so routinely. Also, December strawberries have survived the test of the market: many consumers are willing to pay the market price for strawberries in December even though the price must cover the cost of a more complex supply chain in December than in May.

Innovative fresh fruit and vegetable products may improve Americans' health if those products increase fruit and vegetable consumption. Bagged and washed vegetables might be more expensive than traditional products, and December strawberries might be more expensive than May strawberries. As long as consumers purchase innovative products, they must be getting more benefit from their expenditures than they did in the past—that is the only rational explanation for consumers' voluntarily altering their grocery purchases. Products that reduce time devoted to kitchen labor pay for themselves, for some consumers. Many consumers value additional fresh fruit and vegetable choices in winter months. Offering consumers ever-larger benefits above what they are willing to pay should induce them to add to the quantity of fresh fruits and vegetables in their diets. Despite rising inflation-adjusted prices for broccoli and strawberries, in recent years Americans have been consuming more of both (U.S. Department of Agriculture, Economic Research Service, 2007).

Of course, some households may be unwilling to pay for additional convenience or for products to be available year round. Lower income households might select foods primarily on the basis of price. If so, the benefits to these households of quality change are less certain. We might expect lower

income households to concentrate their purchases on more traditional produce, and therefore not realize any benefits from quality change. However, even if value-added produce, measured in pounds, is generally more expensive to buy than traditional produce, value-added produce may still be less expensive to eat on a per-serving basis. In the case of broccoli, some consumers may treat stems as a waste product. Florets may be cheaper to consume on a per serving basis if the consumer discards the stem (Reed, Frazao, and Istokowitz, 2004).

Future research and debate over the costliness of healthy foods needs to focus on whether low-income households share in the benefits provided by foods that are more convenient and more readily available. These foods can appear more expensive, but may not be so.

References

Alston, Julian M., Daniel A. Sumner, and Stephen A. Vosti. "Are Agricultural Policies Making Us Fat? Likely Links between Agricultural Policies and Human Nutrition and Obesity, and Their Policy Implications," *Review of Agricultural Economics,* 28(2006):313-322.

Boskin, Michael J., E. Dulberger, R. Gordon, Z. Griliches, and D. Jorgenson. *Toward a More Accurate Measure of the Cost of Living*, Final report to the Senate Finance Committee, December 4, 1996. Available at http://www.ssa.gov/history/reports/boskinrpt.html.

Brownell, Kelly D., and Katherine Battle Horgen. *Food Fight: The Inside Story of the Food Industry, America's Obesity Crisis, and What We Can Do About It,* New York: The McGraw-Hill Companies, 2004.

Cook, Roberta, and Linda Calvin. *Greenhouse Tomatoes Change the Dynamics of the North American Fresh Tomato Industry*, Economic Research Report Number 2, April 2005, U.S. Department of Agriculture, Economic Research Service. Available at http://www.ers.usda.gov/Publications/ERR2/.

Davis, David E., and Hayden Stewart. "Changing Consumer Demands Create Opportunities for U.S. Food System," *FoodReview*, Volume 25, Issue 1, Spring 2002, U.S. Department of Agriculture, Economic Research Service. Available at http://www.ers.usda.gov/publications/FoodReview/May2002/frvol25i1d.pdf.

Drewnowski, Adam, and Nicole Darmon. "Food Choices and Diet Costs: An Economic Analysis," *Journal of Nutrition,* 135(2005):900-04.

Flegal, Katherine M., et al. "Prevalence and Trends in Obesity Among US Adults, 1999-2000," *Journal of the American Medical Association,* 288(2002):1723-1727.

Gordon, Robert J. "The Boskin Commission Report: A Retrospective One Decade Later," *International Productivity Monitor*, Number 12, Spring (2006):7-22.

Gordon, Robert J., and Zvi Griliches. "Quality Change and New Products," *American Economic Review,* 87(1997):84-88.

Harris, J. Michael. "New Food Product Introductions Continue to Decline," *FoodReview*, Volume 25, Issue 1, Spring 2002, U.S. Department of Agriculture, Economic Research Service.

Hausman, Jerry. "Sources of Bias and Solutions to Bias in the Consumer Price Index," *The Journal of Economic Perspectives,* 17(Winter, 2003):23-44.

Hedley, Allison A., et al. "Prevalence of Overweight and Obesity Among U.S. Children, Adolescents, and Adults, 1999-2002," *Journal of the American Medical Association,* 291(2004):2847-2850.

