Technological Changes in Beef and Pork Production: Effects on Marketing Margins and Prices

By John M. Marsh and Gary W. Brester

Inflation-adjusted farm prices and farm-wholesale marketing margins for beef and pork have declined over several decades. For example, from 1970 to 1998, real slaughter steer and hog prices declined by 50% and 66%, respectively, while real beef and pork farm-wholesale (FW) marketing margins declined by 57% and 65%, respectively (Figures 1 and 2). These changes have been attributed to declining retail demand, increased red meat and poultry supplies, and increased meat packer concentration (Azzam & Anderson, 1996; Purcell, 1989). However, technological change may also contribute to declines in real farm prices and FW margins.

Technological change in the food processing industry has increased rapidly over the past several decades. The major drivers have been changing relative prices, increasing competitive pressures from globalized markets, improving transportation and logistics infrastructures, evolving information systems, and increasing consumer demands for quality-differentiated products (Antle, 1999; Brester, Schroeder, & Mintert, 1997). In theory, technological change in a competitive food processing industry should reduce unit production costs, consumer prices, and marketing margins while increasing farm output prices.

Our study focuses on the effects of changing meat packer and farm-level technologies on real beef and pork farm-wholesale marketing margins and on livestock prices. Results indicate cost savings from meatpacking technologies increase real livestock prices, while technological changes at the farm level reduce real livestock prices. On balance, the positive effect from meatpacking technology

outweighs the negative effect of farm-level technological change.

Price and Margin Study

For livestock producers, farm prices and FW margins are closely connected. Cost changes that affect FW margins in the meatpacking sector may lead to changes in farm-level prices. Alternatively, changes in farm supplies that change livestock prices can influence FW margins. Overall, primary (i.e., consumer) demand, farm supplies, marketing costs, market power of agribusiness firms, and international trade are known to affect farm prices and margins. Technological change may also influence livestock prices and FW margins.

Previous studies on technological change in the livestock-meat industry have generally focused on meatpacking and its relationship to market concentration. Increases in meatpacker concentration reflect both scale economies and technological change. MacDonald, Ollinger, Nelson, and Handy (2000) estimated the influence of scale economies on meatpacking cost functions with the use of time trends as proxies for technological change. Some studies on meatpacker concentration and livestock prices have also used time trends as proxies for technology. Still others assumed that technological change was subsumed by measures of market concentration. Thus, the effects of technological change and market concentration have not been clearly distinguished.

