Office of the Chief Economist

U.S. DEPARTMENT OF AGRICULTURE

Agricultural Productivity, Food Prices, and Consumer Food Expenditures Long-Run Trends and Short-Run Movements

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Preliminary

U.S. Department of Agriculture
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Executive Summary

This paper examines agricultural productivity growth and its relationship to the Gross Domestic Product (GDP) and income, commodity prices, retail food prices, and domestic and international consumer food expenditures. The last portion of the paper examines how food prices and expenditures react in the short run to a massive shock to the economy and to the agricultural sector – specifically, coronavirus COVID-19 pandemic. Steady productivity growth in the United States is reflected by an increase in the production of staple commodities of over 400 percent between 1929 and 2017 and a simultaneous decrease in cropland area of 9 percent. As production has increased, food prices have fallen despite growing demand and limited cropland acres. Productivity growth in agriculture has supported economic expansion in other sectors of the economy and GDP growth. As a result of GDP growth, rising income and falling food prices, Americans spend less than other countries on food as a percent of household expenditures. The agricultural sector has shown resiliency in the face of the COVID-19 outbreak, as demonstrated by the relatively muted inflation in prices of food-for-home consumption, despite the massive economic shock to the overall economy associated with the outbreak and the significant increase in the portion of total food expenditures going to home consumption.

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Introduction

With the increase in economic wealth, led by the growing economy and fueled by continuing increases in agricultural productivity, has come the improved living standards experienced by developed economies. A key component of this improved living standard has been the continually falling share of income devoted to food. Specifically, the share of food in total U.S. economic activity and in total consumer expenditures has fallen steeply since the middle of the last century. Agricultural productivity growth has been high enough that real commodity prices and consumer food expenditure shares have also fallen. Prices have fallen despite U.S. agricultural land under cultivation changing relatively little over time and food demand growing with increasing population, both in the United States and abroad.

While comparisons across countries are difficult, available data suggests Americans are able to spend less of their income on food consumed at home compared to consumers in other countries. That allows Americans to spend more of their income on other goods and services.

This paper first introduces agricultural productivity growth and its relationship to Gross Domestic Product (GDP), then discusses commodity prices, retail food prices, and finally provides information on consumer food expenditures. Relevant comparisons to other countries are made throughout. Finally, food prices are addressed in the context of the COVID-19 pandemic. [1] [2]

Agricultural productivity growth in the United States

The economic transition fueled by agricultural productivity growth has been especially apparent in the United States. The share of agriculture in total U.S. economic activity has fallen steeply since the middle of the last century, dropping from 8 percent in 1948 to only 0.6 percent in 2018.[3] In 1929, approximately 6.3 million farms produced 105 million metric tons of crop and fiber, which fed and clothed 121 million Americans, and also people around the world via

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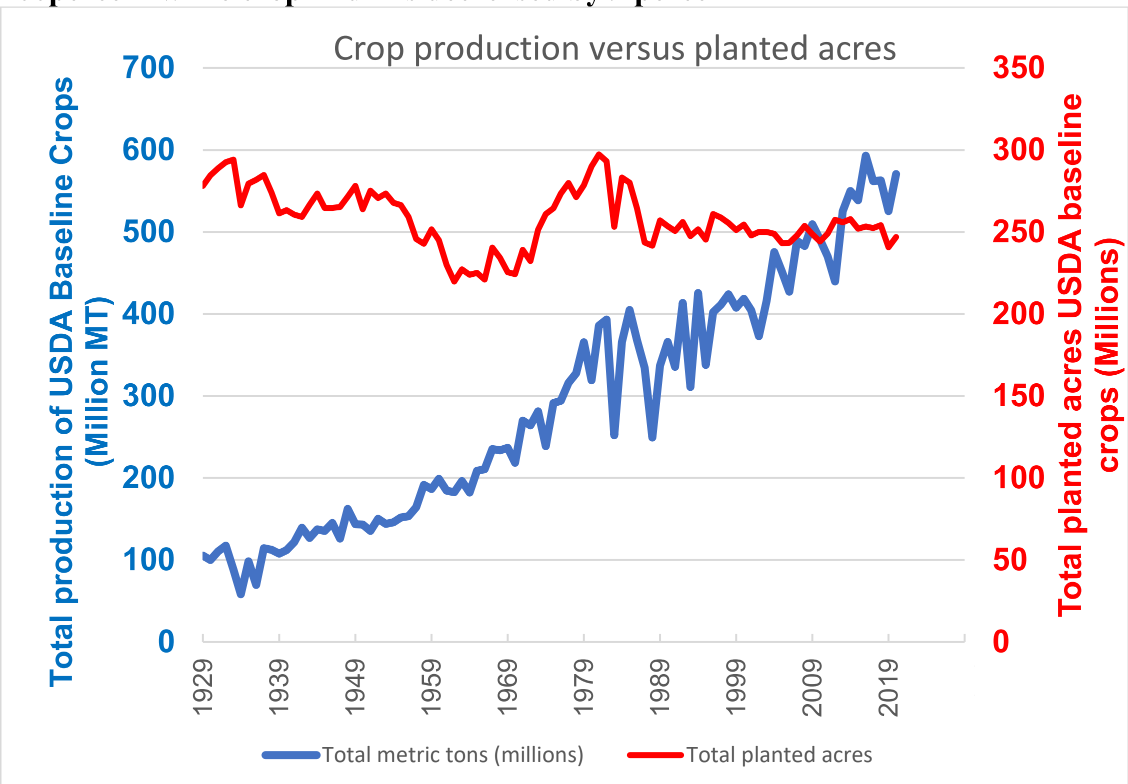
[1] The USDA, Office of the Chief Economist thanks Jayson Beckman, Patrick McLaughlin, and Eliana Zeballos of the USDA, Economic Research Service, and Gianna Short, formerly of the Economic Research Service, for their co-authorship, and Janet Perry of the Economic Research Service for her comments. For questions related to this paper, please contact Joseph Cooper, joseph.cooper@usda.gov (direct line 202-690-6066), or Robert Johansson, OCE Chief Economist, robert.johansson@usda.gov (main line 202-720-5955; main line 202-720-4164).

[2] This preliminary working paper is being released to stimulate discussion of agricultural productivity and consumer food costs. The preliminary findings and conclusions in this working paper are subject to change and do not necessarily represent any final position or policy of the USDA or the U.S. Government. The analysis, findings, and conclusions expressed in this working paper should not be attributed to IRI.

[3] The share is calculated from the Bureau of Economic Analysis' Table 1.35, "Gross Value Added by Sector" (Bureau of Economic Analysis, 2020). Note that the share of agricultural in GDP in the main text covers the direct value of the output of farming as categorized by the Bureau of Economic Analysis. However, the overall contribution of the agriculture sector to GDP is larger than this because sectors related to agriculture—forestry, fishing, and related activities; food, beverages, and tobacco products; textiles, apparel, and leather products; food and beverage stores; and food service, eating and drinking places—rely on agricultural inputs in order to contribute added value to the economy. Agriculture, food, and related industries contributed a 5.4-percent share of U.S. GDP in 2017 (ERS, 2019b).

exports.[4] In 2017, 2.0 million farms produced 561 million metric tons of crops – an increase of more than 400 percent on 9 percent fewer acres, feeding and clothing 330 million Americans and exporting food and fiber to help feed and clothe billions globally (see Figure 1).[5]

Figure 1. Between 1929 and 2017, U.S. production of staple commodities has increased by 400percent while cropland has decreased by 9 percent



Source: USDA, Office of the Chief Economist, using data from USDA, National Agricultural Statistics Service (NASS, 2020).
Notes: Crops in the USDA Agricultural Baseline are corn, sorghum, barley, oats, wheat, rice, soybeans, and cotton. The values for 2020 are NASS forecasts from August and September, 2020.

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[4] The number of farms in 1930 – the year closest to 1929 for which we have data on this statistic, is 6,288,648 (Bureau of the Census, 1930). Note that contemporary estimates of farm numbers are carried out by the USDA (NASS, 2017). The calculation of tons produced is by the USDA, Office of the Chief Economist, using annual survey of crop data from the USDA, National Agricultural Statistics Service (NASS, 2020). The U.S. population figure is from the Census Bureau (Census Bureau, 2019).

[5] USDA data shows that 25 percent of U.S. production of baseline crops (major row crops included in the annual USDA baseline projections) is exported (FAS, 2020b). This translates into an estimate of 110 million people abroad being fed and clothed by U.S. exports of those crops, assuming the same per capita consumption rates as in the United States. Much of the crop production included in this calculation is consumed indirectly through livestock and poultry. Because adding production of animal products to primary crops to develop a measure of total food production would represent double counting, we include only crops in our measure.

Behind those remarkable trends has been steady growth in U.S. agricultural productivity. USDA's index of total factor productivity for agriculture—a measure of output per unit of total inputs—is 4 times higher in 2017 than in 1929 (see Figure 2).[6]

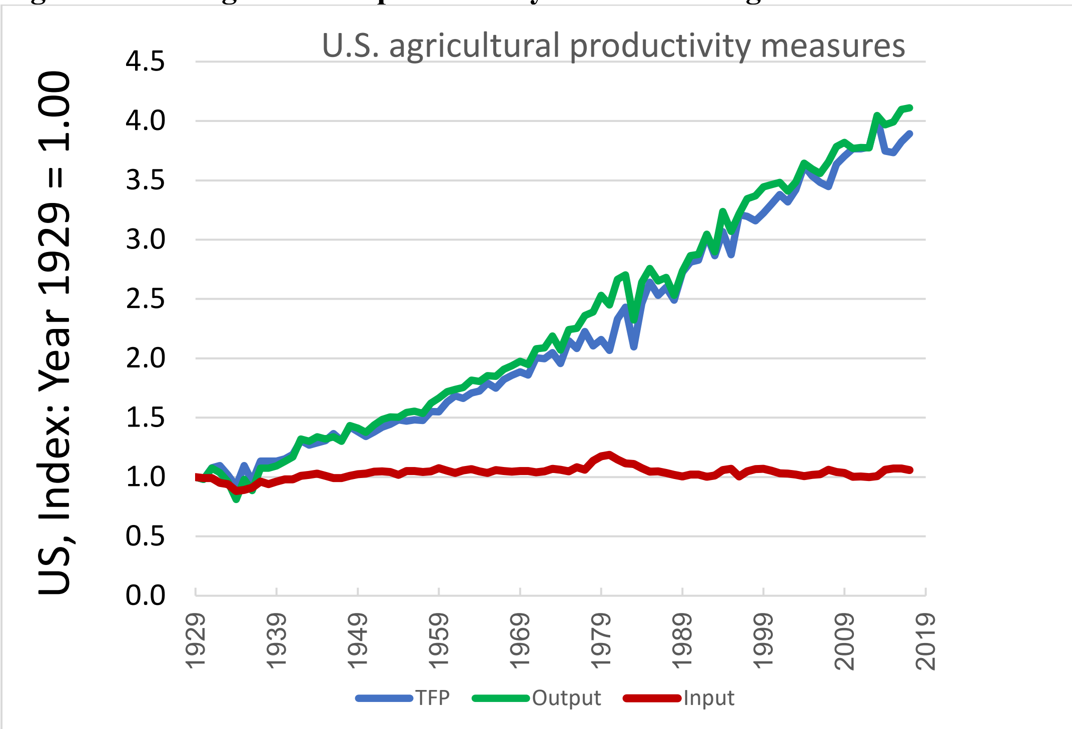
At the same time, the number of farms, farmers, and agricultural laborers needed for primary agricultural production in the United States has fallen dramatically, freeing up labor resources for other sectors of the economy. Between 1930 and 2017, the number of farms in the United States fell from 6.3 million to 2 million, and the number of farmers fell from 31 million to 3.4 million (acres in farms fell by 8.8 percent over this period).[7] [8] In other words, specialization and productivity gains in agriculture over the past 100 years have allowed the majority of Americans to use their time and labor on activities other than food production.

[6] Total factor productivity (TFP) is a broad measure of agricultural productivity performance. Unlike other commonly used productivity indicators like yield per acre (land productivity) or output per worker (labor productivity), TFP takes into account a much broader set of the inputs used in agricultural production. TFP compares all land, labor, capital, and material resources employed in agriculture to the sector's total crop and livestock output, and is calculated as the ratio of total agricultural output to total production inputs.

[7] The data for 1930 is from Table 1 of Bureau of Census (Census, 1930) and the data for 2017 is from Tables 1 and 52 of the Agricultural Census (NASS, 2017). Note that measures for farm populations have changed over time. The 2017 U.S. agricultural census measured "producers", which refers to persons involved in making decisions for the farm operation. In contrast, the 1930 Census measured "farm population", defined as all people living on farms, without regards to occupation. The definition of "farm" has changed as well. In 2017, a farm was "any place from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year." In 1930, a "farm" was "all the land which is directly farmed by one person, either by his own labor alone or with the assistance of members of his household or hired employees" or operated by a partnership.

[8] Going back farther in history, the percentage of the U.S. population involved in agriculture was even higher than in the early 1900s. In 1870 agricultural workers comprised more than half the U.S. labor force, but by the turn of the century their number had fallen to less than 40 percent (Lewis, 1979).