Kaufman, Phil R., et al. *Understanding the Dynamics of Produce Markets: Consumption and Consolidation Grow*, Agriculture Information Bulletin Number 758, August 2000, U.S. Department of Agriculture, Economic Research Service. Available at http://www.ers.usda.gov/publications/aib758/.

Leibtag, Ephraim. *The Impact of Big-Box Stores on Retail Food Prices and the Consumer Price Index*, Economic Research Report Number 33, December 2006, U.S. Department of Agriculture, Economic Research Service. Available at http://www.ers.usda.gov/Publications/ERR33/.

Moulton, Brent R., and Karin E. Moses. "Addressing the Quality Change Issue in the Consumer Price Index," *Brookings Papers on Economic Activity*, 28, Number 1, (1997):305-49.

Perez, Agnes, and Susan Pollack. *Fruit and Tree Nuts Outlook*, FTS-329, Sept. 26, 2007, U.S. Department of Agriculture, Economic Research Service. Available at http://www.ers.usda.gov/Publications/FTS/2007/09Sep/FTS329.pdf.

Putnam, Judith Jones, and Jane E. Allshouse. *Food Consumption, Prices, and Expenditures, 1970-97*, Statistical Bulletin Number 965, April 1999, U.S. Department of Agriculture, Economic Research Service. Available at http://www.ers.usda.gov/publications/sb965/.

Reed, Jane, Elizabeth Frazão, and Rachel Itskowitz. *How Much Do Americans Pay for Fruits and Vegetables?* Agriculture Information Bulletin Number 790, July 2004, U.S. Department of Agriculture, Economic Research Service. Available at http://www.ers.usda.gov/publications/aib790/.

Reinsdorf, Marshall. "The Effect of Outlet Price Differentials on the U.S. Consumer Price Index," *Price Measurements and Their Uses* (Murray F. Foss, Marilyn E. Manser, and Allan H. Young, eds.), Chicago, University of Chicago Press, 1993.

Reinsdorf, Marshall B., and Brent R. Moulton. "The Construction of Basic Components of Cost-of-Living Indexes," *The Economics of New Goods* (Timothy F. Bresnahan and Robert J. Gordon, eds.) Chicago, University of Chicago Press, 1997.

Stewart, Hayden. *How Low Has the Farm Share of Retail Food Prices Really Fallen?* Economic Research Report Number 24, August 2006, U.S. Department of Agriculture, Economic Research Service. Available at http://www.ers.usda.gov/publications/err24/.

Stewart, Kenneth J., and Stephen B. Reed. "CPI Research Series Using Current Methods, 1978-98," *Monthly Labor Review*, 122, Number 6, (June 1999):29-38.

U.S. Department of Agriculture, Economic Research Service. *Tomatoes—Briefing Room*, updated February 27, 2007. Available at http://www.ers.usda.gov/briefing/tomatoes/.

U.S. Department of Agriculture, Economic Research Service. *Food Consumption (Per Capita) Data System*, updated February 15, 2007. Available at http://www.ers.usda.gov/data/FoodConsumption/.

U.S. Department of Health and Human Service and U.S. Department of Agriculture. *Dietary Guidelines for Americans, 2005*, 6th Edition.

U.S. Department of Labor, Bureau of Labor Statistics (2007). *BLS Handbook of Methods*, Chapter 17. Available at http://www.bls.gov/opub/hom/pdf/homch17.pdf.

Variyam, Jayachandran N. "The Price is Right: Economics and the Rise of Obesity," *Amber Waves*, Volume 3, Issue 1, February 2005, U.S. Department of Agriculture, Economic Research Service. Available at http://www.ers.usda.gov/AmberWaves/February05/Features/ThePriceIsRight.htm.

Appendix: CPI Overstates the Rate of Increase in Food Prices, Especially for Fresh Fruits and Vegetables

The CPI may not definitively answer how food prices trended over the past several decades. The CPI overstates the rate of price inflation as compared with what a true cost-of-living index would have reported.[10] In the mid-1990s, the Boskin Commission, an advisory commission, was appointed by the Senate Finance Committee to study the role of the CPI in government benefit programs and recommend needed changes to the CPI. The Commission's December 1996 report estimated the CPI overstated the annual rate of inflation by 1.1 percent. Moreover, not all food groups appear to have been equally affected.

