B R I E F I N G

Technology Changes in the U.S. Beef and Pork Sectors

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Objective

Analysis

for Informed

Decision Making

Substantial technological changes have occurred in the farm production and food processing sectors over the past several decades. Technological improvements in genetics, health and nutrition, capital equipment, processing methods, and products and services are examples of these changes. Technological developments have generally been a result of changing market prices, competitive pressures from globalized markets, improved transportation and storage, advanced information systems, and increasing consumer demands for quality-differentiated products.

Technological adoption by farmers and food processors generally reduces average production costs and occurs when firms have the financial capacity for adoption.

In the U.S. beef and pork sectors, technological change has occurred concurrently with declining real (inflation adjusted) farm (slaughter) prices and farm-wholesale marketing margins.

Farm-wholesale margins are the difference between boxed beef prices and live cattle prices, adjusted for product conversion and by-product values. For example, USDA data indicate that from 1970-1998 real slaughter steer and hog prices declined by 50 percent and 66 percent, respectively, while real beef and pork farm-wholesale marketing margins declined by 57 percent and 65 percent, respectively (Figures 1 and 2).

Economists have attributed the declines in real prices and margins to stagnant or declining retail demand for red meat, increased red meat and poultry supplies, and increased imports (live animal and meat). Technological change may also be a contributing factor to declines in real farm prices and farm-wholesale margins.

Technology Importance

Adoption of new technologies by agricultural producers and processors usually increases labor productivity and lowers average production costs. This can result in changing the supply of agricultural commodities and food products and the demand for production and marketing inputs. In turn, retail, wholesale, and farm prices may change. In the beef and pork meat packing industries, increases in firm size (increasing scale economies) has accompanied technological change.

Market concentration has also increased in the meat packing industry and is often represented by the four-firm concentration ratio, or percent of industry sales by the four largest firms. For steer and heifer slaughter, the concentration ratio increased from 21.0 in 1970 to 80.0 in 1998; for hog slaughter, the ratio increased from 32.0 to 53.0 over the same period.

As a result of high market concentration, producers are concerned that meat packers may be exercising market power and paying lower prices for livestock compared to prices under more competitive conditions. The presumption is that increased market concentration in the meat packing industry reduces competitive bidding on livestock. But, this presumption ignores the potential positive effects on livestock prices from cost-saving technologies.
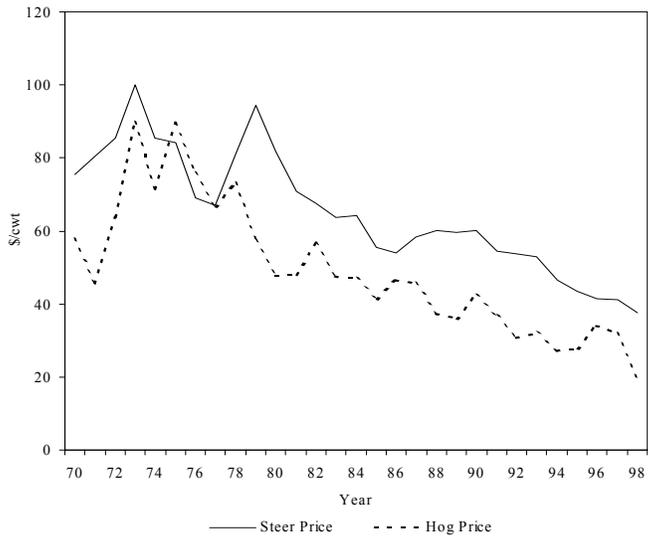
Figure 1. Real Slaughter Steer and Hog Prices, 1970-1998
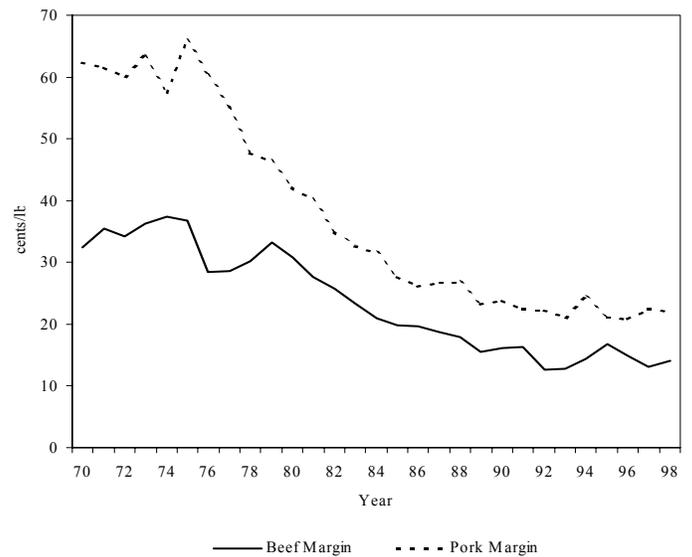
Figure 2: Real Beef and Pork Farm Wholesale Margins, 1970-1998