Figure 2. U.S. agricultural productivity was 4 times higher in 2017 than in 1929

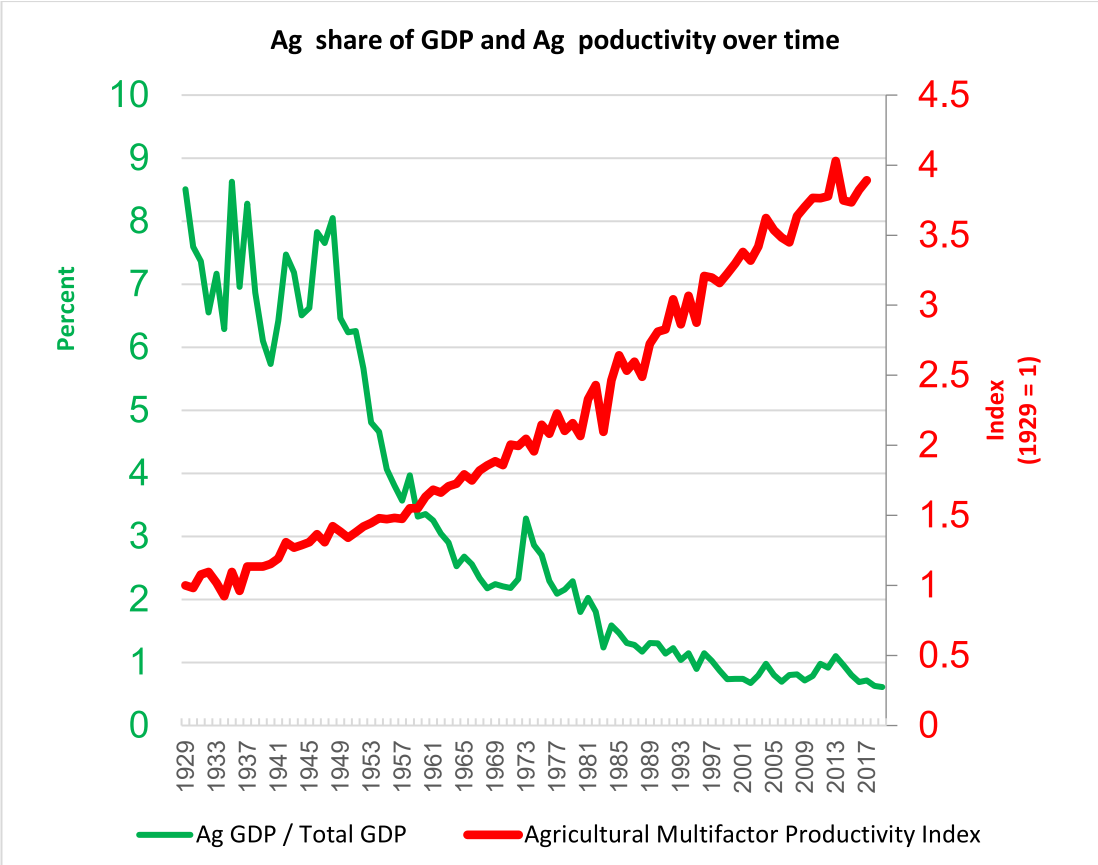


Source: USDA, Office of the Chief Economist, using data from USDA, Economic Research Service (1948-2015) and historical USDA sources (1929-1947; NED, 1980).
Note: In the legend, TFP is Total Factor Productivity, and Output and Input are indices for total output and input use, respectively. The pre-1948 portion of the TFP line is single factor productivity (NED, 1980).

Agricultural productivity and GDP

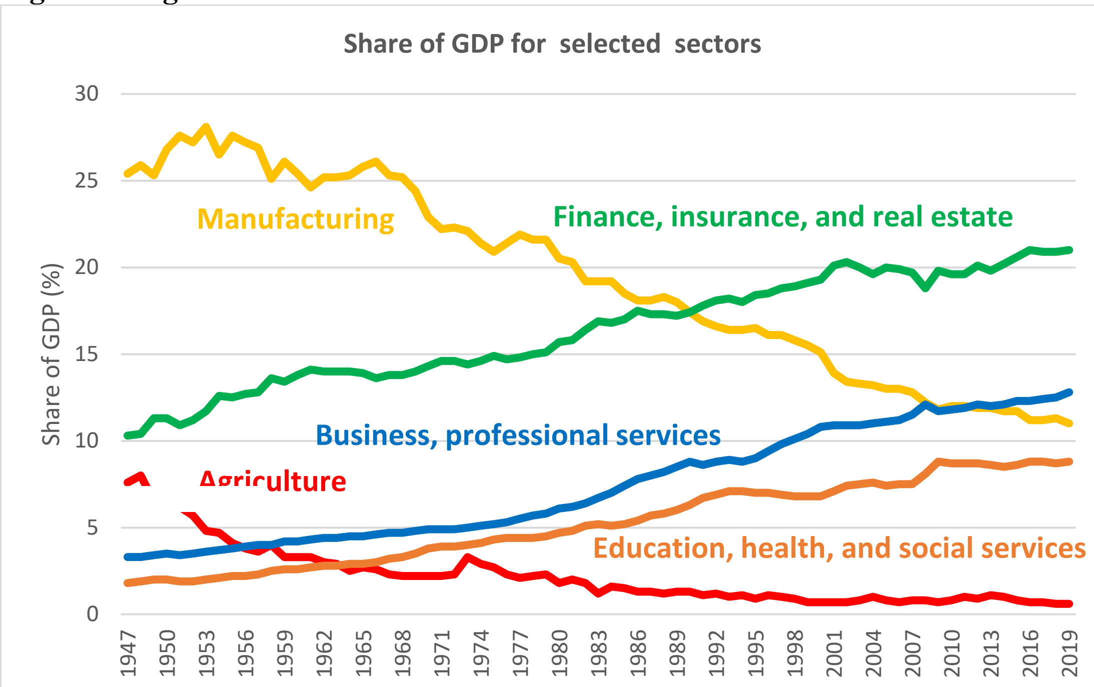
While agricultural productivity has grown by over 150 percent between 1948 and today, agriculture's share of GDP has fallen over the same period, from 8 percent in 1948 to under 1 percent today (see Figure 3). The increase in agricultural productivity has released to other sectors of the economy the labor and other resources that are no longer needed to produce sufficient food to meet demand. That release of resources has fueled growth in those other sectors that dwarfed the contribution of agriculture to the overall economy in comparison (see Figure 4).

Figure 3. As agricultural productivity has fueled economic expansion, its share of GDP has fallen



Source: USDA, Office of the Chief Economist, using data from USDA, Economic Research Service and from historic USDA sources (NED,1980), and from the Department of Commerce, Bureau of Economic Analysis. Note: GDP = Gross Domestic Product.

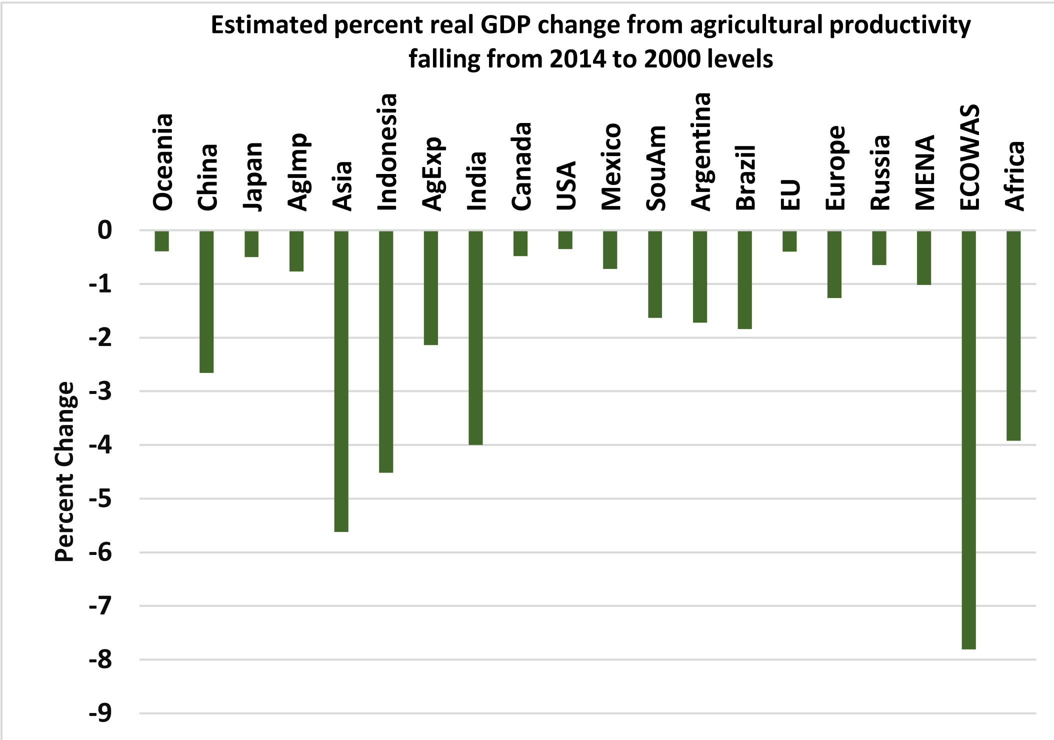
Figure 4. Agriculture's share of GDP has fallen over time



Source: USDA, Office of the Chief Economist, using data from the Department of Commerce, Bureau of Economic Analysis.
Note: GDP = Gross Domestic Product. Although the manufacturing share of GDP has been falling since the mid-1970s, in the immediate post-WWII period, manufacturing share of GDP increased as agriculture's share of GDP declined rapidly.

This effect of increasing agricultural productivity on economic growth is not just important historically. Improvements in productivity continue to affect developed countries even in the 21st century. Using the USDA, Economic Research Service's (ERS) version of the Global Trade Analysis Project's computable general equilibrium model (Beckman et al., 2015), ERS researchers simulated a reduction in 2014 yields for major commodities (rice, wheat, corn, other coarse grains, veg/fruit/nut, oilseed, sugar plant fibers, other crops) to 2000 levels and found that if those yield improvements in primary agriculture from 2000 to 2014 had not occurred, global GDP would be lower by 1.2 percent. Regions which are more dependent on agriculture in the economy would be most impacted, but even U.S. GDP would decrease by 0.35 percent, or nearly $60 billion per year if these yield improvements had not occurred (see Figure 5).

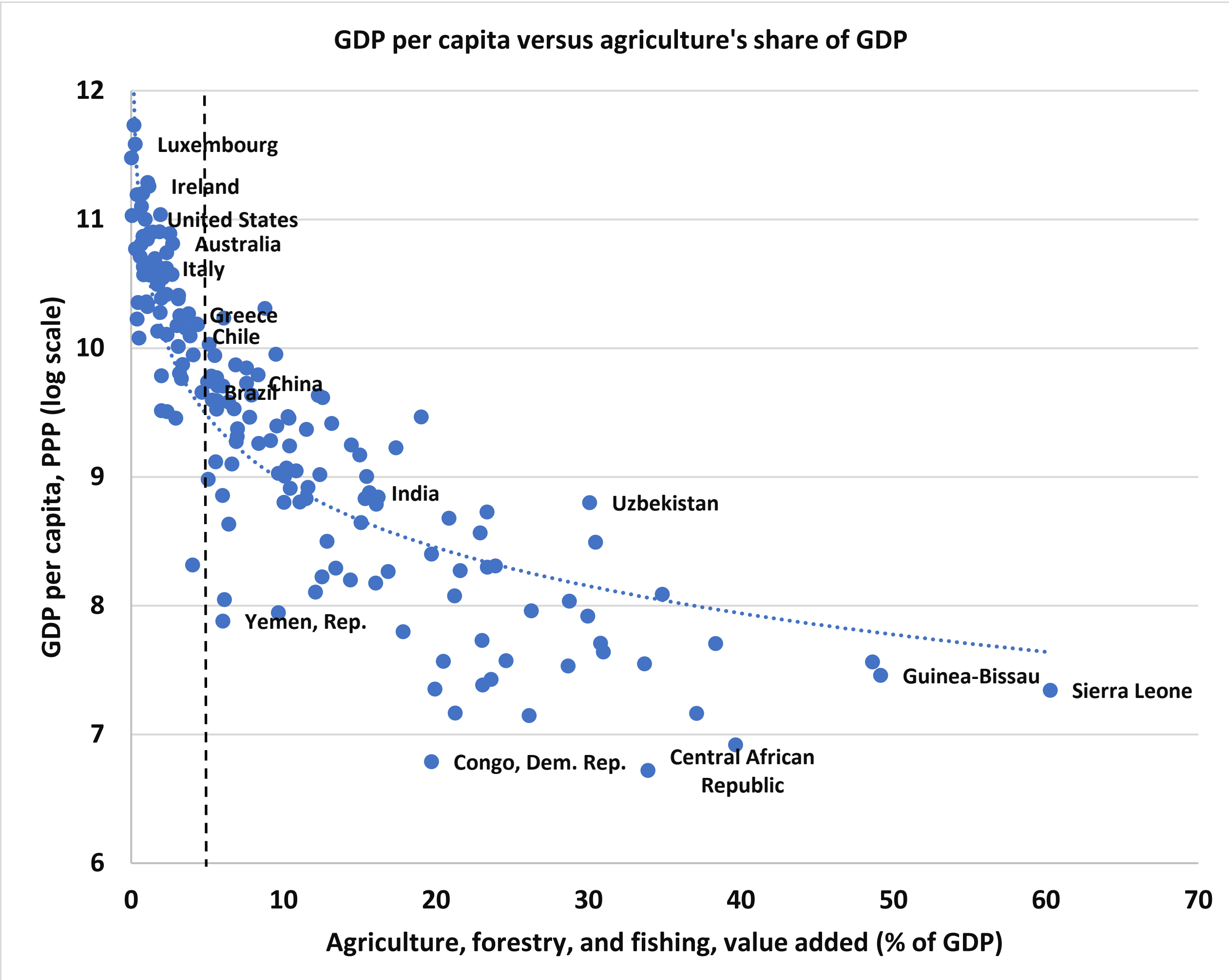
Figure 5. Estimated percent change in real GDP if agricultural productivity in 2014 had remained at 2000 levels



Data: USDA, Economic Research Service. Note: GDP = Gross Domestic Product, AgImp = Agricultural Imports, SouAm = South America, EU = European Union, MENA = Middle East/North Africa, ECOWAS = Economic Community of West African States.

