What Has Caused the Increase in Retail Pork Prices?

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Executive Summary

After a period of stable retail pork prices from 2017 to 2019, consumers began facing volatile and rising pork prices in the aftermath of the COVID-19 related shutdowns. Given rising concerns about food affordability, food security, and food availability, this report seeks to determine the root causes of the observed increases in retail pork prices.

- From January 2020 to April 2022, nominal retail pork prices increased 27.3%. The aggregate drivers of this increase are estimated as follows:
  - Pork prices increased by 13.7% as a result of general inflationary pressures brought about by an increase in money supply and other macroeconomic factors outside the pork industry.
  - Pork prices increased by 8.4% as a result of inner-industry supply-side factors. In particular, the marginal cost of producing and selling pork is estimated to have increased 45.6% over the time period in question, which has put upward pressure on pork prices.
  - Pork prices increased by 5.2% as a result of demand-side factors. U.S. consumers' willingness-to-pay for pork is estimated to have increased by 6.3% from January 2020 to April 2022. Strong domestic consumer demand has led to a slight reduction in exports and an increase in pork imports as retailers attempt to satisfy U.S. consumer pork buying.

- Several factors contributed to the 6.3% increase in consumer willingness-to-pay for pork. Analysis suggests that changes in the prices of beef and chicken relative to pork are probably not major drivers of the increased willingness-to-pay for pork. Rather, a more likely driver behind increasing pork demand is strong consumer food spending, buoyed by federal stimulus and COVID-19 relief payments.

- A number of factors contributed to the estimated 45.6% increase in marginal costs of pork production. These include:
  - Significantly higher feed costs. Inflation-adjusted corn prices increased 79% from January 2020 to April 2022, and soybean meal prices increased 42% over the same period.
  - Fuel and transportation costs have escalated. Real gasoline and diesel prices are about 48% higher than in January 2020, and refrigerated trucking rates were up about 50% at the first of 2022.
  - Wages in packing and retailing have outpaced inflation, pushing up pork prices.

- Farm-level hog prices and wholesale pork prices are more volatile than retail pork prices, and the retail pork price increases facing consumers have increased much less than have the prices facing buyers of hogs or wholesale pork.

- At present, implied annual consumer spending (or seller revenue) is up an inflation-adjusted $6.44 billion/year. Nonetheless, because of higher marginal costs, the profitability of producers, including pork retailers, packers, and farmers, is down by -$22.85 billion/year. Moreover, despite higher consumer demand for pork, because of higher prices and lower quantities available, consumers are -$5.19 billion/year worse off relative to pre-pandemic times.

1. Introduction and Background

Rising food prices have captured headlines and have led to concerns about food affordability and food insecurity. As of April 2022, the annual increase in food at home prices, according to the Bureau of Labor Statistics (BLS), was 10.75%. This is the highest rate observed in more than 40 years. Meat products have experienced some of the largest food price increases in recent months. For example, BLS price index data indicate the annual increase in pork prices as of April 2022 was 13.69%, higher than that for the overall food category.

Figure 1 shows data from the U.S. Department of Agriculture, Economic Research Service, which uses BLS prices to construct an aggregate retail pork price. Prior to the pandemic, in January 2020, retail pork prices averaged $3.57/lb in nominal terms. By April 2022, the figure increased to $4.89/lb, a 37% increase. Even after adjusting for inflation, retail pork prices increased from an inflation-adjusted $4.25/lb in January 2020 to $4.89/lb in April 2022, a 15% increase.[1]

Figure 1. U.S. Retail Pork Prices in Real and Nominal Terms, January 2017 to April 2022

As shown in Figure 1, retail pork prices were fairly stable through 2017, 2018, and 2019. Pork prices started to rise in May 2020 in the aftermath of the COVID-19 related shutdowns of pork packing plants when workers became ill. Retail prices receded following the plant shutdowns, but then began an upward trajectory starting in March 2021, a climb which has subsided in recent months.

Given that most of the significant price movements began in 2020, we focus in on the price movements that have occurred since the start of that year. Figure 2 shows changes in

[1] Nearing the completion of this report, the USDA-ERS released the pork retail price for May 2022. The May 2022 figure, $4.886/lb, was essentially unchanged from the April 2022 figure of $4.885/lb.

nominal and real pork prices since January 2020. From January 2020 to April 2022, retail pork prices increased 27.3%. Over the last year alone, from April 2021 to April 2022, retail pork prices increased 13%.

The primary objective of this report is to determine the cause of the retail pork prices increase from January 2020 to April 2022.

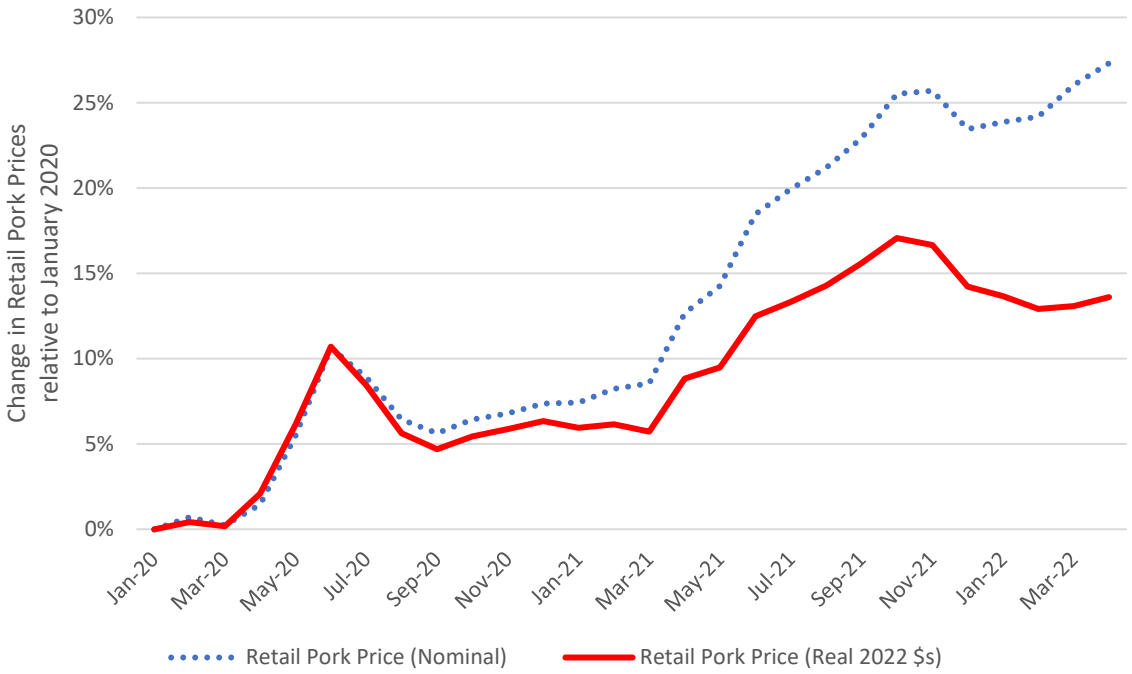

Figure 2. Changes in Nominal and Real U.S. Retail Pork Prices Since January 2020

To fully understand supply and demand drivers, price changes must be analyzed alongside changes in quantity produced and consumed. Figure 3 shows quarterly data from the U.S. Department of Agriculture, Office of the Chief Economist on U.S. pork production, exports, imports, and consumption from the World Agricultural Supply and Demand Estimates (WASDE) from the first quarter of 2017 to through the second quarter of 2022 (the last quarter is an estimated value). Production and consumption are seasonal, reaching a local high in the fourth quarter of the year (October, November, and December) and tend to bottom out in the second quarter (April, May, and June). The difference between U.S. production and consumption is largely explained by exports, which were slowly rising from 2017 to 2020, before falling in recent quarters.