Technological developments in the beef and pork industries have varied in type and scope. At the farm production level, genetics, animal health and nutrition, and other management practices have increased calf-crop percentages and calf weaning weights. The latter has contributed to heavier dressed weights of steers and heifers. Likewise, the size of pig litters and pigs saved per litter have increased, and hogs have been fed to heavier slaughter (and dressed) weights while maintaining relatively lean carcasses.

At the livestock finishing level, technological changes are the result of capital substitution for labor, improved health and feed nutrition management, and advanced information (computer) systems. These factors, along with improved animal genetics, have increased livestock feed conversion rates and slaughter weights consistent with quality and yield grade requirements by meat packers.

At the meat packing level, technological changes have been manifest in new capital equipment, processing and handling methods, infrastructure, and information systems. These changes have increased labor productivity and lowered average (or per head) costs of slaughtering and processing. Labor productivity, measured by an index of output per employee hour in the meat packing industry, has demonstrated a strong positive trend (Figure 3). Specifically, the labor productivity index

(base year of 1987 = 100) increased from 57.7 in 1970 to 103.8 in 1998, or nearly 80 percent.

Price and Margin Study

The economic well-being of livestock producers is highly related to the level of farm prices. Farm prices and farm-wholesale margins are also closely related. For example, meat packer technology that increases slaughtering and carcass fabrication efficiencies

reduce average slaughter and processing costs and farm-wholesale margins. In addition, reduced average slaughter and processing costs may result in packers passing on cost savings to producers by paying higher prices for livestock. On the other hand, increases in farm supplies from technology changes may reduce livestock prices. For example, genetic changes that increase average slaughter weights generally reduces slaughter prices (holding demand constant). However, larger animals can increase
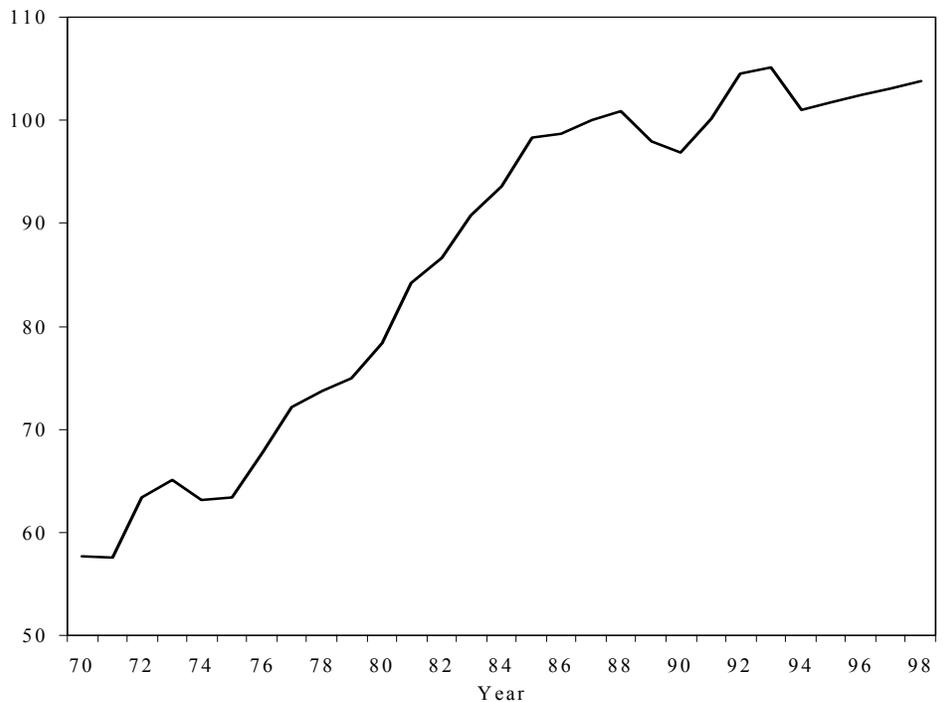
Figure 3: Meat Packer Productivity, Index of Output Per Employee Hour (1987=100), 1970-1998

handling costs and, therefore, increase the size of farm-wholesale margins.