Like the United States, other countries with high GDPs tend to have a lower agricultural share of GDP. Data from the World Bank show that across countries, the lower the share of overall GDP that agriculture contributes, the higher the country's GDP per capita tends to be. In the United States., EU-12, Japan, and Australia, agriculture's share of GDP is less than 4 percent, with the United States under 1 percent (to the left of the vertical dashed line in Figure 6). For lower income countries (to the right of the vertical dashed line), agriculture's share of GDP ranges up from 5 percent, with India, for example, at 14 percent and countries in the lowest income brackets as high as 60 percent.

Figure 6. Agriculture's share of GDP tends to be lowest in countries with highest GDP per capita



Source: USDA, Office of the Chief Economist, using World Development Indicators data, The World Bank. Note: GDP = Gross Domestic Product. Data are for 2017.

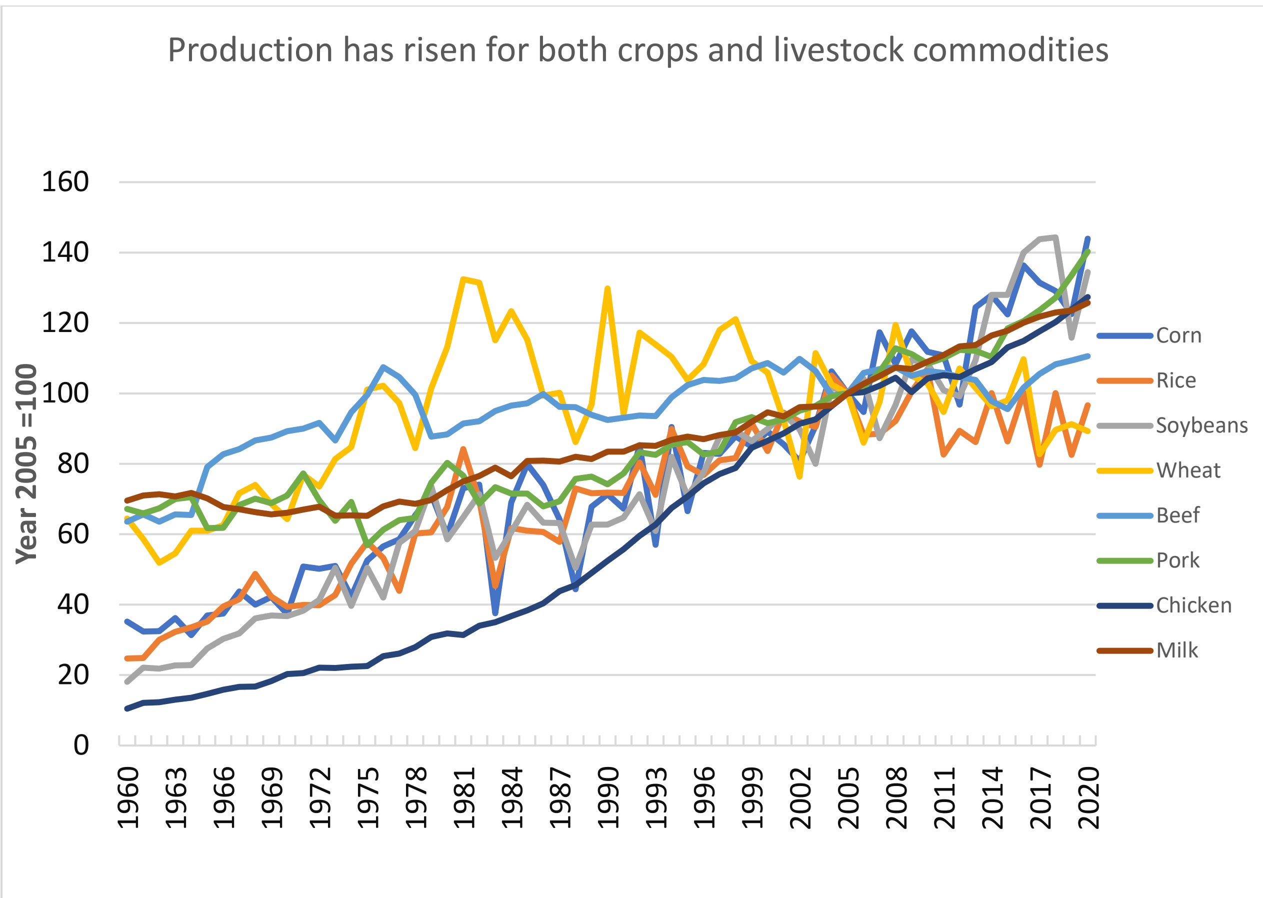
Figure 6 clearly shows that there is an inverse relationship between GDP per capita and agriculture's share of GDP, but this relationship does not necessarily indicate that a high share of GDP in agriculture means that a country will be poor. While there is abundant evidence that increases in agricultural productivity correlate with economic growth, there is little definitive evidence that a high share of agriculture in GDP causes low economic growth (Gollin, 2010). Nonetheless, the countries in Figure 6 with higher shares of agriculture in GDP are developing countries, and agricultural productivity in many developing countries remains severely constrained by low technology and poor infrastructure links between small-holder farmers and the agri-food supply chain (DID, 2014). Low agricultural productivity generally indicates that countries are devoting more resources to producing food than countries with higher agricultural productivity.

Agricultural productivity and food prices

Economic principles suggest that the more plentiful a product is, the less it will generally cost. Agricultural productivity growth in the United States and worldwide has indeed triggered a rise in production and a reduction in real commodity prices (Figures 7a and 7b). This is demonstrated, for example, in the United States between 1980 and 2018, where:

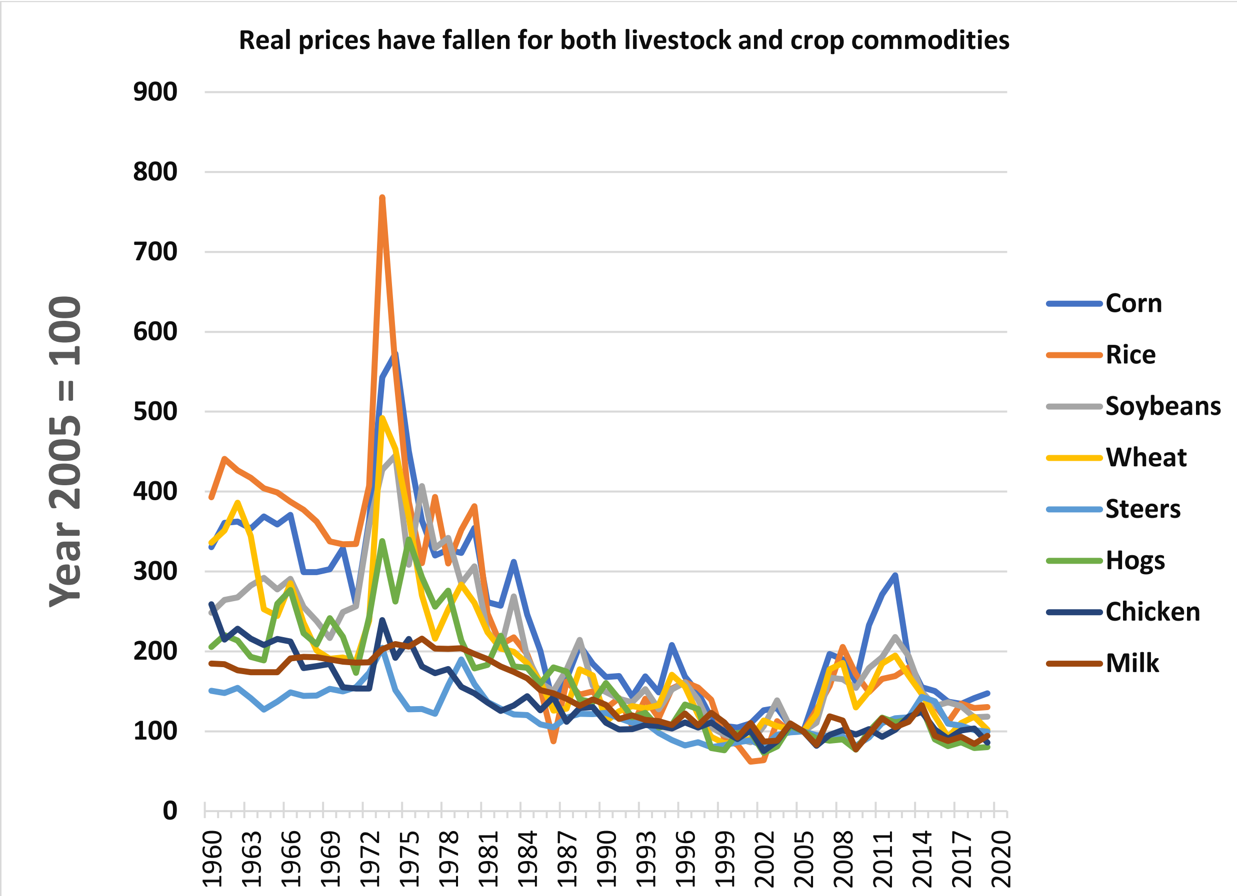
- Soybean production increased by almost 700 percent and corn production by nearly 270 percent, while commodity prices fell by 50 percent for soybeans and by 60 percent for corn.
- Production of beef, pork, and chicken more than doubled, while commodity prices fell by more than 50 percent.

Figure 7a. In the United States, growing commodity production since 1960…



Data: USDA, Office of the Chief Economist using data from USDA, Foreign Agricultural Service (Production, Supply, and Distribution database).

Figure 7b. … has been accompanied by falling commodity prices

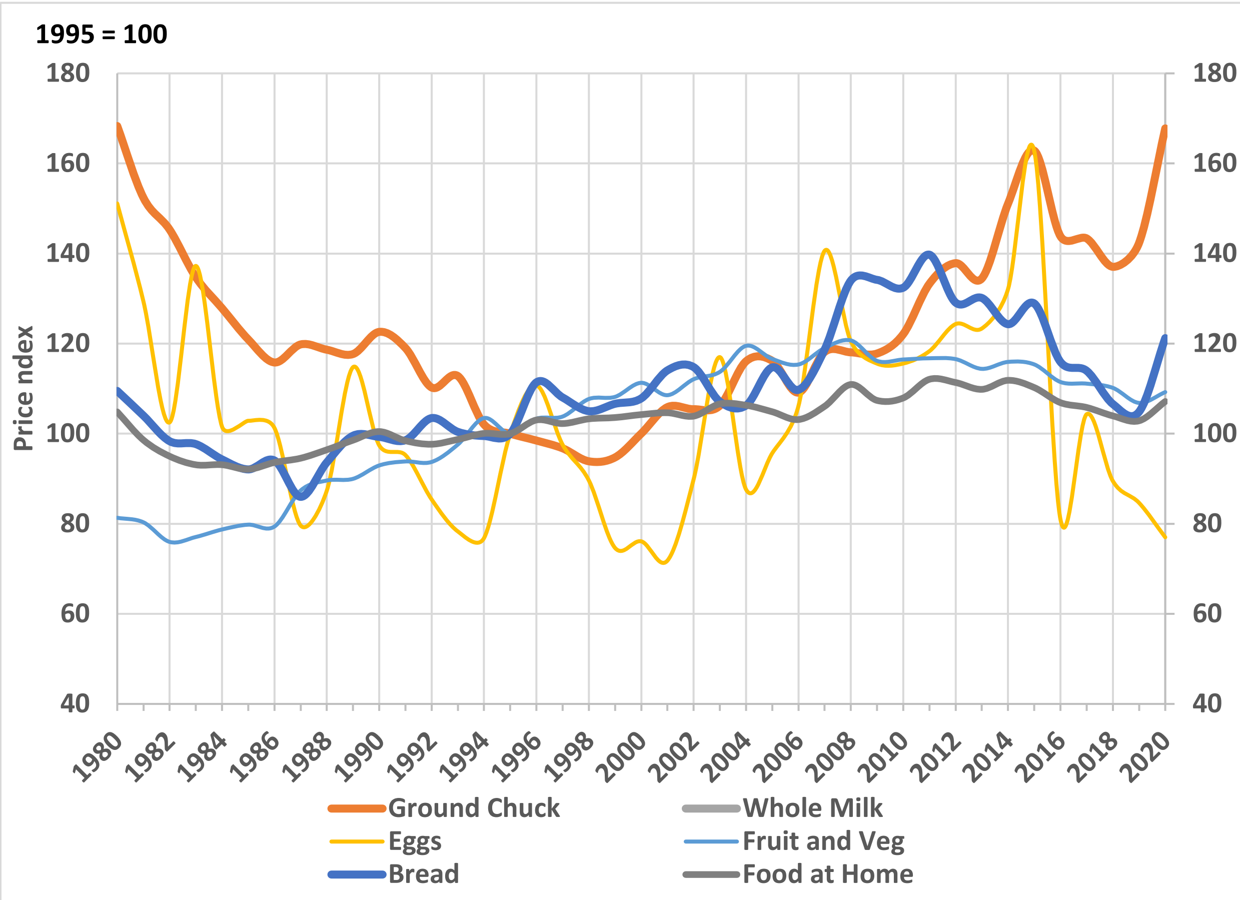


Source: USDA, Office of the Chief Economist using data from USDA, National Agricultural Statistics Service, and the Bureau of Labor Statistics (for the deflator for prices).