Figure 4 shows changes in production and consumption since the first quarter of 2020. Since the first quarter of 2020, the quantity of pork consumed in the United States has fallen 4.8%. There has been a reduction in exports and an increase in imports, suggesting strong domestic demand, pulling pork off international markets. The large *percentage* change in pork imports is partly explained by the fact that the volume of import imports is small relative to exports and domestic production and consumption

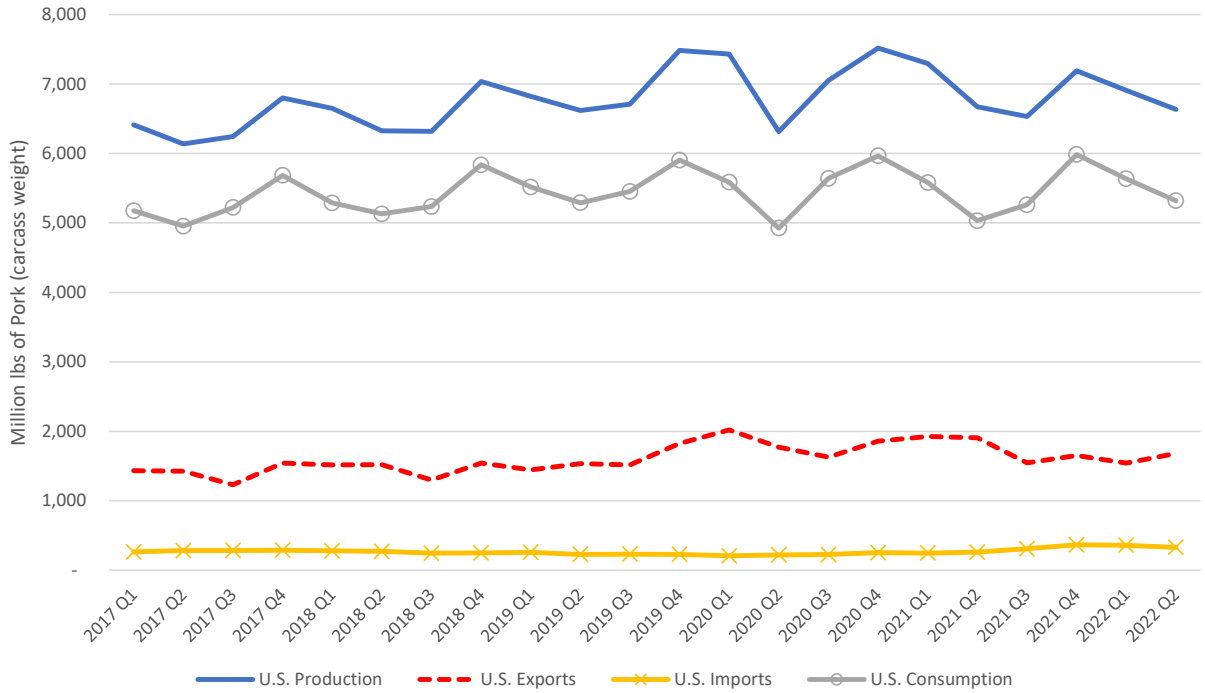

Figure 3. U.S. Pork Production, Exports, Imports, and Consumption, 2017 to 2022

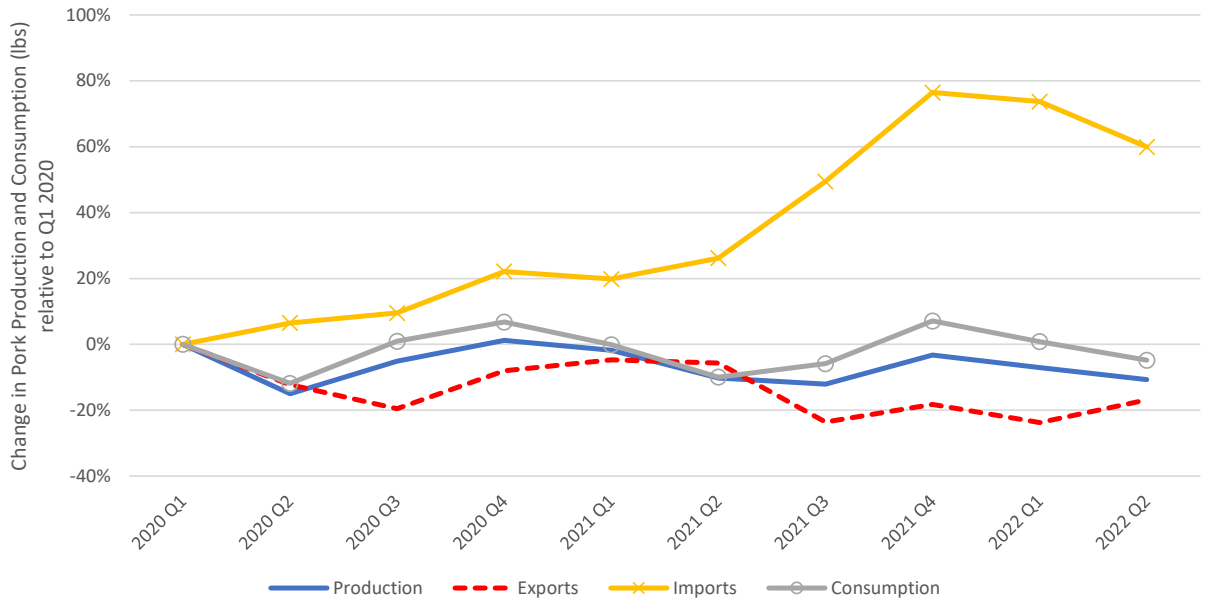

Figure 4. Changes in U.S. Pork Production, Exports, Imports, and Consumption since First Quarter of 2020

2. Effects of General Macroeconomic Inflation

As shown in Figure 2, from January 2020 to April 2022, retail pork prices increased 27.3%. Over the same time, the overall Consumer Price Index (CPI), as reported by the BLS, increased 12.1%. Thus, some of the overall price increase in pork was a result of general price increases across the economy.

Causes of the general inflationary pressures are hotly debated, but it is clear that the aggregate money supply significantly increased following the stimulus packages and aid relief efforts following the onset of the pandemic (see figure 5). The aggregate money supply (M2), as reported by the U.S. Federal Reserve System, increased more than 40% from January 2020 to April 2022.