Overall, consumer demand, farm supplies, marketing costs, and international trade are known to affect prices and margins. Some research has suggested that increased meat packer concentration has contributed to increases in farm-wholesale margins and reductions in livestock prices. Such conclusions may fail to account for the positive price effects of technological cost savings in the meat packing industry.

We econometrically estimated factors contributing to long-term declines in real slaughter prices and farm-wholesale margins in the beef and pork sectors for the years 1970 to 1998 (see Brester and Marsh). The economic arguments of our model include factors that determine demand and supply at the meat packing and farm production levels, but our primary emphasis was on technological change.

Technological change in the beef and pork sectors was measured in three areas: (1) meat packing technology represented by an index of output per employee hour in beef and pork slaughtering; (2) livestock finishing technology represented by the percent of cattle feeding firms with capacities greater than 16,000 head and the percent of hog production firms with sow inventories exceeding 500 head; and (3) farm production technology proxied by average dressed weights of steers and heifers and average dressed weights of hogs.

From 1970-1998, meat packing technology increased by about 80 percent. Livestock finishing technology (larger finishing firms) for cattle and hogs increased by about 151 percent and 356 percent, respectively. For the same period, average dressed weights increased by 18 percent for steers and heifers and 12 percent for hogs. Dressed weights of slaughter livestock represent productivity increases of breeding herds caused by genetics and animal nutrition/management.

Technological Impacts—Margins

Our research strongly suggests that technological cost savings in the meat packing industry have contributed to reductions in farm-wholesale margins.

Statistical results indicate that for every 1 percent increase in meat packer productivity, real farm-wholesale beef and pork margins decline by 1.85 percent and 1.43 percent, respectively. Based on the 80 percent increase in meat packer technology from 1970 to 1998, the cost savings were responsible for reductions in the beef and pork margins of 34.9 cents/lb (148.0 percent) and 43.1 cents/lb (114.4 percent), respectively, for this period.[1]

The other technology factors of firm finishing size and farm productivity affected the farm-wholesale beef margin, but they did not affect the pork margin. Increases in feedlot size tended to increase beef farm-wholesale margins, suggesting that large feedlots with scale economies could offer cattle to meat packers at lower prices due to cost savings. Alternatively, larger feedlots selling more finished (higher quality) cattle on value-based contracts may have led to lower prices of remaining cattle sold on *averages* in the open market, thus, increasing the farm-wholesale beef margin.

Of particular interest is the effect of farm production technology on beef farm-wholesale margins. Statistical results (coefficients) indicate that a 1 percent increase in average dressed weights of cattle increases the beef margin by 2.8 percent, suggesting that increases in animal size may increase handling and processing costs.

From 1970 to 1998, average dressed weights of cattle increased by about 18 percent. Based on our results, the change in farm production technology for this period increased the margin by 11.9 cents/lb. (50.4 percent).[2] The combined effects of farm production and meat packer technologies in the beef sector indicate packer technology has dominated, contributing to a net reduction in the farm-wholesale beef margin of 23.0 cents/lb. This estimate is consistent with the overall decline in the real farm-wholesale beef margin.

Technological Impacts—Prices

Although technological changes have influenced farm-wholesale margins, beef and pork producers are particularly concerned about the effects of technological changes on livestock prices. For example, changes in meat

packer technology may affect packer demand for livestock and changes in farm production technology may affect the supply of livestock. Our statistical results indicate that cost-reducing meat packer technology has demonstrated positive effects on slaughter cattle and hog prices.

For example, a 1 percent increase in meat packer technology increased cattle and hog prices by 0.17 percent and 0.34 percent, respectively. At least some competition existed in the meat packing industry during a period of increasing market concentration. That is, part of the packer technological cost savings have been passed on in the form of increased prices for livestock and reduced farm-wholesale margins.