Reductions in commodity prices have helped to keep average real retail food prices relatively flat over time despite increasing global demand. (see "food at home" in Figure 8 below). On average, real food prices in 2019 were 2 percent lower than in 1980. In real terms, retail prices in 2019 relative to 1980 were 1 percent lower for white bread, 18 percent lower for ground beef, and 27 percent lower for eggs. Real retail price for milk dropped by 19 percent between 1995 and 2019. However, not all retail prices have fallen. For example, fresh fruit and vegetable retail prices have increased on average between 1980 and 2019, reflecting conditions specific to the markets for those commodities, including, for example, availability of higher priced off-season products.

One of the reasons that food price reductions over this time are relatively small in comparison to the commodity price reductions is that the farm sector contributes only about 15 percent to the price of food that the consumer purchases (ERS, 2020d). In 2018, the latest data available, the farm sector provided about 20 percent of the food value for food purchased and consumed at home, but only about 3 percent of the food value for food purchased for consumption at restaurants or other locations outside of the home. Other components of the food dollar include energy, transportation, marketing, packaging, etc.[9]

Figure 8. Prices of individual retail food products are varying over time, but average retail prices ("Food at Home" series) are 2 percent lower in 2019 than in 1980, adjusting for inflation



Data: Source: USDA, Office of the Chief Economist, using data from Bureau of Labor Statistics and Bureau of Economic Analysis (the latter for the GDP chain deflator). The 2020 prices are for July.

Food-price trends in other high-income countries are similar to those in the United States. For the purposes of comparison among *high- income* countries, prices for agricultural commodities tend to be more readily available in public databases than retail prices. A notable exception is the United States, for which the USDA publishes extensive series of prices at the commodity, wholesale, and retail levels. USDA, NASS and AMS provide prices for primary commodities at the farm, wholesale and retail levels. USDA, ERS provides regular data on retail price changes (Food Price Outlook) and periodic snapshots of retail prices (Quarterly Food-at-Home Price

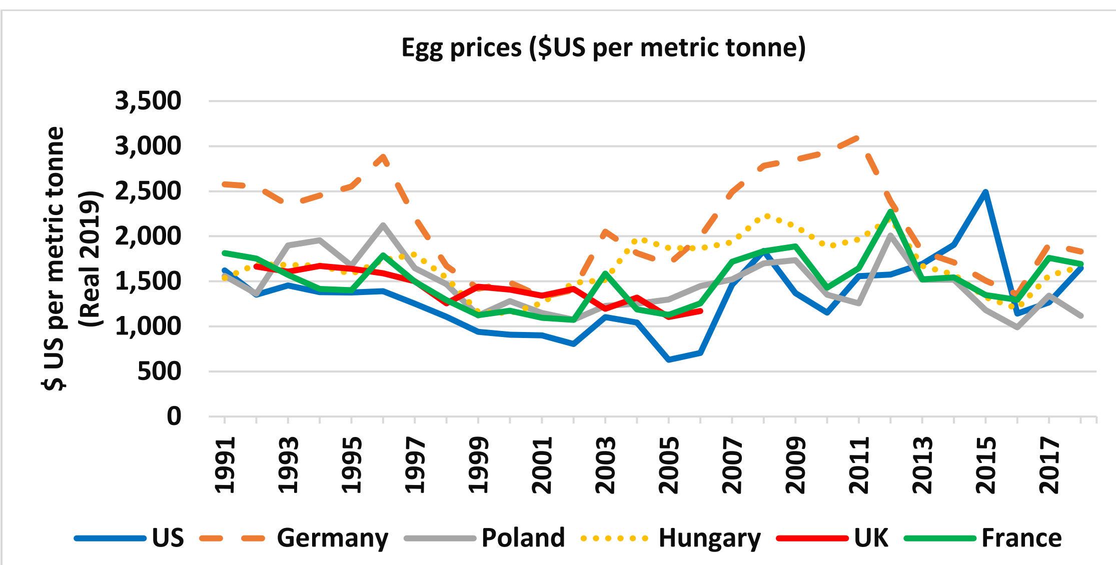
[9] The ERS Food Dollar (ERS, 2020d) uses an analysis of BLS and BEA data to break out how a dollar spent on U.S. domestically produced food gets divided along the supply chain. ERS presents the food dollar through three primary series—the marketing bill series, the industry group series, and the primary factor series. The three series represent distinct perspectives on the sources of market value for the combined annual food dollar expenditures. See the appendix for more discussion of the food dollar.

Database, Farm to Consumer Price Spreads). The European Union (EU) provides a centralized point for accessing agricultural price data for EU countries through Eurostat (European Commission, 2019), but the data is quite thin relative to that provided by the USDA data on U.S. food prices.

FAO provides information on prices for *low-income* countries through two main portals: (1) the international price portal, which includes international prices and the FAO Food Price Index cited above; and (2) the domestic price portal, which include agricultural producer prices, wholesale and retail prices, consumer and food price indices (FAO, 2020a; FAO, 2020b; FAO, 2020d). The international price portal includes export and import prices. Export prices are determined in export markets for products intended for delivery outside the boundary of the country. Import prices are prices of goods purchased in the country but produced out of its boundaries. In the domestic price portal, agricultural producer prices are the prices received by farmers for their produce at the farm gate; wholesale prices are the prices at which wholesalers sell products in bulk quantities to retailers, manufacturers and industrial users; and retail prices are the prices at which the products are sold to the end consumer for consumption, and include expenses plus a margin of profit. Consumer food price indices are also available at the country level.

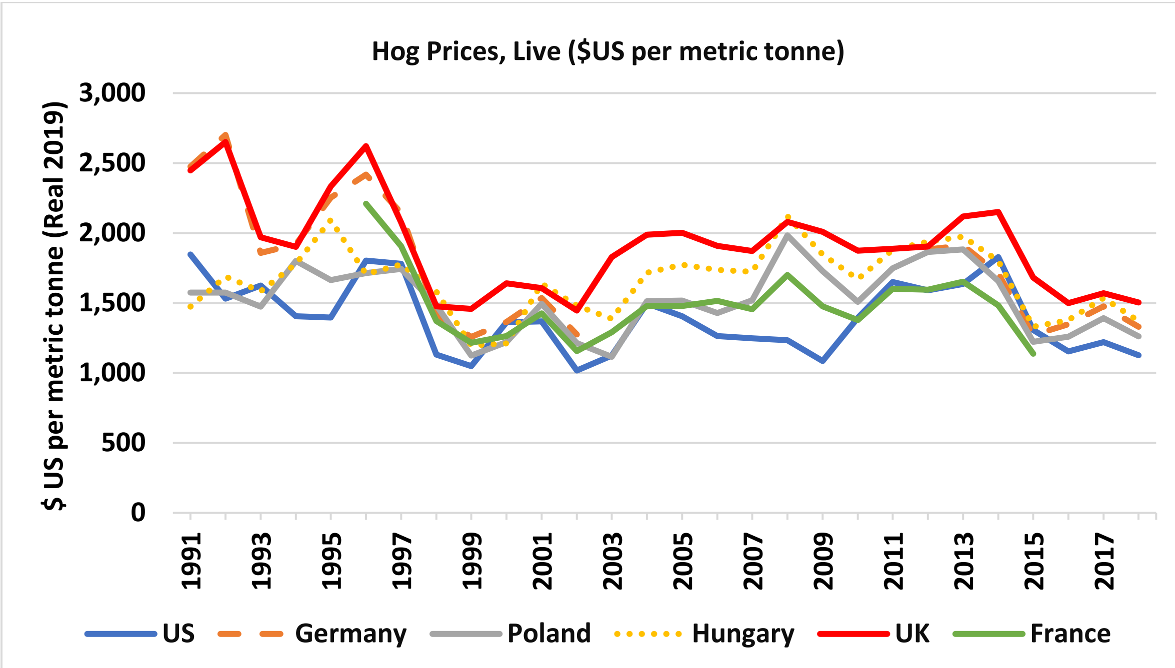
While wholesale and retail price data are not provided for the high-income countries for which we have compared food expenditures in this report, we can use FAO's agricultural producer prices to compare farm-level prices for several commodities for those countries (as in the examples in Figures 9a-9c). While prices tend to generally track each other in Figures 9a-9c, the United States tends to be near the lower end in most years, and especially for the two livestock charts, which is not surprising given the productivity of U.S. agriculture. This producer data series shows more volatility than the consumer price indices presented above given that primary agricultural commodities make up only a portion of food costs at the retail level.

Figure 9a. Comparative producer prices for eggs



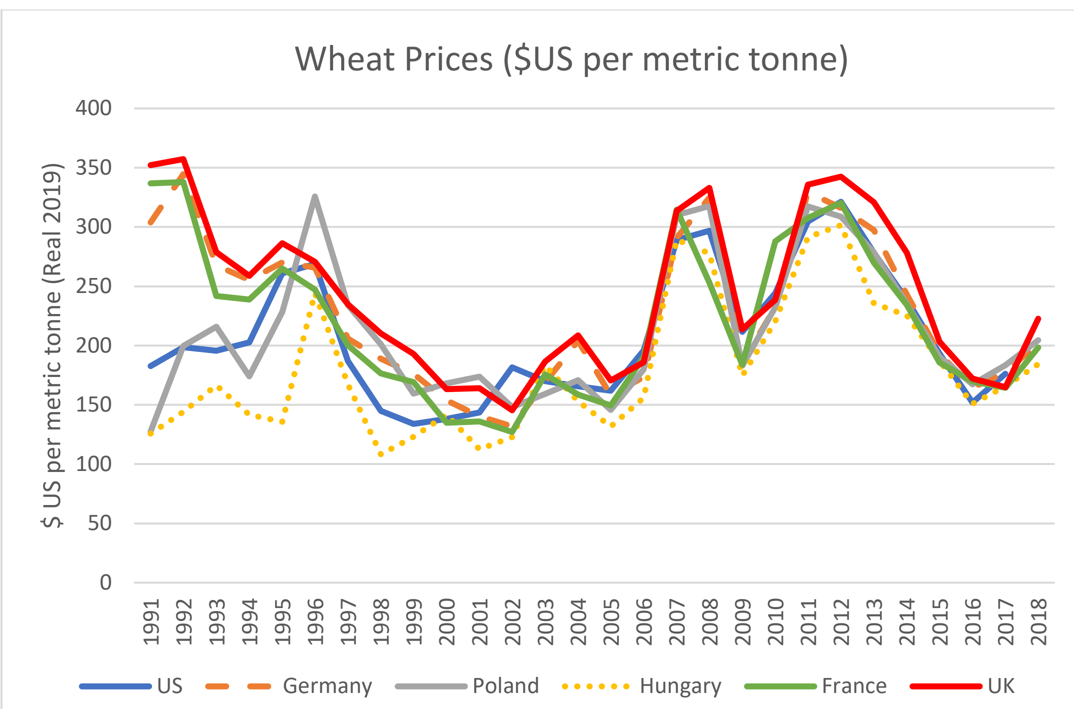
Source: USDA, Office of the Chief Economist, using data from the Food and Agriculture Organization of the United Nations (FAO).Note: FAO's FAOSTAT data is not reported for the UK for some years.

Figure 9b. Comparative producer prices for hogs



Source: USDA, Office of the Chief Economist, using data from the Food and Agriculture Organization of the United Nations (FAO). Note: FAO's FAOSTAT data is not reported for France and Germany for some years.

Figure 9c. Comparative producer prices for wheat



Source: USDA, Office of the Chief Economist, using data from the Food and Agriculture Organization of the United Nations (FAO).

U.S. domestic food expenditures

Multiple data series are available for measuring U.S. food spending. The ERS Food Expenditure Series provides the most comprehensive measure of the total value of all food acquisitions in the United States (ERS, 2020a). The series tracks food expenditures at grocery stores, supercenters, warehouse clubs, and other retail stores (for food at home, or FAH) and at restaurants, school cafeterias, hotels and motels, recreational places, and other away-from-home eating places (for food away from home, or FAFH). The series also estimates the value of home production—food grown or caught for personal consumption. The USDA, ERS data is presented as a share of disposable income, on a household basis, and on a per capita basis.