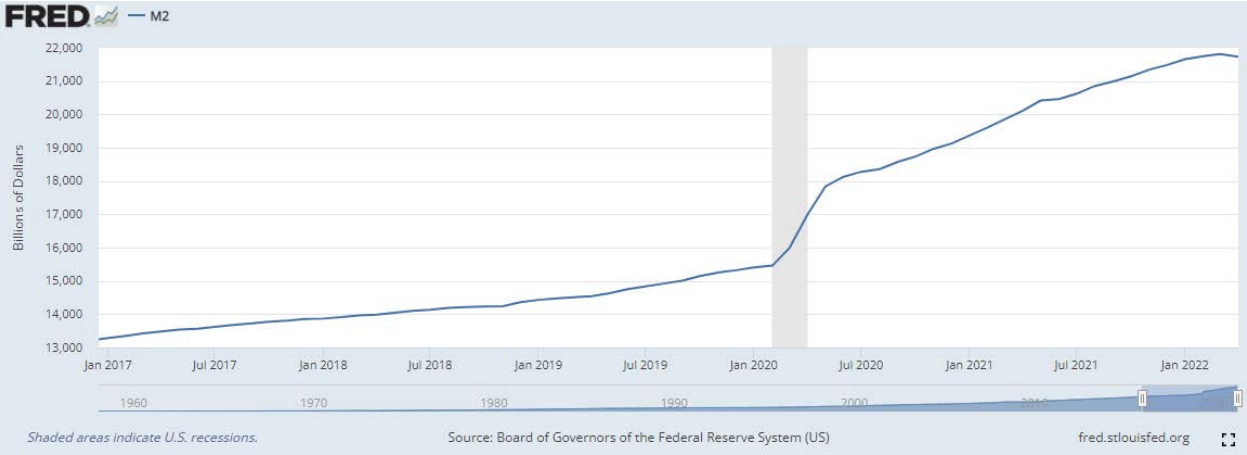

Figure 5. Total U.S. Money Supply (M2) (source: Board of Governors of the Federal Reserve System)

Adjusting the pork prices for the overall rate of inflation, we calculate that real, inflation-adjusted pork prices increased 13.6% from January 2020 to April 2022 (see figure 2). Thus, a little less than half the observed retail pork price increase ((13.6/27.3)*100 = 49.8%) can be explained by real supply and demand factors unique to pork, whereas the remaining 27.3-13.6 = 13.7% of the price rise (50.2% of the total price increase) is a result of overall rates of macro-economic inflationary pressures such as increasing money supply.

3. Decomposing the Inflation-Adjusted Price Increase

As described in the previous section, the real price of pork increased 13.6% from January 2020 to April 2022. What caused this inflation-adjusted price increase? The question can be answered by decomposing the price increase into supply and demand factors.

Following the basic approach outlined in Lusk and Tonsor (2021), let the inverse demand curve for pork, which shows how the price consumers are willing to pay varies with the quantity on the market, be written in differential form as:

(1) $$\hat{P} = \frac{1}{\eta}\hat{Q} + \alpha$$

where $\hat{P}$ is the proportionate change in pork price (i.e., $\hat{P} = \Delta P/P \approx \mathrm{d}\ln P/P$), $\hat{Q}$ is the proportionate change in quantity of pork, and η is the own-price elasticity of demand. One expects η to be negative; as a larger quantity of pork is supplied to the market, the price must fall to induce consumers to consume the extra amount, and by contrast, the smaller the quantity of pork supplied to the market, the price must rise as consumers bid against each other to ration the smaller amount of remaining pork. α is a demand shock representing the proportional change in

consumer's willingness-to-pay for pork - it is the magnitude of the vertical shift in the demand curve expressed relative to the initial equilibrium price. α is the key value of interest for this analysis as it measures the size of the demand shock contributing to the price rise.

The inverse supply curve of pork, which shows how marginal cost (which is also the price the marginal pork producers are willing to accept) varies with the quantity of the market can be expressed in differential form as:

(2) $\hat{P} = \frac{1}{\varepsilon}\hat{Q} + \beta,$

where ε is the own-price elasticity of supply, and β is the statistic of interest representing a supply shock or the increase in marginal cost of production. β is the vertical shift in the supply curve expressed as a proportion of the initial equilibrium price. $\hat{Q}$ and $\hat{P}$ are previously defined. One expects ε to be positive; as consumers demand larger quantities of pork, it takes higher prices to induce producers to make the investments required to generate the higher level of output.

Given data on $\hat{Q}$ and $\hat{P}$, and assumptions about the sizes of the own-price supply (ε) and demand (η) elasticities, the magnitudes of the supply and demand shifts, α and β, can be identified. Simply re-write equations (1) and (2) in terms of the shocks yields the following:

(1') $\alpha = \hat{P} - \frac{1}{\eta}\hat{Q}$, and

(2') $\beta = \hat{P} - \frac{1}{\varepsilon}\hat{Q}.$

From the previous section, we know the change in price and quantity that has occurred since the beginning of 2020. As described in the previous section, the proportionate change in the real price of pork is $\hat{P} = (P_t - P_0)/P_0$ = 0.136, and the proportionate change in the domestic quantity of pork consumed is $\hat{Q} = (Q_t - Q_0)/Q_0 = -0.048$. Following Lusk and Tonsor (2021) and the reference cited therein, we assume the aggregate own-price elasticity of demand for pork is -0.66 (i.e., $\eta = -0.66$), and the aggregate own-price pork supply elasticity is 0.15 (i.e., $\varepsilon = +0.15$). Thus, we calculate the following supply and demand shifts:

(1'') $\alpha = 0.136 - \frac{1}{-0.66}(-0.048)$ = 0.063, and

(2'') $\beta = 0.136 - \frac{1}{0.15}(-0.048) = 0.456.$

These calculations indicate that since January 2020, consumers' willingness-to-pay for pork has increased 6.3%. Over the same time, producers' marginal costs of production have increased 45.6%.

How do these demand and supply shifts factor in to the observed price changes? While we already know the change in price, $\hat{P}$, from observed data (i.e., $\hat{P} = 0.136$), we can see how this observed equilibrium price is achieved by equating equations (1) and (2) and solving for the equilibrium quantity and price changes. We find that the equilibrium price is given by:

(3) $\hat{P} = \frac{-\alpha\eta + \beta\varepsilon}{\varepsilon - \eta} = \frac{-\alpha\eta}{\varepsilon - \eta} + \frac{\beta\varepsilon}{\varepsilon - \eta}.$

Thus, the observed price change can be broken down into the demand-side factors, $\frac{-\alpha\eta}{\varepsilon - \eta}$, and supply-side factors, $\frac{\beta\varepsilon}{\varepsilon - \eta}$. Stated differently, an increase in consumer willingness-to-pay of α will increase the ultimate equilibrium price by $\frac{-\alpha\eta}{\varepsilon - \eta}$. Similarly, an increase in marginal cost of production of β will increase the ultimate equilibrium price by $\frac{\beta\varepsilon}{\varepsilon - \eta}$.