We focus on factors contributing to long-term declines in real slaughter prices and FW margins in beef and pork over the 1970–1998 period (Brester & Marsh, 2001). Technological change and other
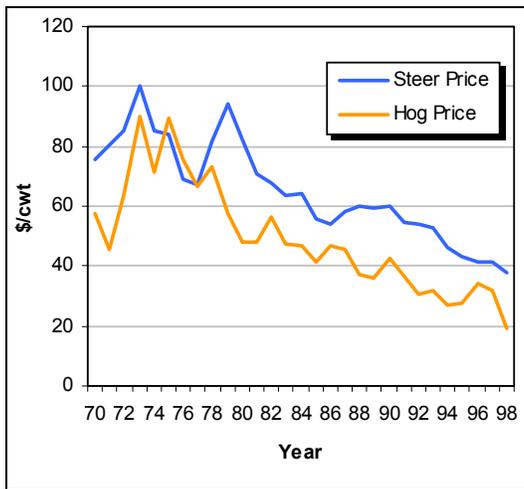
**Figure 1.** Real slaughter steer and hog prices, 1970–1998.
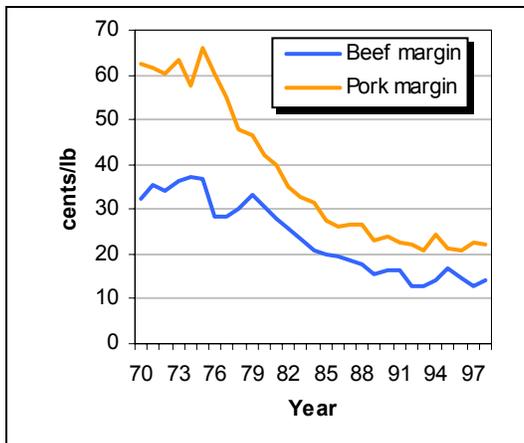
**Figure 2.** Real beef and pork farm-wholesale margins, 1970–1998.
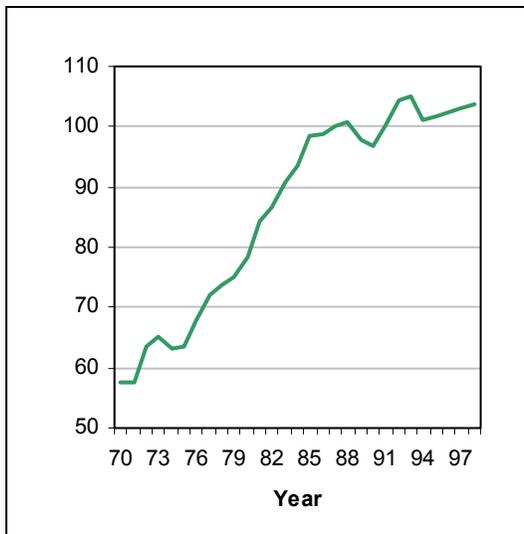
Figure 3. Meatpacker productivity, index of output per employee hour (1987=100), 1970–1998.

supply-demand factors were considered. Technological change was measured at three levels: (a) *meatpacking*—output per employee hour in beef and pork slaughtering; (b) *livestock finishing*—percent of cattle feeding firms with capacities greater than 16,000 head and the percent of hog firms with sow inventories exceeding 500 head; and (c) *farm-level productivity*—average dressed weights of steers, heifers, and hogs. Sector competition should make farm prices and margins responsive to the level and source of technological change. For example, changes in technology at the farm versus meatpacker levels could yield opposite impacts on FW margins and livestock prices.

Importance of Technology

Technological changes and increasing scale economies have led to significant market concentration in the beef and pork meatpacking industry. Between 1970 and 1998, the four-firm steer and heifer slaughter concentration ratio increased from 21.0 to 80.0, and the hog slaughter concentration ratio increased from 32.0 to 53.0 (concentration ratios have changed little since 1998).

Technological developments vary in type and scope. In the beef industry, breeding genetics, animal health and nutrition, and other management practices have increased calf-crop percentages, calf weaning weights, and dressed weights of steers and heifers. Similarly, pig litters and pigs saved per litter have grown in size, and hogs have been fed to heavier slaughter weights while maintaining relatively lean carcasses.

In livestock finishing, technological changes have reflected increased capital intensity, improved health and feed nutrition management, and electronic information systems. These developments have led to increased livestock feed conversion and slaughter weights consistent with quality and yield grades desired by meat packers.

Technological changes in meatpacking include new capital equipment, processing and handling methods, and evolving infrastructure and information systems. These changes have increased labor productivity and lowered unit costs of slaughtering and processing (Duewer & Nelson. 1991). Figure 3 shows that labor productivity, measured by the index of output per employee hour (1987 = 100) in meat packing increased from 57.7 in 1970 to 103.8

in 1998, or nearly 80%. From 1998 to 2000, labor productivity is estimated to have increased about 0.80% annually (United States Department of Labor, 2003).

Impacts of Technology on Margins

National and regional studies have shown that increased meat packer concentration has not significantly distorted livestock or meat prices largely because meat packers (especially in beef) have faced persistent excess capacity (Azzam & Anderson, 1996; Azzam & Schroeter, 1995; Morrison-Paul, 2001). The result has been more aggressive pricing of slaughter animals and boxed meat outputs.