Unlike other series that encompass only spending by households, such as the Bureau of Labor Statistics' (BLS) Consumer Expenditure Surveys (CES; BLS, 2020b) and the Bureau of Economic Analysis' (BEA) Personal Consumption Expenditures (PCE; BEA 2020), ERS's series includes data on the value of foods obtained as part of a food-away-from-home (FAFH) activity or location, such as meals served to airplane passengers, hospital patients, nursing home residents, and prison inmates (Okrent et al. 2018). The value of these meals is included in the ERS FAFH category. [10] CES and PCE do not explicitly show the value of food from such activities or institutions in their estimates. CES expenditure data is also organized by various demographic characteristics, such as age and income. Given differences in data design and categorization, values will differ across the data sets. For example, for 2018, the BEA's "Food and beverages purchased for off-premises consumption," which includes alcoholic beverages, was 28 percent larger than ERS' food at home (FAH) (but only 12 percent larger when ERS' Alcohol at Home is added to FAH).

Food spending is measured using three primary metrics: share of total income, share of disposable income, and share of consumption expenditures. The choice of which metric to use depends on the question to be answered, and in some cases on the availability of data, especially when making international comparisons. The choice of metric influences the food spending share values. Total income is, by definition, larger than consumption expenditures. As a result, the same absolute level of spending on food will be a smaller share of total income than of consumption expenditures (see Figure 10).[11] The same is true for U.S. disposable income, since going back at least as far as 1929, U.S. disposable income has always been larger than consumption expenditures.

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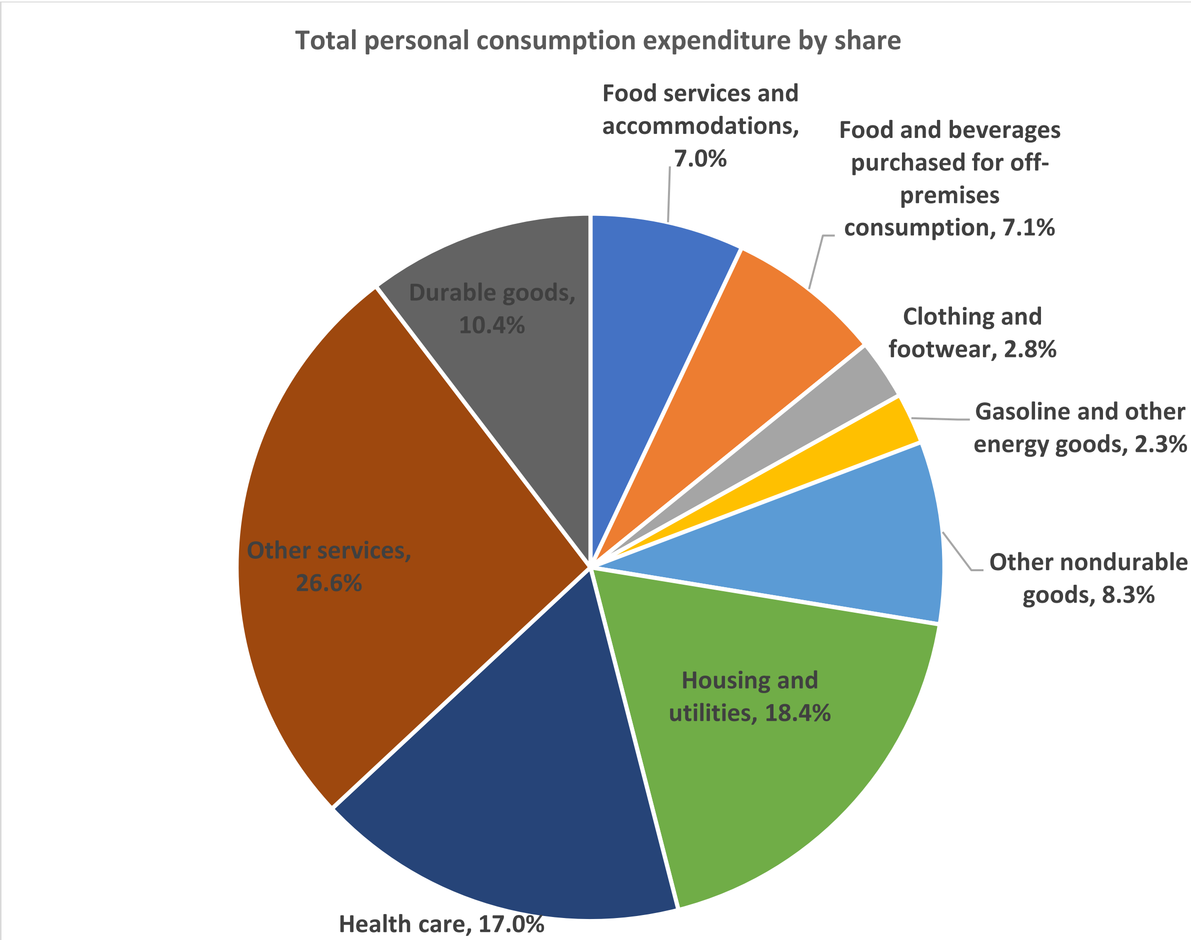
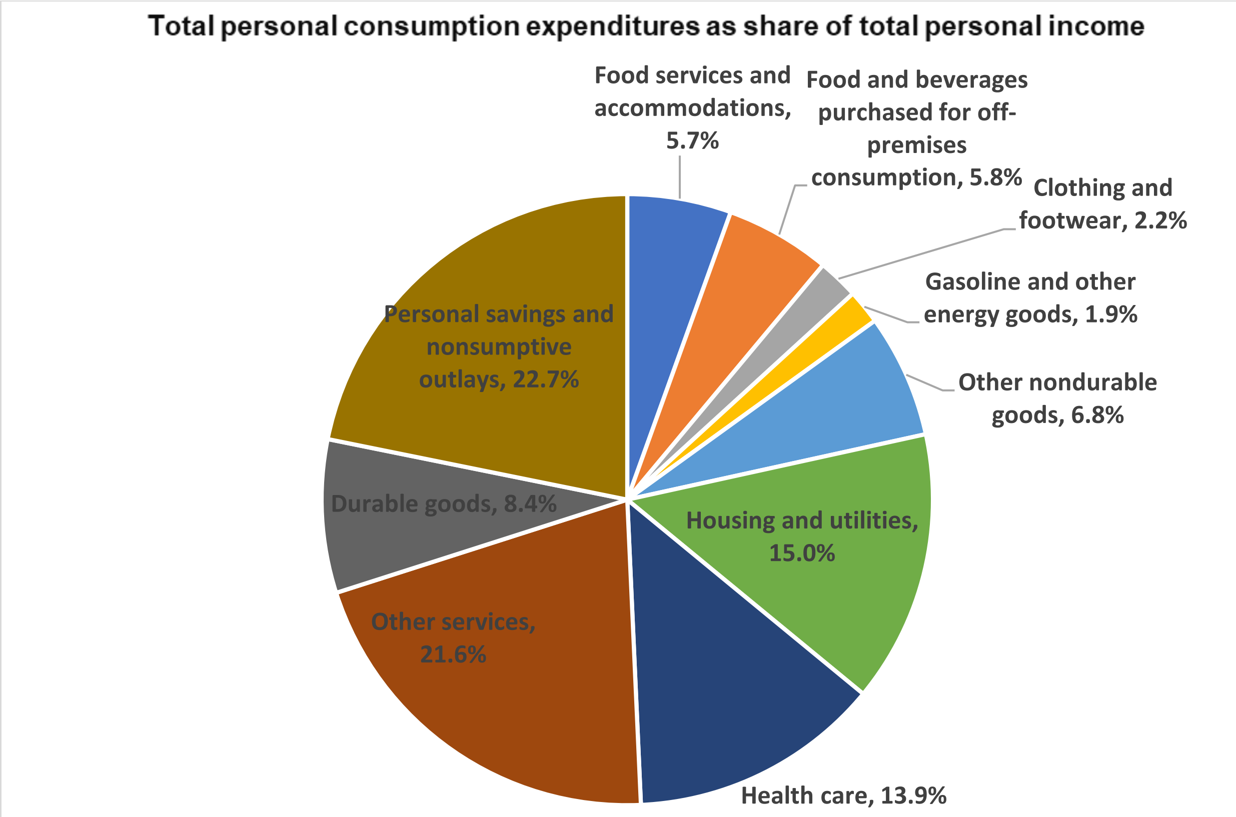
[10] For BEA personal expenditure data on food – "Food and beverages purchased for off-premises consumption" under "nondurable good" and "Food services and accommodations" under the "services category -- see Table 1.5.5 or equivalently, Table 2.3.5 (BEA, 2020).

[11] Note that for the reasons discussed in the text, the food expenditures shares calculated in the figures using the BEA's Personal Consumption Expenditures (PCE) will differ from expenditure shares from the BLS' Consumer Expenditure Survey data (CE) (Garner et al., 2006). More broadly, PCE data are designed in a "National Accounts" sense with a macroeconomic focus and are calculated from GDP data with adjustments. The Consumer Expenditure Survey data (CE), produced by BLS, have a microeconomic focus, with the data being collected from household survey respondents. This section uses the BEA-based data to give more of a macro (GDP) focus. See ERS (2019a) for a pie chart using the CE data.

Figure 10. Food expenditures are a greater share of total personal consumption expenditures than of total personal income (2019)



Source: USDA, Office of the Chief Economist, using data from the Department of Commerce, Bureau of Economic Analysis.

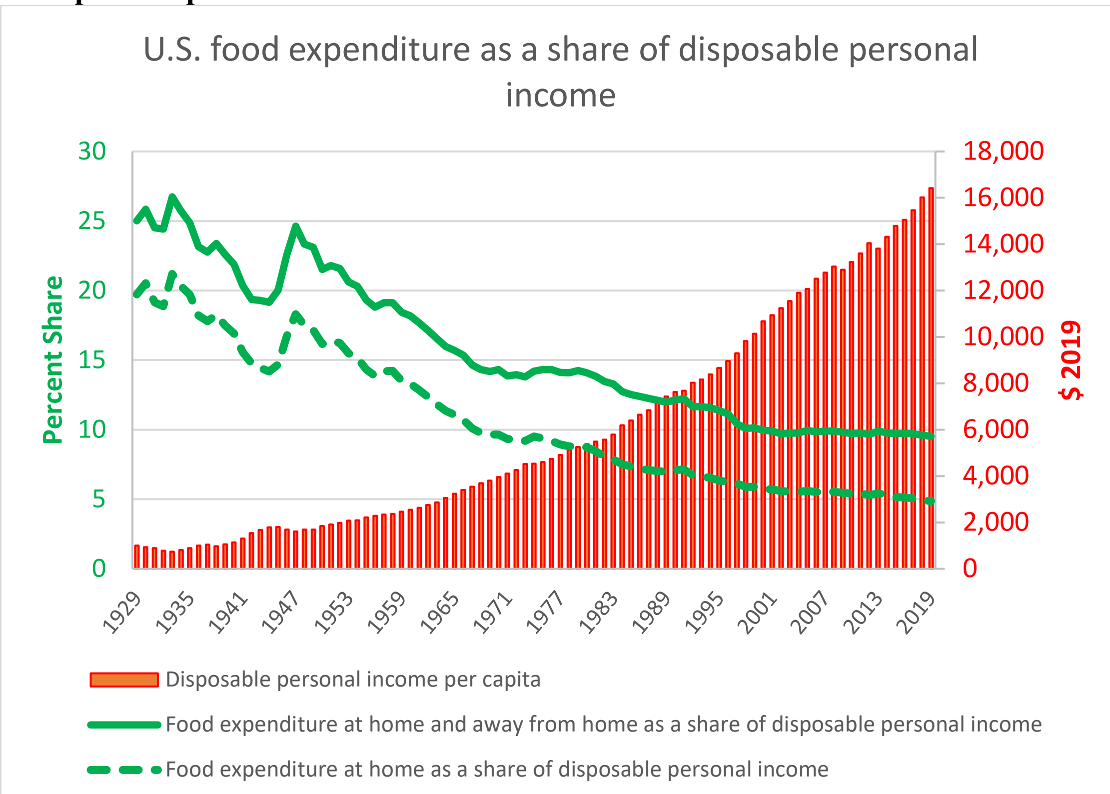


Source: USDA, Office of the Chief Economist, using data from the Department of Commerce, Bureau of Economic Analysis.
*Nonconsumptive outlays are personal taxes, transfers, and nonmortgage interest payments

Comparing the ERS Food Expenditure Series data on the share of disposable income used for food expenditure with the BEA data on disposable income per capita shows the decline in food spending as a share of disposable personal income and the simultaneous increase in total personal disposal income over time (see Figure 11).[12] Real total disposable income has risen steadily since the early 1940s (as has per capita disposable income), while the share of disposable income used for food expenditure decreased relatively quickly from 1947 to 2000, then began to decrease at a slower rate. One explanation for the slowing rate is the larger percentage of expenditure for food away from home and ready-made meals, which generally cost more than food prepared at home given the additional services comprising food away from home. Food away from home spending can react quickly to income declines –when disposable income fell during the Great Recession, a smaller portion of food spending was dedicated to food away from home (Saksena et al., 2018).

[12] For a discussion of expenditure shares and income in the context pf price volatility, see Schnepf (2013).