Using these relationships, we determine that the 6.3% increase in consumer willingness-to-pay for pork has led to a 5.2% increase in the price of pork (i.e, $\frac{0.063(0.66)}{0.15+0.66} = 0.052$), and the 45.6% increase in the marginal cost of production has led to an 8.4% increase in the price of pork (i.e, $\frac{0.456(0.15)}{0.15+0.66} = 0.084$). The combined demand (5.2%) and supply (8.4%) price increases add up to the total observed retail pork price increase of 13.6%.

Figure 6 illustrates the phenomena at play. As indicated, beyond general macroeconomic inflation, two exogenous shocks have hit the pork market. The first is the 45.6% increase in marginal cost of production. This shifts the supply curve leftward from S_0 to S_1. While this is a sizable shift in marginal cost, the ultimate impacts on quantity produced is somewhat muted by the fact that the supply curve is highly inelastic (i.e., producers' supply of pork products is highly insensitive to retail pork prices, at least in the short run).[2]

The second shock to the market is a 13.5% increase in consumers' willingness-to-pay for pork. This shifts the demand curve upward and to the right from D_0 to D_1. The combined supply and demand shifts move the equilibrium from point A on the graph to point B, pushing up retail prices by 13.6% and leading to a reduction in quantity of -4.8%.

As previously indicated the total price increase of 13.6% can be broken down into an 8.4% price increase resulting from the supply shift (caused by the 45.6% increase in marginal costs) and a 5.2% price increase resulting from the demand shift (caused by the 13.5% increase in consumers' willingness-to-pay).

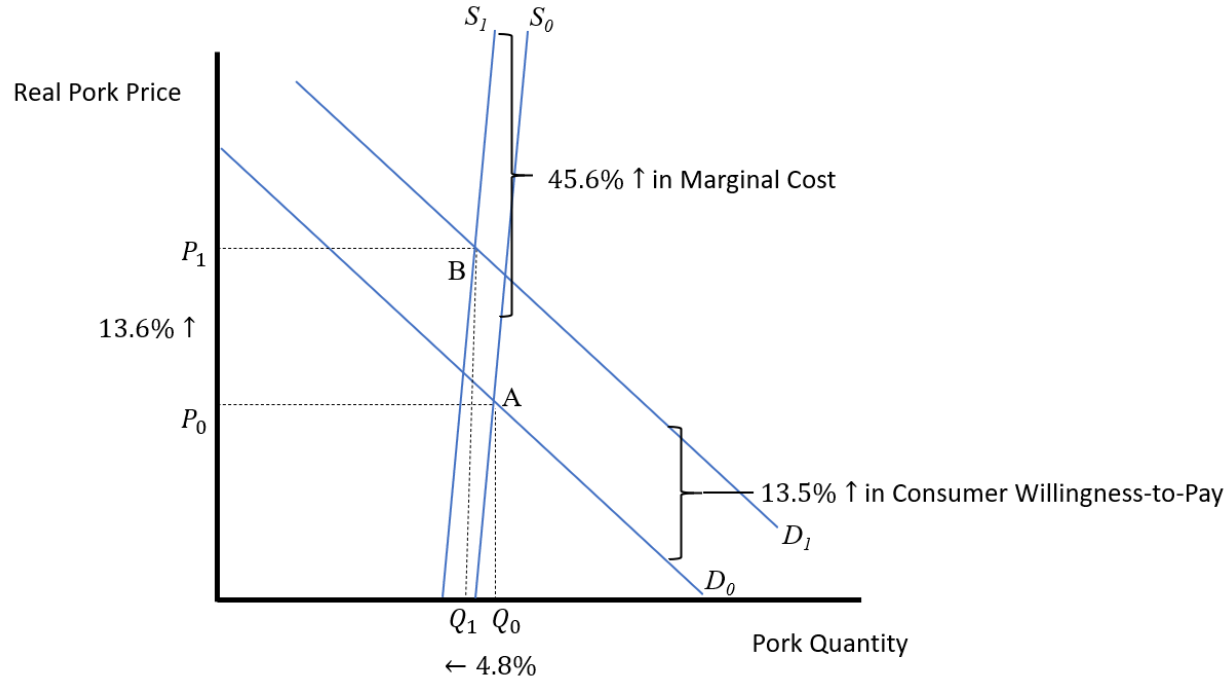

Figure 6. Shifts in Pork Supply and Demand Leading to Observed Price Increase and Quantity Decline

[2] The increase in marginal cost is represented by the 45.6% vertical shift (i.e., in the price direction) in the supply curve. This is equivalent to a $-\varepsilon\beta = -0.15 * 0.456 = -0.068$, or -6.8% inward horizontal shift (i.e., in the quantity direction).

4. Increase in Demand and Consumer Willingness-to-Pay

Figure 6 shows that consumer willingness-to-pay for pork increased 13.5% from January 2020 to April 2022. What are the factors contributing to increased pork willingness-to-pay? One possible explanation is increases in prices of substitutes, such as beef and poultry. If prices of beef and poultry rise, consumers will substitute away from those protein alternatives toward pork. In addition, under the assumption that pork is a so-called normal good, increases in income will be associated with increases in pork demand.

Figure 7 shows changes in inflation-adjusted disposable income (obtained from the Bureau of Economic Analysis) and retail prices of beef, pork, and broilers (obtained from the USDA ERS) since January 2020. From January 2020 to April 2022, beef prices are up 10.8%, broiler prices are up 14.2%, disposable income is up 1.5%, and as previously indicated, pork prices are up 13.6%.

These changes mask a great deal of volatility occurring over this time period. For example, beef prices increased 24% in May 2020 (relative to January 2020) following the COVID-19 related packing plant shutdowns before rapidly falling in the following months. Disposable income spiked in April 2020, January 2021, and March 2021. These were the months in which large government transfers occurred as a result of stimulus and COVID-19 relief payments.