Our study (Brester & Marsh, 2001) suggests that cost savings from new technology in meatpacking have significantly lowered FW margins. A 1% increase in meatpacker productivity reduces real FW beef and pork margins decline by 1.85% and 1.43%, respectively. Thus, the 80% increase in labor productivity in meatpacking from 1970 to 1998 reduced real FW beef and pork margins by 34.9 cents/lb (147.8%) and 42.6 cents/lb (114.3%), respectively.

The other technology variables—firm finishing size and farm-level productivity—affected the beef margin but not the pork margin. Increases in feedlot size tended to increase beef FW margins. One explanation for this result is that technological change has reduced unit costs of feeding cattle, increased fed cattle weights, and ultimately reduced fed cattle prices. In addition, larger feedlots may be selling more of their higher quality cattle on value-based contracts. With the remaining cattle sold in cash markets, the fed cattle prices used to calculate FW margins may be lower because of increased value-based marketing.

Increased farm-level technology has also increased marketing margins because genetic advances have increased weaning weights. Increased weaning weights are partially responsible for heavier fed cattle—many of which receive significant price discounts because of lower quality and meat yields. A 1% increase in average dressed weights of cattle (steers and heifers) increases the beef margin by 2.8%. Taken together, these results indicate that meat packer technology has dominated farm technology in yielding lower margins over time. To illustrate, from 1970 to 1998, the 18.2% increase in dressed weights of cattle increased the margins by 51.5% or 12.1 cents. During the same period, the 80% increase in meat packer output per employee reduced the margin by 147.8% or 34.9 cents—yielding a net margin reduction of 22.8 cents.

Impacts of Technology on Livestock Prices

Our results indicate that improvements in meatpacking technology, combined with increased market concentration, positively affected slaughter cattle and hog prices. For example, a 1% increase in the productivity index increased cattle and hog prices by 0.17% and 0.34%, respectively. Thus, packer cost savings have reduced farm-wholesale margins and increased producer livestock prices through increased input demand. Livestock finishing technology did not affect beef or pork slaughter prices. However, a 1% increase in carcass weights generated by farm technologies reduces slaughter cattle prices by 0.6%.

The changes in farm-level and meat packer technologies in the beef sector provide an interesting comparison. Data from 1970 to 1998 show increases in farm technology for beef of 18.2% and in meatpacker productivity of 80.0%. Our findings translate these productivity gains into an increased slaughter steer price of $8.85/cwt (13.6%) for packer technology and a decreased slaughter price of $7.12/cwt (10.9%) for farm technology. Thus, the effect of meatpacker productivity offset that of farm-level productivity for a net gain in slaughter cattle price of $1.73/cwt (2.7%) and a relative decline in the FW margin for beef.

Conclusions

Changes in meat packing technology in a highly concentrated industry have reduced the real farm-wholesale marketing margins for beef and pork and increased real slaughter prices for cattle and hogs. Apparently, competition in meatpacking during our sample period was large enough to transfer cost savings to producers through increased demand for livestock inputs. Conversely, changes in farm-level technology have contributed to declines in real farm prices—especially in beef. These estimates account for the impact of other factors such as changes in meat supplies, by-product values, feed

costs, food marketing costs, and consumer expenditures.

For livestock producers, the benefits of cost-saving technologies come through the price, quantity, and income effects of changes in supply and demand. In this case, new biotechnology and information technology may further expand livestock supplies and put downward pressure on real livestock prices. Farm income would then depend on demand factors, including increasing retail demand and the continuation of the past benefits arising from new meatpacking technology on margins and prices.

Technological changes have significantly influenced marketing margins and livestock prices. The above results are estimated assuming *ceterus paribus* conditions. That is, although the positive effects of meatpacking technology on livestock prices have exceeded the negative effects of farm-level technology, real livestock prices have declined over the past several decades. These overall declines are attributable to a variety of other supply and demand factors.

For More Information

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