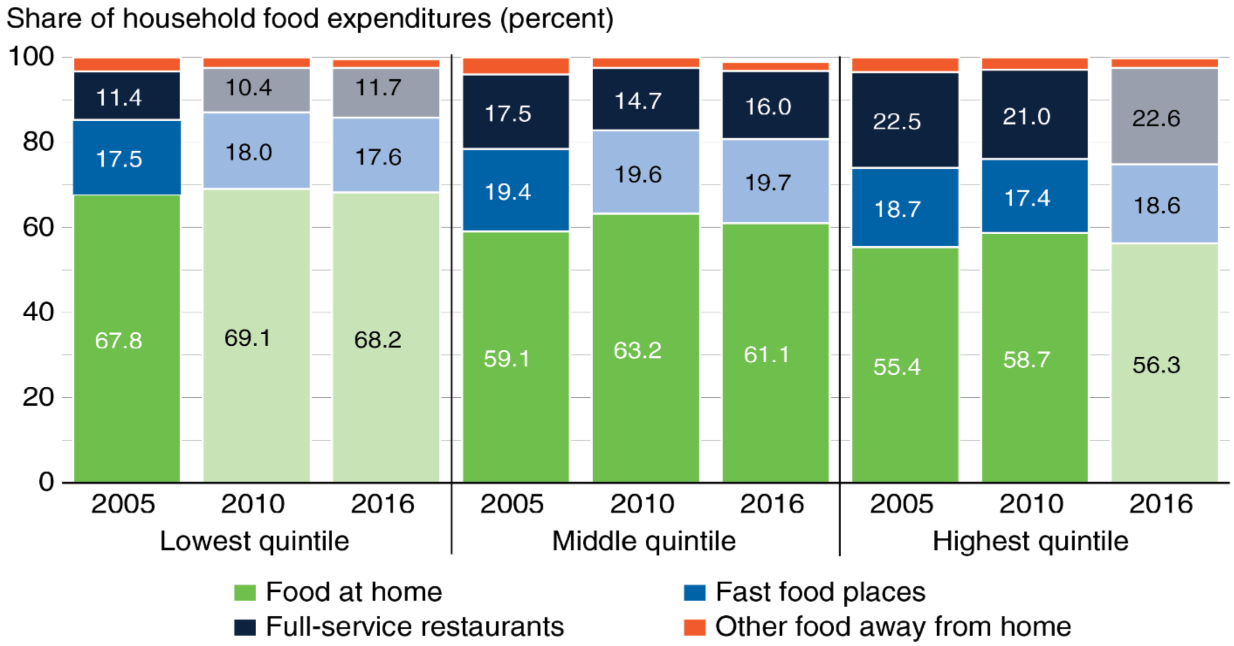
Figure 11. As total disposable income has risen over time, U.S. food expenditures as a share of disposable personal income have fallen



Source: USDA, Office of the Chief Economist, using the Food Expenditure Series dataset from the USDA, Economic Research Service and income data from the Department of Commerce, Bureau of Economic Analysis. Note: Disposable personal income is total personal income less personal taxes. Data for the United States also shows that generally the higher the household's income, the lower its share of consumer expenditures going to food.

We can use BLS data to examine the allocations of total household expenditures to food consumed at home and away from home for different brackets of household income (see Figure 12), both for total food expenditures and for expenditures on food at home as a share of total food expenditures. For example, to examine food expense shares, Clare, Todd, and Saksena (2018) separated households into five groups to compare households in the lowest, middle, and highest income quintiles. Figure 12 shows that among all households, those in the highest income quintile allocated the largest share of their food budgets to food away from home, while those in the lowest income quintile allocated the least (*ibid.*). This difference is largely due to a greater share of spending at full-service restaurants among the highest income households.

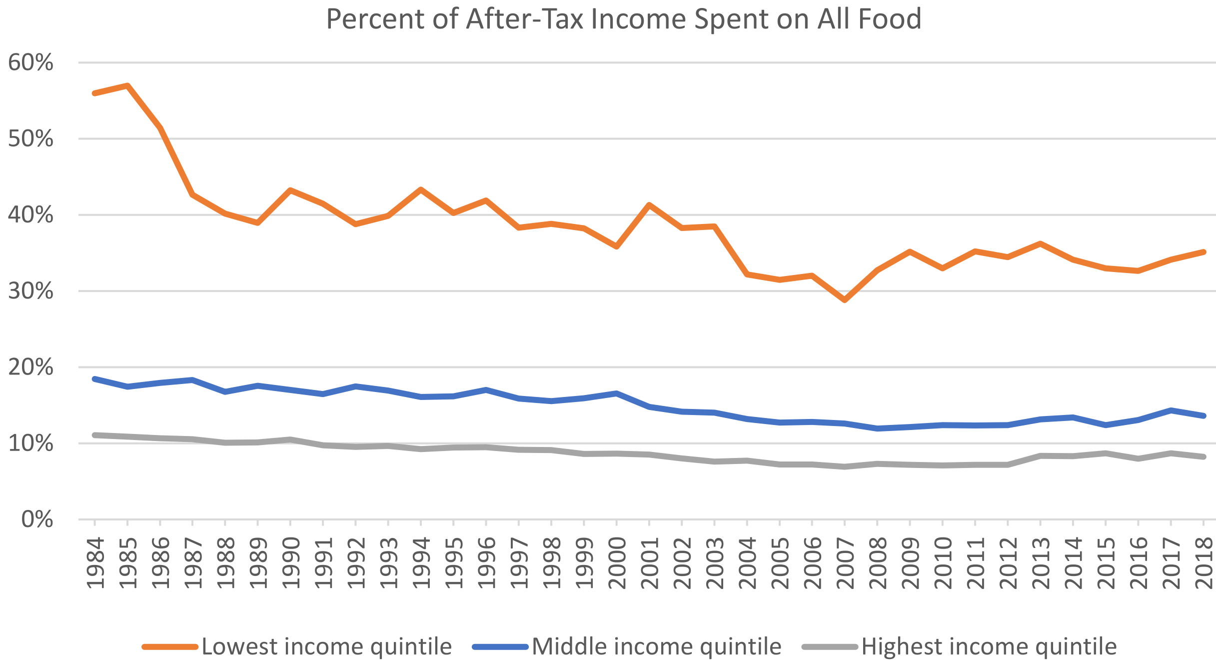
Figure 12. Lower income households devote a greater share of total household food expenditures to food consumed at home



Source: USDA, Economic Research Service using data from the Bureau of Labor Statistics, Consumer Expenditure Survey.
Note: "other food away from home" includes purchases at catered events and vending machines. The darker colors for 2010 and 2016 indicate statistically significant changes from 2005, whereas the lighter shading indicates changes that are not statistically significant (p<0.5), except for other food way from home.

Looking more broadly at food expenditures, households in lower income brackets or quintiles spend a greater share of their total income on food (see Figure 13). Poorer households spend less money on food than higher income households, but this accounts for a greater share of their income (Tuttle and Kuhns, 2016). In 2014, the lowest quintile income group in the United States spent over 35 percent of their before-tax income on food. In addition, those households in the lowest quintile have experienced much greater volatility in the share of food spending compared to those in the highest quintile (*ibid.*). Given that food is an essential good, increasing food prices disproportionately affect the spending behavior of low-income households, often requiring them to allocate a larger share of their incomes to food as prices rise.

Figure 13. While food spending has declined for all income brackets, households in the lowest bracket show greater volatility in the share of total expenditures on food



Source: USDA, Economic Research Service using data from the U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys 1984-2018.

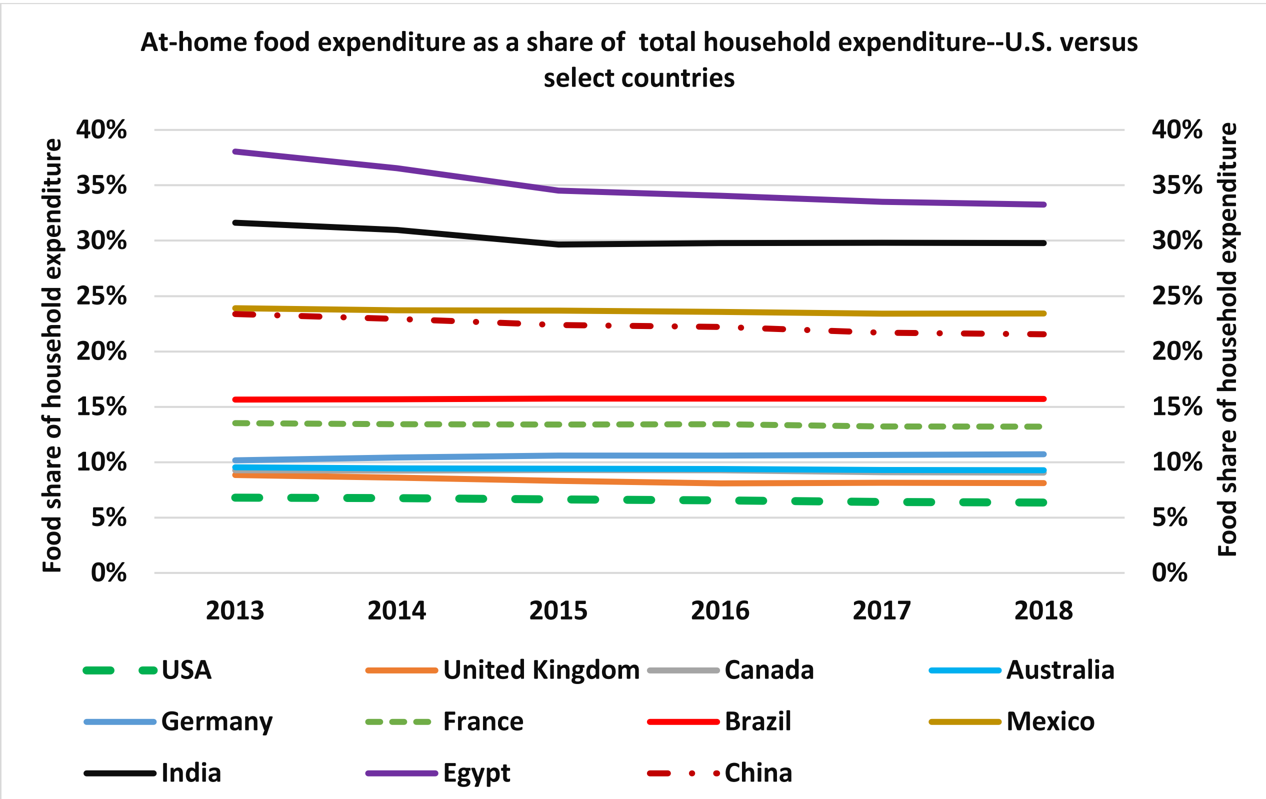
International food expenditure comparisons

Generally, agricultural productivity and greater economic development within a country are associated with a declining share of household consumption or income spent on food, reflecting both the higher incomes that come with economic development and the lower costs of commodities that come with increasing agricultural productivity. As food prices fall and income rises, Americans have enjoyed a steadily falling share of spending dedicated to food over many decades. Similar trends can be found in other developed countries. Making comparisons of food spending across countries, however, requires data that are consistent across all countries being compared.

The USDA, Economic Research Service has compiled a data set that compares at-home food expenditures for over 100 countries from 2013 to 2018 (ERS, 2020b). That data show consumers in middle-income countries—such as Brazil, China, Mexico, India, and Egypt—spend a considerably higher share of their expenditure on food and nonalcoholic beverage at home compared to high-income countries—such as the United States and France (see Figure 14). For example, the food-at-home share of expenditures is 16 percent in Brazil, 22 percent in China, 24 percent in Mexico, 30 percent in India, and 33 percent in Egypt (similar to low-income consumers in the United States). Of the high-income countries, the United States has the lowest average at-home food expenditure at 6 percent, while France is among the highest at 13 percent.

Based on the food expenditure share data for the United States and France as well as assuming that total household expenditures are invariant to the share spent on food, if Americans were to allocate the same share of their consumption spending to food purchases for at-home consumption as the French do, they would spend approximately $830 billion more on food and that amount less on other items.[13]

Figure 14. As a share of expenditures, Chinese spend about 22 percent on food at home



Source: USDA, Economic Research Service.