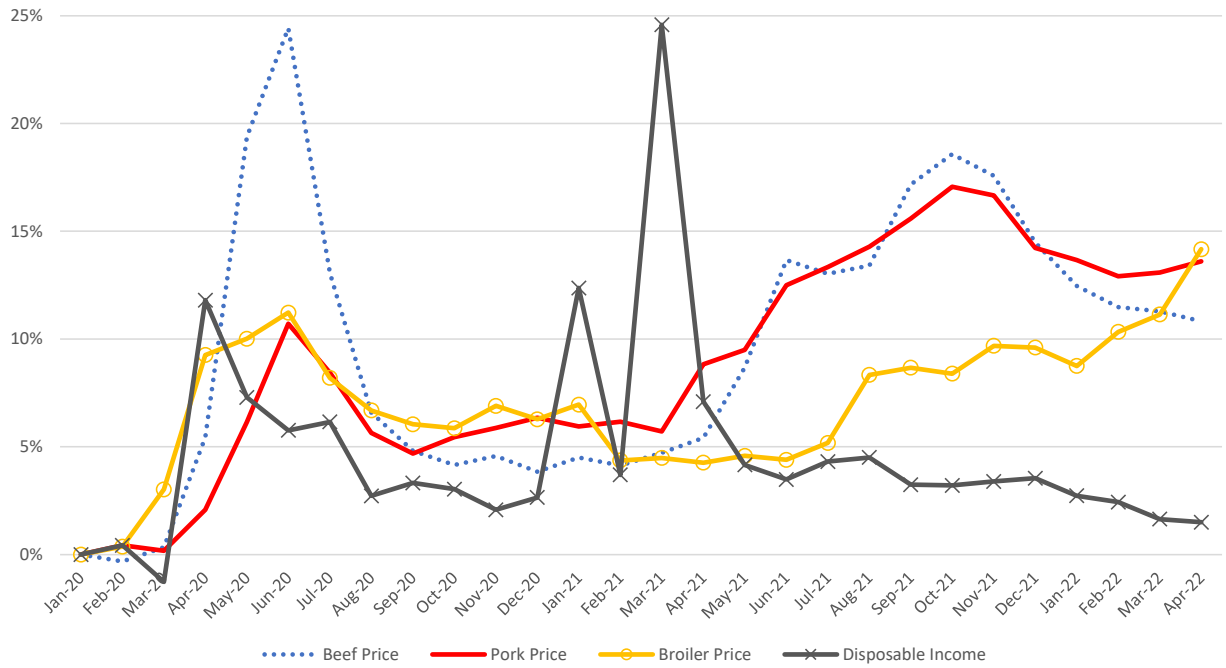

Figure 7. Change in Inflation-Adjusted Disposable Income and Prices of Beef, Pork, and Broilers Since January 2020

The large spike in disposable income in March 2021 occurred just prior to the rapid increases in beef, pork, and broilers prices, lending some support to the view that the influx of government payments helped fuel demand for meat products. It should be noted that overall consumer savings rates show a similar temporal pattern as disposable income in figure 7, which implies the monies received in these months were likely saved and then spent over the subsequent months.

Indeed, real personal consumption expenditures on all goods and services continued to rise over this period, suggesting people used the stimulus and COVID-19 relief payments to smooth spending over time. From January 2020 to April 2022, total inflation-adjusted consumer expenditures increased 5.6%, and from April 2021 to April 2022, they increased 2.8%. Focusing specifically on food spending, Figure 8 shows data from the USDA ERS. While there was a severe drop in food away from home spending (e.g., spending at restaurants) in the early stages of the pandemic, as of March 2022 (the latest data available), real food away from home spending is 11% higher than in January 2020. Inflation-adjusted spending on food for at home consumption (e.g., spending at grocery stores) has consistently been running higher than pre-pandemic levels. As recently as December 2022, spending on food at home was 25% higher than in January 2020, and as of March 2022, spending on food away from home was 11% higher than in January 2020.

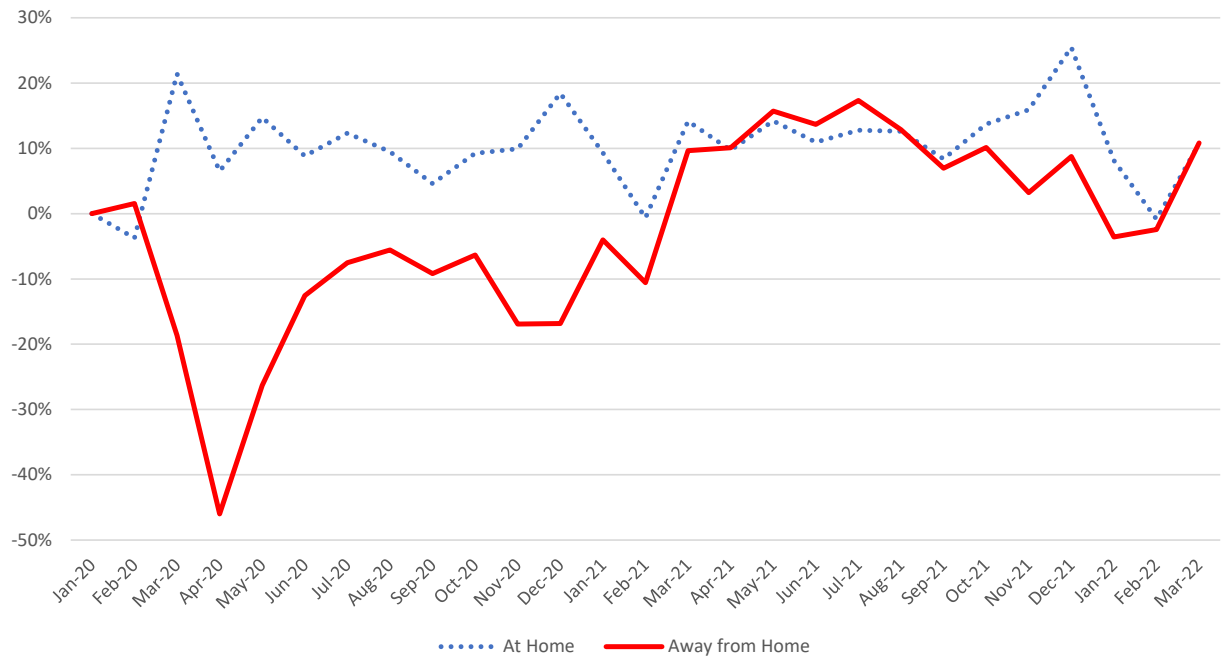

Figure 8. Change in Inflation-Adjusted Spending on Food at Home and Away from Home Since January 2020

Substitution toward or away from pork is driven not only by price changes in isolation but by changes in *relative* affordability. To explore this issue, we calculated price ratios and divided prices of beef and broilers by the price of pork. In general beef tends to be about 1.5 times the price of pork, whereas broilers tend to be about half the price of pork. Figure 9 shows how these price ratios have changed since January 2020. Early in the pandemic, beef and pork became relatively more expensive compared to pork. However, since March 2021 (the beginning of the recent price rises), beef has only become slightly more expensive relative to pork, whereas broilers first trended less and then more expensive to pork.