Livestock finishing technology did not affect beef or pork slaughter prices, while farm production technology only affected beef prices. Increases in farm technology reduced slaughter cattle prices due to larger beef supplies (pounds). Statistic-ally, the coefficients indicate that a 1 percent increase in farm technology (average carcass weights) reduced slaughter cattle price by 0.60 percent.

Farm production technology and meat packer technology have opposite farm-level impacts in the beef sector. Economic theory suggests that increases in farm production technology such as animal genetics and health and feed nutrition would increase livestock supplies and reduce livestock prices. In addition, increases in meat packer technology such as new capital equipment and processing methods would increase the demand for livestock and increase livestock prices.

USDA data from 1970 to 1998 show that average dressed cattle weights increased by about 18 percent and meat packer productivity increased by about 80 percent. Based on an average real slaughter steer price ($65.20/cwt) for this period, the increase in meat packer productivity increased slaughter steer price by $8.87/cwt (13.6 percent), and the increase in farm productivity decreased slaughter price by $7.04/cwt (10.8 percent).[3] Thus, the positive price effect of meat packer productivity offset the negative price effct of farm productivity,

resulting in a net gain in slaughter cattle price of $1.83/cwt (2.8 percent). This net price gain difference is consistent with the decline in the farm-wholesale margin for beef.

Conclusions

We find that changes in meat packing technology in a highly concentrated industry contributed, in part, to reductions in the real farm-wholesale beef and pork marketing margins. Packer technological change also supported, in part, real slaughter cattle and hog prices during a period of real price declines. This suggests that enough competition existed in the meat packing industry during the 1970-1998 period to transfer some technological cost savings (reductions in average slaughter costs) to producers through increased demand for livestock. Increased meat packer concentration may have caused some decrease in livestock prices, but technological cost savings in the meat packing industry have also been passed on to beef and hog producers. Changes in farm production technology have contributed to declines in real farm prices, especially in the beef sector. Another major factor causing declines in real farm prices (and overwhelming the packer technology effect) has been the decline in consumer demand for beef between the mid-1970's and 1998.

Successful firms in a competitive commodity production sector rely heavily upon the adoption of low-cost strategies. Livestock and meat producers adopt technologies which lower average production costs. Increased profits will invite firm entry into the industry, and unless consumer demand (domestic and international) substantially increases, real livestock prices will decline. Thus, the adoption of technologies which enhance productivity may continue to exert downward pressure on real livestock prices.

Endnotes

[1] The estimated beef coefficient of -1.85 multiplied by the 80 percent increase in meat packer productivity results in a 148.0 percent decrease in the beef farm-wholesale margin. The 148.0 percent decrease multiplied by the 1990-1998 average value of the beef farm-wholesale margin (23.58 cents/lb.) results in a 34.9 cents/lb. decrease in the beef margin. The estimated pork coefficient of -1.43 multiplied by the 80 percent increase in meat packer productivity results in a 114.4 percent decrease in the pork farm-wholesale margin. The 114.4 percent decrease multiplied by the average value of the pork farm-wholesale margin (37.65 cents/lb.) results in a 43.1 cents/lb. decrease in the pork margin.

[2] The estimated beef coefficient of 2.8 multiplied by the 18.0 percent increase in average dressed cattle weight results in a 50.4 percent increase in the beef farm-wholesale margin. This 50.4 percent multiplied by the 1970-1998 average value of the beef farm-wholesale margin (23.58 cents/lb.) results in a 11.9 cents/lb. increase in the margin.

[3] The estimated beef coefficient of 0.17 (effect of packer technology on steer price) multiplied by the 80 percent increase in meat packer productivity results in a 13.6 percent increase in slaughter steer price. The 13.6 percent multiplied by the 1970-1998 average real steer price (65.20/cwt) results in a steer price increase of $8.87/cwt. The estimated beef coefficient of -0.60 (effect of farm technology on steer price) multiplied by the 18 percent increase in average dressed cattle weight results in a 10.8 percent decrease in slaughter steer price. The 10.8 percent multiplied by the average steer price of $65.20/cwt results in a steer price decrease of $7.04/cwt.

For More Information

Brester, G. W., and J. M. Marsh. "The Effects of U.S. Meat Packing and Livestock Production Technologies on Marketing Margins and Prices." *Journal of Agricultural and Resource Economics* (December 2001):445-462.