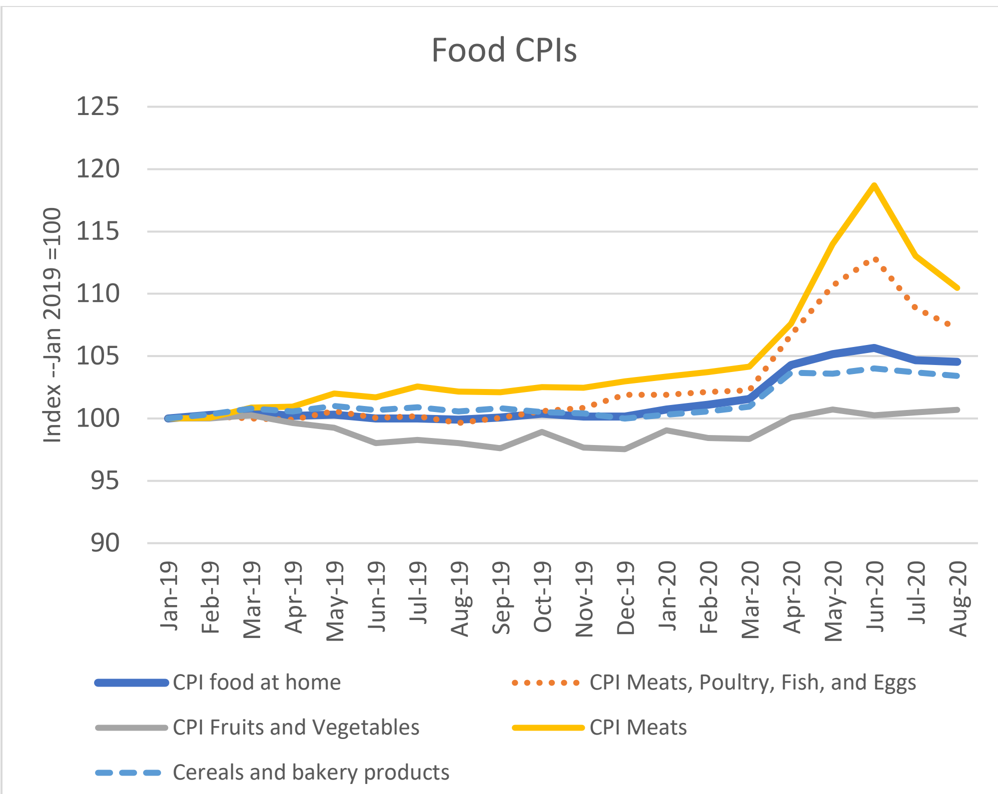
Implications of the COVID-19 pandemic for consumer food prices and expenditures

The relationship between agricultural productivity and food prices covers a long run perspective, but some shocks with price implications are significant enough that they are hard to not raise in this report. In particular, how does the food sector today, shaped by the advances in productivity that produced the downward trend in the share of total consumer expenditures spent on food respond to massive shocks? On March 13, 2020, the U.S. Federal Government declared a national emergency concerning the novel coronavirus disease (COVID-19). The rapid proliferation of COVID-19 at home and abroad and subsequent shutdown of entire economic

[13] Cultural differences between countries may account for some of the difference between countries in the percentage of household expenditures devoted to food. It is possible that the French may desire to spend more on food at the expense of other goods than either Americans or the British, for example.

sectors led to an unprecedented and simultaneous supply and demand shock to the food system and wreaked havoc throughout the economy. For example, unemployment rose in 2020 from very low levels not seen since the 1960s to the highest since the Great Depression. In June 2020, the International Monetary Fund projected an 8.0 percent annual decrease in U.S. GDP, while in January it projected a 2.0 percent annual increase (IMF, 2020). The spread of COVID-19 in the United States and responses to it have impacted food markets from multiple directions. Short-run impacts include reduced FAFH consumption due to mobility restrictions, supply-chain disruptions for some commodities, shortages of some items at grocery stores, higher retail prices, and lower farm-gate prices. Medium-run impacts may include demand loss due to lower economic growth, and shifts in consumer demand to food consumed at home not only due to mobility restrictions and consumer concerns over eating out, but also due to income effects. This section examines consumer food prices and sales in the wake of the COVID-19 outbreak.

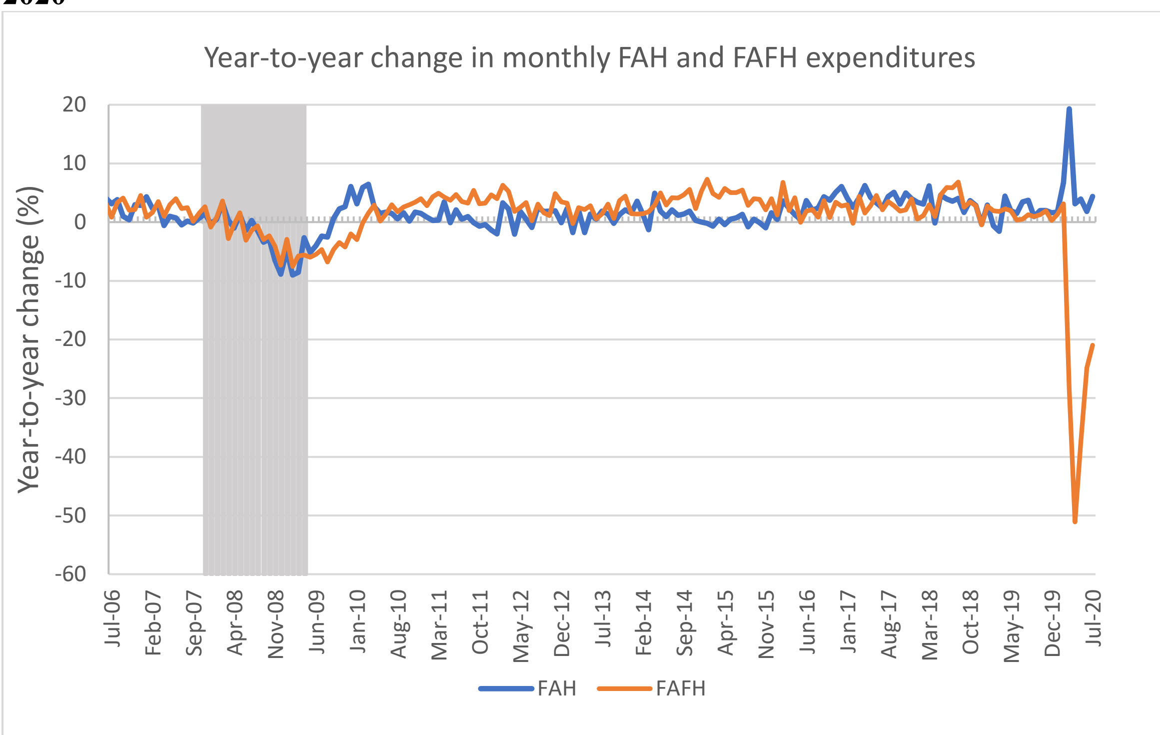
Figure 15. Food CPIs up sharply from March to May 2020, but slowing or decreasing in June



Source: USDA, Office of the Chief Economist, using data from the Bureau of Labor Statistics. CPI = Consumer Price Index.

The market disruptions starting in March 2020 are evident in the food consumer price indices in Figure 15. Between February and June 2020, the food at home CPI increased 4.5 percent. While CPIs for all food categories in the chart increased over this period, by far the largest increase was the meat CPI, at 14.4 percent in June. The CPI started to fall back down around June, with the meat CPI falling almost 5 percent between June and July. Reductions in meat processing capacity associated with COVID-19 outbreaks were a likely cause of the increase in the meat CPI. For example, on April 29, pork packing plant capacity utilization bottomed out at 54 percent, compared to 100 percent in early April (Haley, 2020). By mid- June, capacity utilization in pork processing plants was near 95 percent (*ibid.*), and consumer prices for pork were falling. Other disruptions in the food chain were due to the precipitous drop in FAFH and the associated increase in FAH, given differences between product types and production and distribution processes targeted at FAFH versus for FAH, and the efforts needed to re-channel goods.[14] Overall, even after the decrease in the CPI for food consumed at home from its peak in June, in August it was still 3.4 percent higher than in February 2020. In contrast, the headline CPI for all goods – the CPI-U – actually fell from February to May, but as of August is 0.5 percent higher than in February. The gasoline CPI fell 23 percent from February to May, likely driving much of that decrease in overall CPI.

Figure 16. Food-away from home (FAFH) expenditures took a big hit starting in March 2020



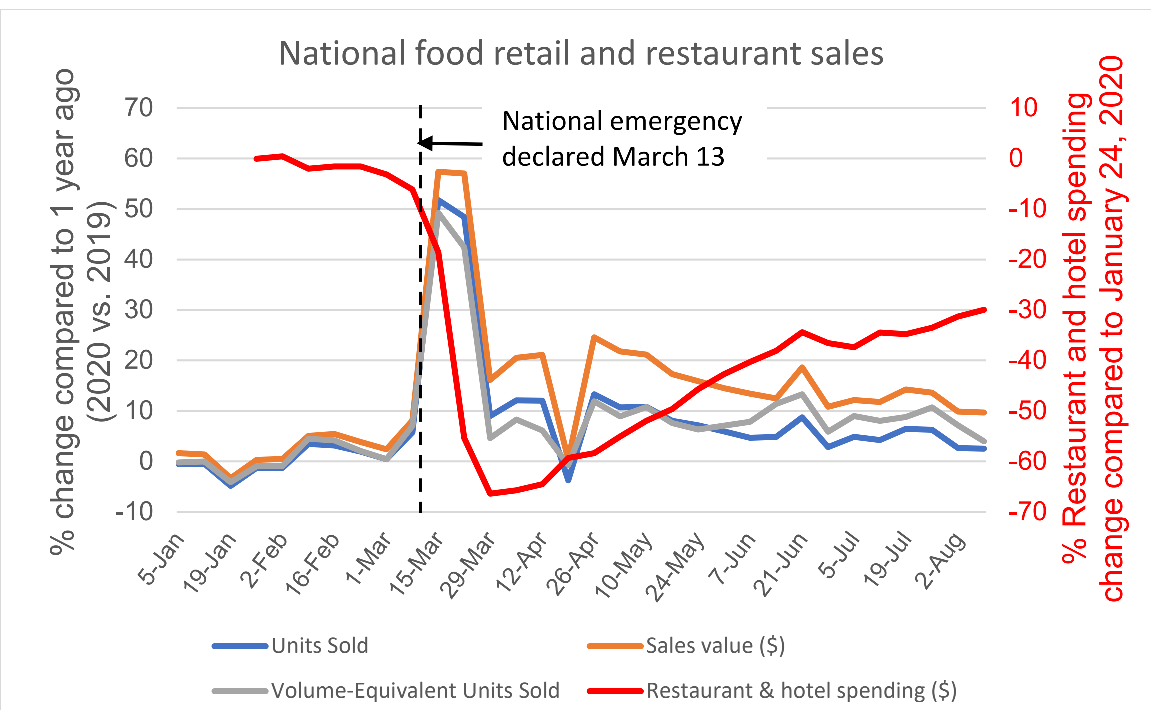
Source: USDA, Office of the Chief Economist, using the Food Expenditure Series dataset from the USDA, Economic Research Service.
Notes: The grey bar is the period of the Great Recession. FAH = Food at Home, FAFH = Food Away from Home.

[14] For example, products intended for distribution to the food service sector tend to be packaged in larger unit-packages than for purchase in grocery stores (e.g. Cessna, 2020). In addition, different food commodities are consumed in different proportions in FAFH and FAH settings (Lin *et al.*, 2016).

In the 15 years prior to COVID-19, year-to-year changes in the monthly FAFH and FAH data were relatively small, except around 2008 during the Great Recession (see Figure 16). In response to the mobility restrictions and other reaction to COVID-19, inflation-adjusted FAH expenditures were 19.3 percent higher and FAFH expenditures 28.6 percent lower in March 2020 compared with March 2019. FAH expenditures fell after the initial shock in March 2020, but were still higher than the equivalent months in 2019, and FAFH expenditures were climbing back up after further downturn in April but by July 2020 were still lower than the same month in 2019. Total FAH and FAFH spending in June 2020 was $12 billion less than in June 2019 (Zeballos and Sinclair, 2020) and while up in July 2020, was still lower than in July 2019.

Expenditures on both FAH and FAFH decreased in the time period covering the Great Recession of 2008 (the shaded area in Figure 16), with the largest decrease occurring in February 2009. Superficially, the Great Recession of 2008 may seem to be a good model for the current FAH versus FAFH relationship, given that data in Figure 16 shows that it took FAFH expenditures longer to recover from the GDP decreases than for FAH. The same could be expected in the aftermath of COVID-19. However, the comparison to the Great Recession can only be taken so far given that in the COVID pandemic, the initial divergence in FAH and FAFH was not caused so much by GDP decreases and unemployment effects but directly through shut down orders and rules limited operating capacity, and related social distances measures and concerns. Nonetheless, unemployment is expected to affect food expenditures, as has previously been the case (Saskena et al., 2018).

Figure 17. Weekly data particularly emphasizes the speed of the COVID-19 shock on food expenditures



Source: USDA, Office of the Chief Economist and Economic Research Service, analysis of data from IRI and Opportunity Insights.

While monthly food expenditure data clearly shows the shocks induced by the response to COVID-19, higher frequency data is more dramatic, depicting the greater swings within a month that get averaged out over the course of a month. The left hand axis of Figure 17 measures the weekly change in food retails sales at grocery stores and supermarkets in the U.S. – units sold, volume equivalent units sold, and total sales changes relative to the same week a year earlier, based on analysis of scanner data supplied by IRI. Comparing growth in units sold versus volume-equivalent units sold indicates the degree to which sales growth is a function of changes in package size of food items purchased. Generally, the two lines move together, but there were periods of divergence between the two after COVID-19 hit, suggesting some changes in package size. The righthand axis measure the change relative to January 24, 2020, in credit and debit card purchases at restaurant and hotels (Opportunity Insights, 2020).[15] Results are broadly consistent with those in Figure 16 even though these represent different sources and types of data. In early March, the three food retail indicators displayed a rapid increase of more than 50 percent relative to March in 2019, around the time the national COVID-19 emergency was declared and shut-down rules on food away from establishments implemented in many regions nationwide.

In Figure 17, the year-to-year changes in sales value tend to be higher than the changes in units sold and volume-equivalent units sold, which is indicative of price inflation in food at home sales, and is consistent with the changes in the CPI measures in Figure 15. Since June, the gap between the sales value and the volume-equivalent units sold has been generally decreasing, implying decreasing food price inflation rates. However, the dip in the volume-equivalent units sold relative to sales in August may be portending a future increase in the food CPI, but the CPI for food consumed at home still decreased slightly from July to August. Note that the mid-April dips in the FAH lines are likely largely due to differences in the timing of Easter -- April 21 for 2019 and April 12 for 2020. The cause of the June 21 uptick in the FAH lines is less certain and may have something to do with consumers reacting to COVID-19 and treating the first days of summer differently in 2020 than in 2019. For instance, normally at that time of year, there would have been wedding and high school graduation parties and the like at restaurants.