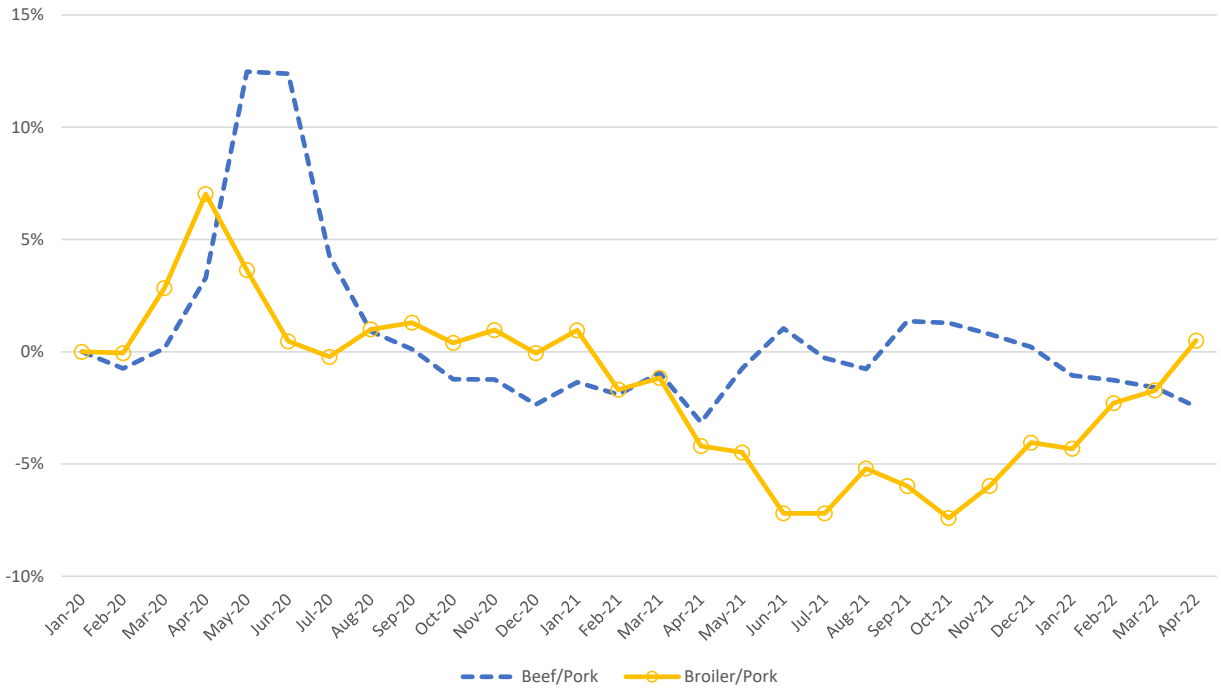

Figure 9. Changes in Beef and Boiler Prices Relative to Pork Prices Since January 2020

Combined the data illustrated in figures 7, 8, and 9 suggest that changes in the price of beef and chicken relative to pork is probably *not* a major driver of the increased willingness-to-pay for pork. Rather, a more likely driver is strong consumer food spending, buoyed by federal stimulus and COVID-19 relief payments.

5. Reduction in Supply and Increases in Producer Cost

As indicated, we estimate a 45.6% increase in marginal costs of pork production, which contributed to an 8.4% increase in real pork prices since January 2022 (see figure 6). This section considers the specific factors that pushed up the cost of production.

Figure 10 considers changes in feed costs, relying on USDA-AMS reported cash prices. Inflation-adjusted corn prices (Chicago) increased 79% from January 2020 to April 2022. Inflation-adjusted soybean meal prices (48% protein from Illinois) increased 42% from January 2020 to April 2022. Because feed often represents more than half the total costs of half production, these increases in food ingredient prices have undoubtedly pushed up the cost of pork production.

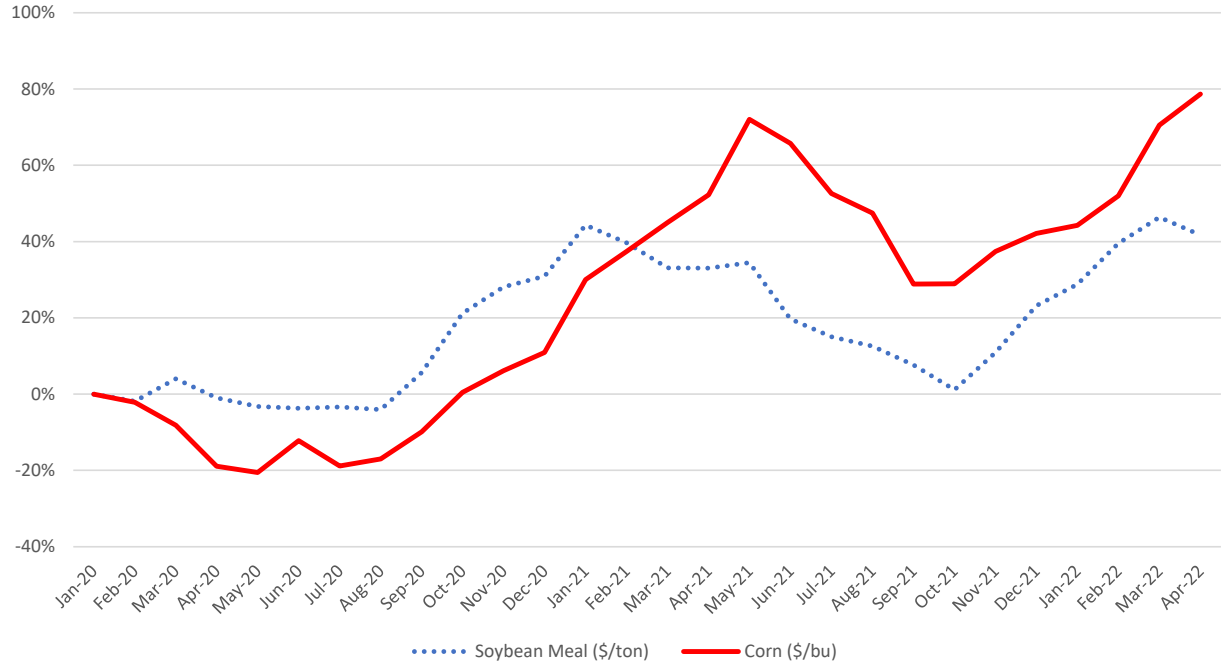

Figure 10. Change in Inflation-Adjusted Costs of Feed Since January 2020

Another significant driver of retail pork costs is transportation. Moving hogs from farm to market, and then meat from packer to retailer requires fuel and trucking. Data from the Bureau of Labor Statistics on the cost of gasoline and diesel were collected, and were adjusted for inflation. As show in figure 11, both diesel and gasoline prices have increased 48% from January 2020 to April 2022.

To our knowledge, there are not widely available public information on trucking rates specific to livestock or meat. However, the USDA-AMS reports refrigerated trucking rates ($/mile) for fruits and vegetables, which might serve as a proxy for hog and pork shipping rates. Figure 11 shows a 35% in refrigerated trucking rates from January 2020 to April 2022. This is off a high in January, when trucking rates were almost 50% higher than in January 2022.