Economic research points to several reasons why the CPI was biased over this time period.[11] One source of CPI bias was the formula used by the BLS to calculate the rate of price change for commodities.[12] Following an example in the Boskin Commission Report (Boskin et al., 1996), suppose that the price of beef was $1.00 in January, but increased to $1.60 in February. We would have observed a 60-percent price increase for February. If the price fell back to $1.00 in March, we would observe only a 37.5-percent price decline. By the formula it previously used, BLS would have determined the average rate of price change from February to March to have been 11.25 percent (i.e., 60 percent minus 37.5 percent divided by 2 months), even though prices were the same at the beginning and end of the period. This particular problem was resolved when BLS changed its formula in January 1999.

Though the rate of price change formula has since been corrected, Reinsdorf and Moulton (1997) show that problems with the formula previously used by BLS did not affect all food indices equally. They re-estimated rates of inflation using two different formulas. The first formula reflected BLS methodology at the time. The second corrected for oscillating prices, as well as for other types of bias associated with the first formula. Reinsdorf and Moulton (1997) found that formula bias impacted the index for fresh fruits and vegetables more than price indices for other types of food. They believed that prices for fresh fruits and vegetables tend to be more volatile than those for other foods.

A more controversial question is whether quality changes have also contributed to the upward bias in the CPI. The Boskin Commission argued that quality and new product bias accounted for about half of the overall bias in the CPI (Boskin et al., 1996; Gordon and Griliches, 1997; Gordon, 2006).[13]

Moulton and Moses (1997) argued that the Boskin Commission's estimate of the rate of quality bias was too high. Consider that BLS prices tens of thousands of products. The goods and services comprising its sample are not constant. BLS rotates products in and out of the sample according to a pre-planned schedule. Also, items being priced may be unexpectedly discon-

[10]The objective of the CPI is to approximate a cost-of-living index. For example, if we compare the cost of living this year against that of a past year, the CPI should measure how much more (or less) households need to spend in order to achieve the same level of utility (well-being) as they did in the previous year (e.g., Bureau of Labor Statistics, 2007).

[11]The BLS defines bias as differences between the CPI and what a true cost-of-living index would report (Bureau of Labor Statistics, 2007).

[12]This occurred at the lower level of index construction, meaning that BLS would later aggregate these price changes to calculate changes in the overall CPI.

[13]The CPI was estimated to have overstated the rate of inflation by 0.60 percent due to quality and new product bias alone.

tinued or become permanently unavailable and need to be replaced. Rotating and replacing products is problematic if the products entering the sample are different in quality from the goods they replace. For example, imagine that a bag of ready-to-eat baby carrots replaces a bag of traditional, unpeeled and uncut carrots. The former is typically more expensive per pound. Moulton and Moses (1997) argued that BLS would take appropriate steps to separate out how much of the price increase is due to quality change rather than actual price inflation. The BLS could assume the difference in price between the two goods to be explained by a difference in quality. If the price of baby carrots in a prior month were available, for example, it might then compare the price of baby carrots in the current month against the historical price, not against the price of traditional, unpeeled, uncut carrots.

Despite the best efforts of BLS analysts, however, when an older product is replaced by an entirely new product, the potential for bias remains. Gordon and Griliches (1997) argued that the CPI will be biased if the new product is superior in quality to the older product by more than the differential in price between the two. Applying this same logic to our carrot example, we would expect the benefit provided to households by ready-to-eat baby carrots to exceed the cost differential between them and the traditional product. If this were not true, it would be hard to explain why the more expensive, value-added product has grown in popularity.[14] When entirely new products are introduced and gain market share, households typically enjoy large increases in welfare above the higher prices they pay for those new products (Hausman, 2003). Hausman argued BLS needs to incorporate these large welfare changes into its calculations for the CPI to more closely approximate a true cost-of-living index.[15]

New product and quality bias might also have affected the CPI for fresh fruits and vegetables more than indices for other foods. The Boskin Commission Report and Gordon and Griliches (1997) put the annual rate of new product and quality bias for fruits and vegetables at twice that for other foods.

Since the late 1990s, the BLS has worked to improve the CPI (Stewart and Reed, 1999; U.S. Department of Labor, Bureau of Labor Statistics, 2007). Aside from the ongoing debate over quality change, the CPI may provide a better estimate of future relative price changes. Our focus, however, is retrospective. We want to examine how relative prices have changed since 1980.

[14]Otherwise, there would be no increase in consumer surplus and households would be indifferent between buying traditional carrots and the newer ready-to-eat product.

[15]If households are obtaining greater utility from newer goods than BLS analysts assume, the CPI could be measuring how a household's expenditures need to change for that household to buy baskets of goods and services providing greater-and-greater utility. The CPI would not then approximate a cost-of-living index.