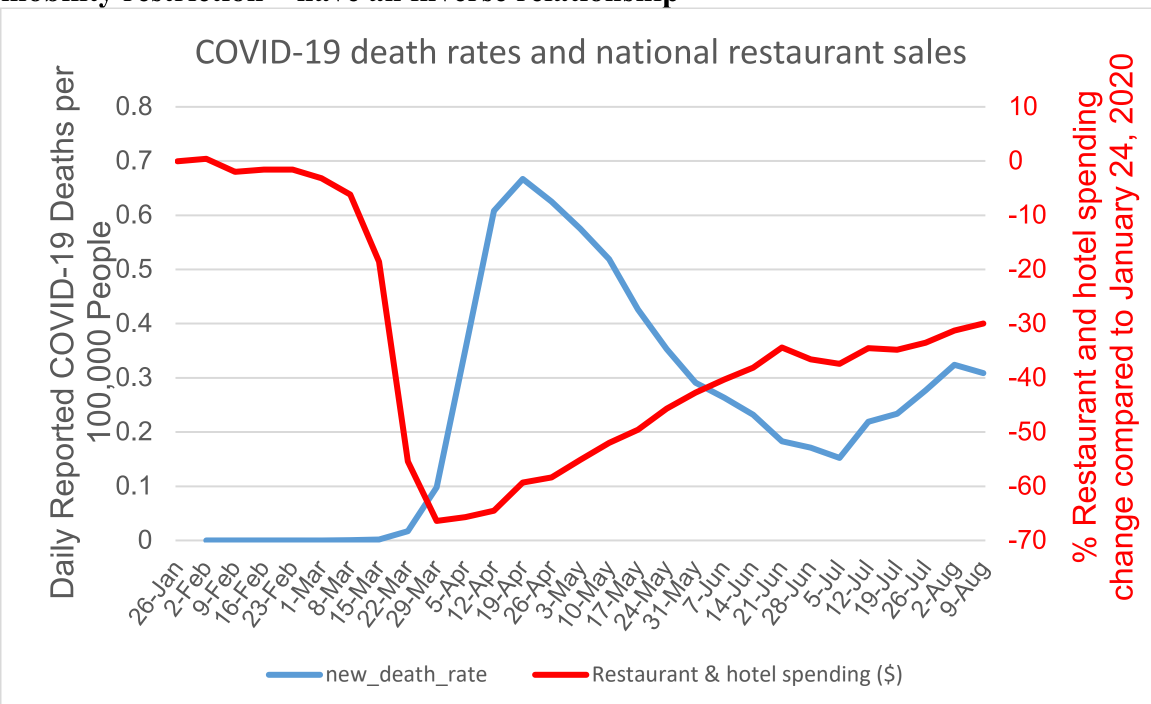
At the same time food retail sales swung upwards in March, the restaurant and hotel expenditures fell even more compared to the pre-COVID-19 period, by around 65 percent by late March. That the increase in retail food expenditures was lower in March than the decrease in food-away-from-home sales is not indicative of lower total food consumption given the greater value-added in the food service sector. By late March/early April, retail food purchases had stabilized somewhat but with sales value and volumes staying higher than the same time the year before. The dollar value of total food retail sales the week of July 26, 2020, was 13 percent higher than the same week last year, while the level of volume-equivalent units sold was 11 percent higher. Year-to-year growth in the value of sales remains higher than volume growth in July but at a smaller margin than in June.

As one might expect, food-away-from-home consumption will tend to fall with increases in mobility restrictions such as shutdown and social distancing policies, and people's concerns over

[15] The restaurant and hotels expenditure data available from Opportunity Insights is not separable.

COVID-19 transmission. Statistics on the number of people infected or dying from COVID-19 can serve as proxies measures and concerns. Figure 18 shows a strong inverse relationship between COVID-19 death rates and restaurant and hotel sales.[16] In April and May 2020, restaurant and hotel sales were increasing as the death rate decreased. Around the period, closure-orders were relaxed. In late June 2020, the rate of increase in restaurant sales started decreasing, likely reflecting concerns over disease transmission as both the COVID-19 death rate and case rate started increasing after a period of decrease.

Figure 18. Restaurant sales and COVID-19 deaths – a proxy for customer behavior and mobility restriction – have an inverse relationship



Source: USDA, Office of the Chief Economist analysis of data from Opportunity Insights.

Supermarket and grocery stores sales as well as units sold, volume equivalent units sold have been on a downward trajectory since later April 2020, moving back towards levels from last year (Figure 17). However, this path shows enough flattening-out that based on a simple projection of the path, reversion of these sales to pre-COVID-19 levels will not happen anytime soon barring significant changes in factors determining these elevated sales levels. In net however, the drop in food CPIs after the initial shock of COVID-19 worked its way through the economy suggests that the U.S. food supply chain has been resilient in face of the massive disruptions associated with major losses in the food-away-from-home markets, the re-channeling of products to home consumption, as well as in dealing with potential challenges in supply associated with minimizing disease transmission threats. This resiliency suggests that the advances in technologies and production and distribution processes that have reduced real food prices over time have been relatively robust in the face of the pandemic.

[16] The simple Pearson correlation coefficient between the COVID-19 death rates and restaurant and hotel sales is -0.74 and is -0.38 for the correlation between reported COVID-19 case (infection) rates and restaurant and hotel sales.

Summary

Increasing agricultural productivity has affected consumer food costs in two primary ways. It has released labor and capital resources once required for agricultural production into the broader economy, supporting economic growth and raising living standards. And it has reduced the costs of producing the commodities that go into food.

While this transition has been common across high-income countries and can be seen at work more recently in countries transitioning from centrally planned economies and in developing countries, it has been particularly pronounced in the United States. U.S. agricultural productivity has grown rapidly over the last century, simultaneously with a decline in the share of agriculture in the broader economy and a concurrent rise in the share of GDP contributed by other sectors.

Key notes from this paper are:

The production of staple commodities in the United States increased by over 400 percent from 1929 to 2017 (or expressed in multiples, it is five times what is was in 1929). This production increase was achieved with 9 percent less cropland area. In 1929, U.S. farms produced 105 million metric tons of basic commodities on 278 million acres of cropland; by 2017, U.S. farms produced 561 million metric tons of those same commodities. Over the same period, the amount of cropland has fallen from 278 million acres in 1929 to 252 million acres in 2017.

Reductions in commodity prices have helped to keep average real retail food prices relatively flat and even falling over time despite increasing global demand. On average, real retail prices for food consumed at home were 2 percent lower in 2019 than in 1980. And lower food prices translate into lower levels of spending compared to other expenditures or as percentage of income.

Americans are able to devote a smaller share of their household expenditures to food consumed at home than people in other countries. Americans' share of expenditures allocated to food consumption at home is about 6 percent, the French allocate about 13 percent, and the Chinese about 22 percent.

The U.S. food supply chain has been resilient in face of the COVID-19 outbreak. Despite the massive disruptions in food supply chains and in mobility as people and commercial enterprises respond to restrictions and lockdowns and disease transmission threats, food price inflation has been falling back to pre-COVID levels for the most part after the initial shock of COVID-19 worked its way through the economy, suggesting that the agricultural sector has been adaptable in dealing with the outbreak.

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Appendix. *ERS Food Dollar Series*

In examining the role of agricultural productivity in the changing costs of food, we also want to consider the changing share of those costs that is accounted for by agricultural commodities. That can be done relatively easily for the United States using the ERS Food Dollar (ERS, 2020d), which breaks out how a dollar spent on U.S. domestically produced food gets divided along the supply chain. The Food Dollar Series is generated by ERS based on their analysis of BLS and BEA data. ERS presents the food dollar through three primary series—the *marketing bill* series, the *industry group* series, and the *primary factor* series. The three series represent distinct perspectives on the sources of market value for the combined annual food dollar expenditures.[17]

The *marketing bill* series is based on sales proceeds. Proceeds from each food dollar expenditure are divided into two sub-components of market value:

- The farm share measures the proceeds of farm commodity sales for the commodities tied to a food dollar expenditure and sold to non-farm establishments. It does not include sales of farm commodities that are incorporated into other commodities and resold to a domestic farm industry that will be used to produce a different consumer food item, such as corn sold for processing into animal feed, which will then become meat—this eliminates double counting.
- The marketing bill is the market value added to farm commodities that are embodied in a food dollar expenditure, measured as $1 minus the farm share.

For calendar year 2017, the farm share was 14.6 cents of each food dollar expenditure, and the marketing bill was 85.4 cents, accounting for the remainder of the food dollar.

The other two series--the *industry group* and *primary factor* series--are value-added concepts and help to clarify the farm-level value of food costs and where along the supply chain beyond the farm gate the various final consumer costs are added.

For establishments contributing to the U.S. food supply, value added for an establishment equals the proceeds from the sale of outputs minus the outlays for commodities purchased from other establishments. The sum of value added by all establishments that contribute to total food dollar purchases equals $1. The *industry group* series is divided into 12 groups, ranging from agribusiness, farm production, and food processing, to legal and accounting.

For calendar year 2017, farm production value added was 7.8 cents of each food dollar expenditure, implying that 6.8 cents from farm commodity sales (from the 14.6-cent farm share) was used to purchase products from the other industry groups. The 2017 industry group value-added food dollar also indicates that about 49.3 cents of the food dollar value covers the services from food retailers (12.6 cents) and foodservice establishments (36.7 cents). The use of energy throughout the food supply chain accounted for 3.8 cents of every 2017 food dollar expenditure. Advertising accounted for 2.6 cents of a food dollar expenditure.

The *primary factor* series are assets employed by establishments to use or transform products purchased from other establishments (intermediate inputs) to produce and market a different

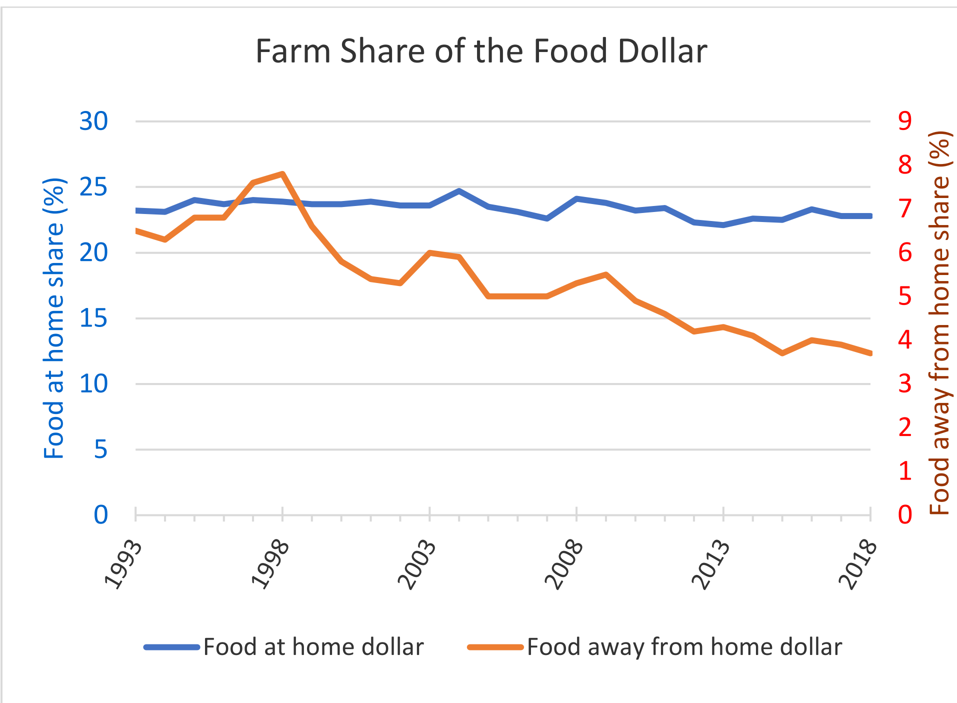
[17] The food price data spreads by ERS provide an alternate look at farm, wholesale, and retail prices (ERS, 2020f; ERS, 2020g).

product. These assets add market value to the purchased intermediate products. The primary factors are salary and benefits, property income, output taxes, and imports.

For calendar year 2017, the *primary factor series* indicates that 50.5 cents of every food dollar expenditure goes to the salary and benefits of domestic workers, 35.3 cents is dispensed as property income, and the remainder is split between U.S. government (output taxes) and international assets (imports).

Over time, the share of food costs accounted for by the value chain beyond the farm gate has increased. As food prices have absorbed both the increasing demand for food services by U.S. households and the increased demand for higher priced services (e.g., full- versus limited-service restaurants), the farm share of the food dollar has fallen steadily (Canning, 2011), as seen in the figure below. This is particularly the case for food consumed away from home.

Appendix Figure 1. As consumer demand for services in food provision has increased, the farm share of food spending has fallen



Source: USDA, Office of the Chief Economist, using data from USDA, Economic Research Service.

Of course, there are other components of the food dollar, such as energy inputs, transportation, marketing, packaging, etc. that have also been increasing or decreasing over time. Nevertheless, the overall cost of food has been declining in the United States for almost all major food categories.