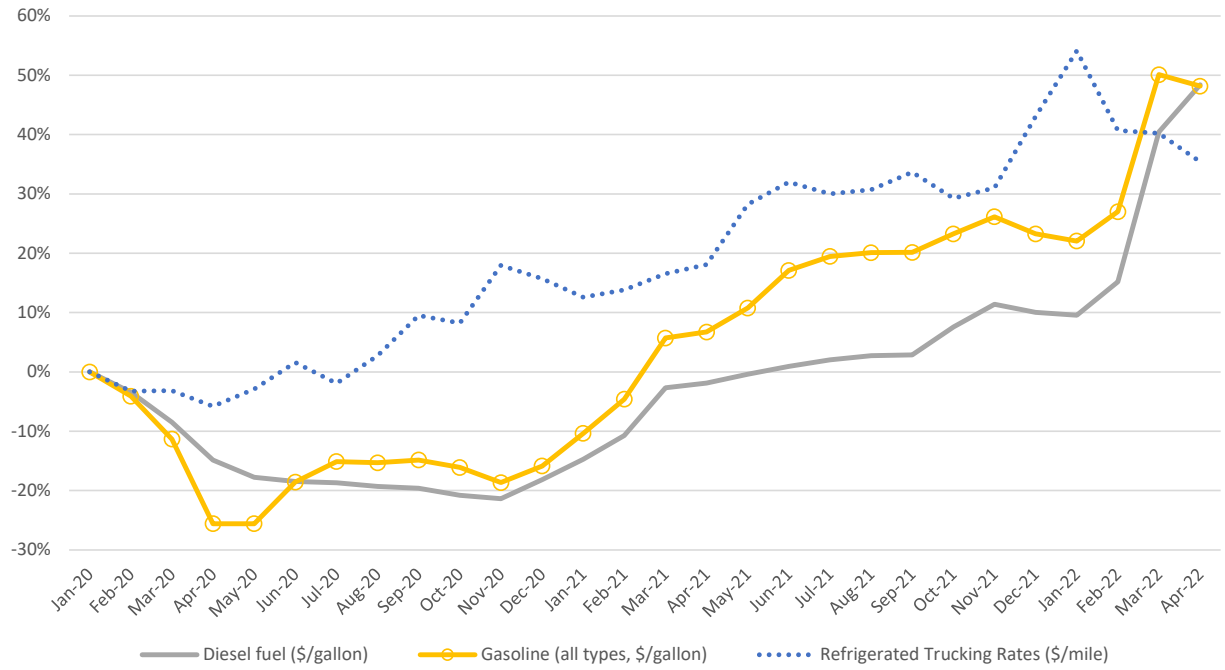

Figure 11. Changes in Inflation-Adjusted Cost of Fuel and Transportation Since January 2020

Another cost driver is labor. Figure 12 shows BLS data for different measures of labor cost. Inflation-adjusted wage rates ($/lb) for all employees increased 2% for meat packing and 6% for grocery since January 2020. Looking at total weekly earnings by non-supervisory employees, real pay is up 10% in meat packing since January 2020, while being flat for grocery.

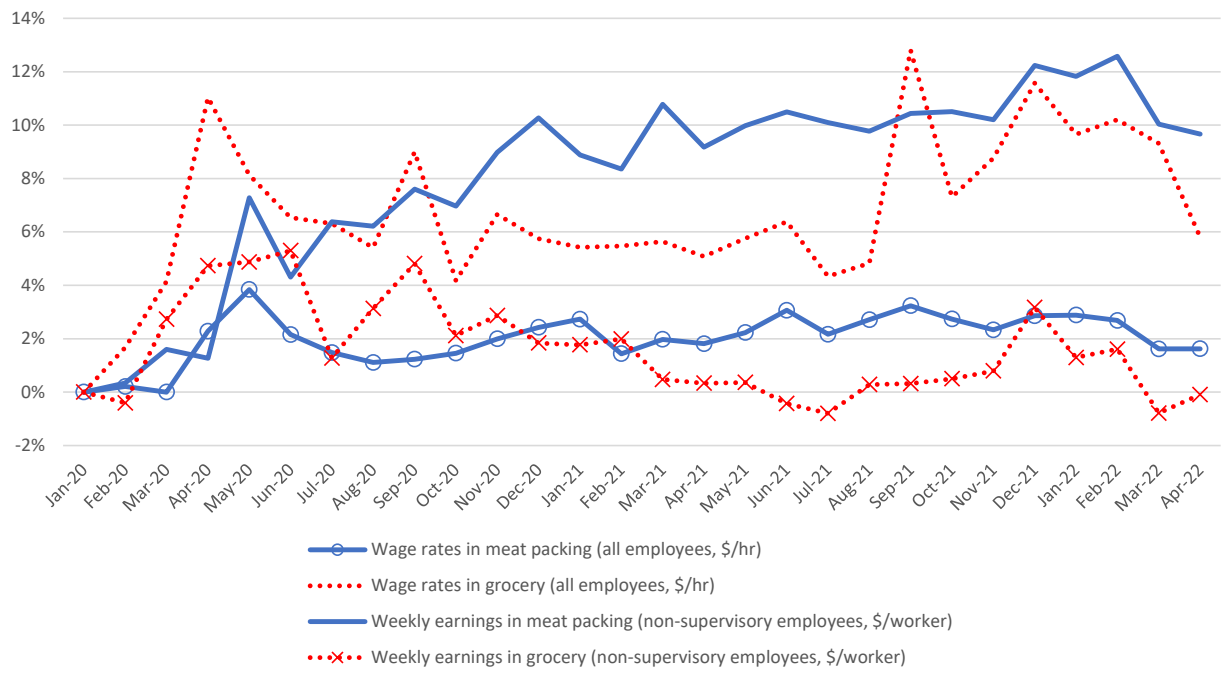

Figure 12. Changes in Inflation-Adjusted Cost of Labor in Meat Processing and Retailing Since January 2020

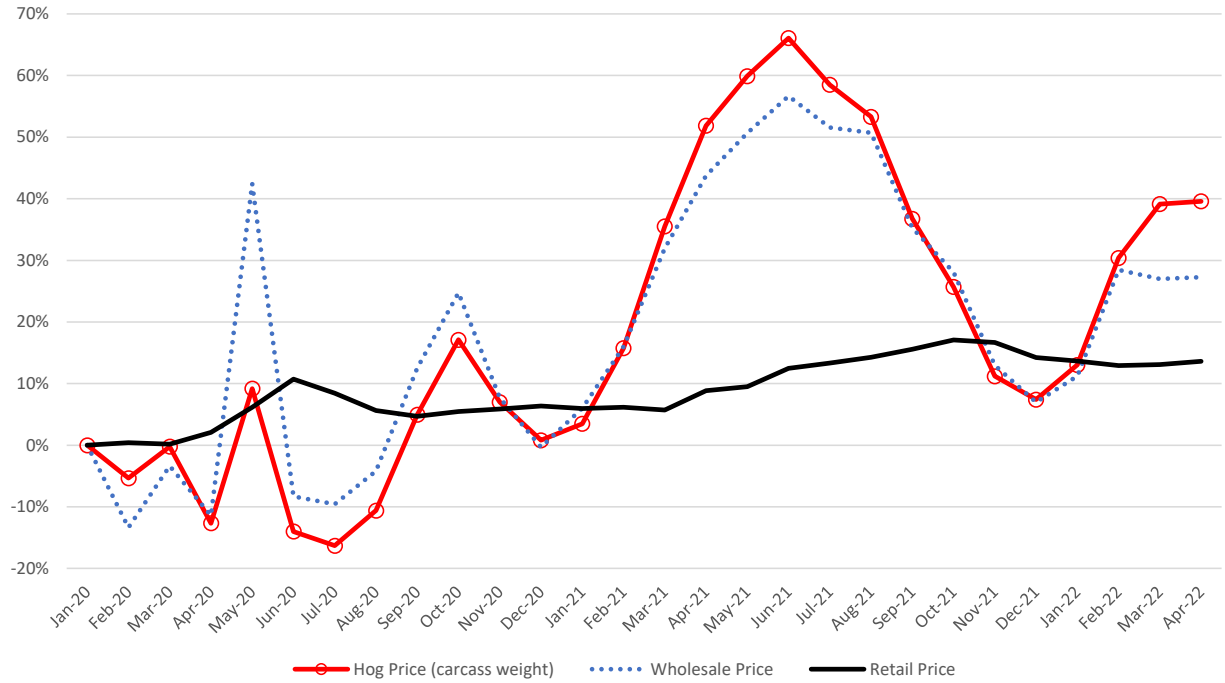

Figure 13. Change in Inflation-Adjusted Farm, Wholesale, and Retail Pork Prices since January 2020

Figure 13 shows the changes in inflation-adjusted hog and wholesale pork prices since January 2020. From January 2020 to April 2022, hog, wholesale pork, and retail pork prices increased 39.6%, 27.3%, and 13.6%, respectively. Of course, some of the increase in hog and wholesale pork prices reflect the increasing feed, transportation, and labor costs illustrated in figures 10 through 12. Figure 13 further reveals, however, that farm and wholesale prices are much more volatile than retail prices and that consumer prices have not increased at the same rate as have hog and wholesale pork prices.

6. Changes in Consumer and Producer Economic Well-Being

Given data on changes in prices and quantities, $\hat{P}$ and $\hat{Q}$, and the magnitudes of the supply and demand shifts, α and β, all of which were calculated in the previous sections, it is straightforward to calculate economic welfare changes. First, note that we can approximate changes in total consumer spending or total revenue to pork sellers as $\hat{R} \approx \hat{P} + \hat{Q} = 0.136 - 0.048 = 0.088$. Thus, compared to the situation pre-COVID, total pork spending and revenue is up 8.8%. To put this in absolute terms, note that in the three years prior to COVID, 2017 through 2019, real monthly pork prices averaged $4.37/lb. The implied annual retail pork consumption over this time was 16.7 billion pounds, implying annual revenue, pre-COVID of $4.37*16.7 = $73.17 billion/year. Combined, this implies that at present, implied annual consumer spending (or seller revenue) is up 73.17*0.088 = $6.44 billion/year.

While this large increase in revenue might be interpreted to imply a positive outcome for pork sellers, that need not be the case. Recall, we calculate marginal costs have increased 45.6%. To calculate a measure of producer profitability (here producer includes every party from the grocery store to the packer to the producer), we can calculate change in producer surplus as

(4) $\Delta PS = P^0 Q^0 (\hat{P} - \beta)(1 + 0.5\hat{Q})$,

where P^0 and Q^0 are the price and quantity at the initial equilibrium, making $P^0 Q^0$ total revenue/expenditures for pork at the initial equilibrium. Plugging in the numbers, we calculate that at current price and quantity levels, implied annual producer profitability is down -$22.8 billion/year relative to the 2017-2019 average. It is further important to appreciate this decline in producer economic well-being would have been more extreme if not for consumer pork demand growth which supported higher pork prices.

In a similar manner, changes in consumer well-being can be calculated. Even though consumer willingness-to-pay has increased 13.5%, they're also paying 13.6% higher prices and consuming 4.8% less pork. Change in consumer surplus is given by:

(5) $\Delta CS = -P^0 Q^0 (\hat{P} - \alpha)(1 + 0.5\hat{Q})$,

which amounts to -$5.19 billion/year. That is, consumers are worse off by -$5.19 billion per year at current price and quantity levels. This is the amount of money that would have to be given to consumers, as a group, to make them as well off as they were prior to the shocks that began after January 2020.

Combined, these estimates indicate that consumer and producer economic well-being is $28 billion/year lower than the 2017-2019 period.

7. Summary

This report examines the underlying causes of retail pork prices increasing since January 2020. Figure 14 provides a convenient summary of the main findings. General macroeconomic factors are responsible for 50.2% of realized retail pork price increases. Meanwhile inner-industry supply-side factors resulting from increased production costs have driven 30.8% of the observe price increase and consumer demand factors resulting from increased willingness-to-pay have driven 19% of realized retail pork price increases. Given society-wide interest in the topic of inflation these estimates provide valuable context on the root drivers of higher retail pork prices.

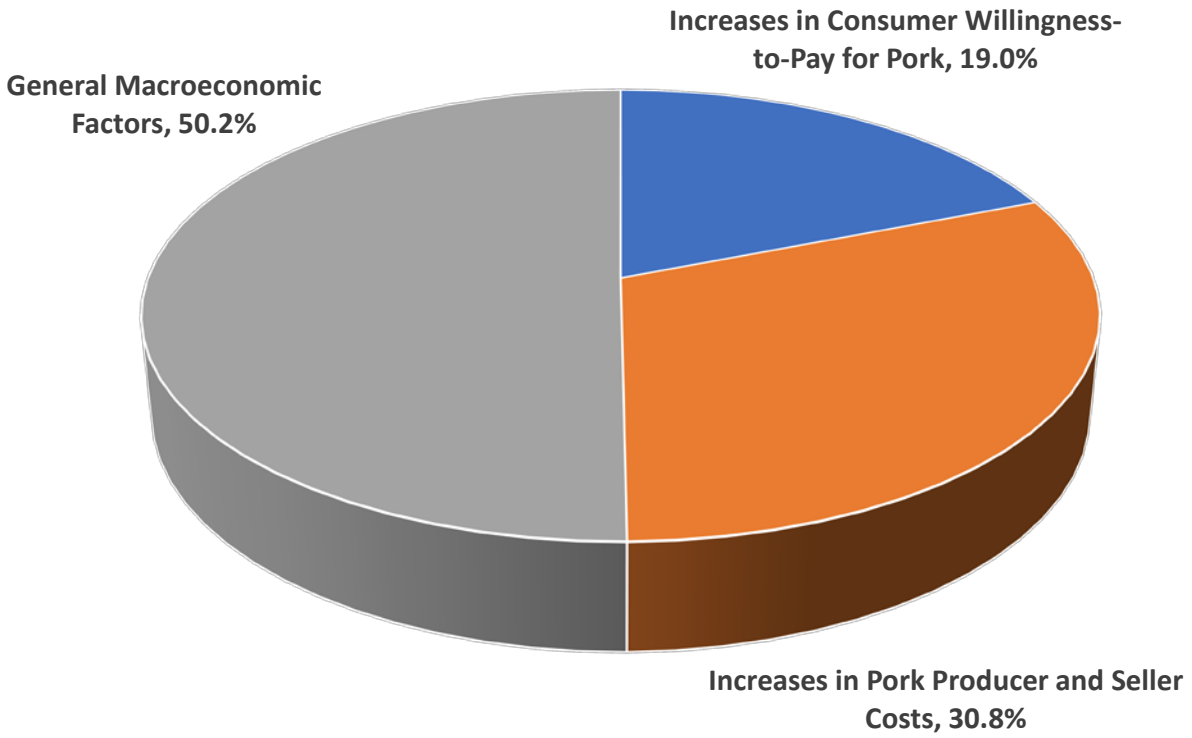

Figure 14. Relative Drivers of Change in Retail Pork Prices since January 2020

8. References

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