What's with These Steel Prices?

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Agriculture is no stranger to rising costs. In recent years, agricultural producers have been forced to deal with higher fertilizer and fuel costs. This increase in costs has been especially burdensome to producers who grow input intensive crops. Unfortunately, the rise in production costs does not appear to end with fertilizer and fuel. Recently, steel prices have been rising as well—potentially resulting in higher costs for many agricultural inputs and services. This paper will provide some explanation for the increase in steel costs, and describe the impact that these higher costs may have in agricultural production.

A Snapshot of the Steel Industry

The process for making steel was developed by British inventor Henry Bessemer in 1856. Although civilizations had been making metal objects for several thousand years, steel was not produced in large quantities until a suitable system of heating iron ore to the necessary temperature (2500 degrees F) to reduce the amount of carbon content in the "hot metal" to 0 to 1.5% was developed. This process, in which iron ore, coke (a converted form of coal), lime, and recycled steel are fed into a blast furnace is referred to as the Basic Oxygen Steelmaking (BOS) process (steeluniversity.org).

The Electric Arc Furnace (EAF) is the second method of making steel. With this method, carbon electrodes produce intense heat, melting scrap iron and steel into molten steel. EAF mills have increased in the United States for several reasons. First, EAFs require smaller initial capital investment. Second, scrap metal is found throughout the country, allowing mills to be built in regions without raw material deposits. Third, steel is the most recycled material in North America, with a recycling rate of 68% (EIA). Generally, steel produced from the BOS process is of higher quality than EAF steel, but is more expensive to produce as well. Following the initial BOS or EAF steelmaking process, steel is then cast and formed. From that point, it can be converted into finished products such as wire, pipe, bars, rods, and sheets.

In 2003, the United States produced 91,360,000 metric tons of crude steel. This value was down 1.0% from the previous year (Table 1). Steel production peeked in 2000, with nearly 102 million metric tons produced. Overall, the United States provides 9.6% of the world crude steel supply. China is the largest producer of steel, followed by Japan, the United States, Russia, and South Korea. Worldwide crude steel production has increased over 30% in the last 10 years, with China being responsible for over one-half of the increase.

Table 1. Total Production of Crude Steel (thousand metric tons)

Year	U.S.	China	Japan	S. Korea	Russia	World
1994	91,244	92,613	98,295	33,745	48,812	725,107
1995	95,191	95,360	101,640	36,772	51,589	752,271
1996	95,535	101,237	98,801	38,903	49,253	750,001
1997	98,485	108,911	104,545	42,554	48,502	798,932
1998	98,658	114,588	93,548	39,896	43,822	777,311
1999	97,427	123,954	94,192	41,042	51,510	788,995
2000	101,803	127,236	106,444	43,107	59,136	847,426
2001	90,104	150,866	102,866	43,852	58,970	850,040
2002	92,241	181,688	107,745	45,390	58,590	885,766*
2003	91,360	220,115	110,510	46,306	61,325	945,140*

Source: International Iron and Steel Institute (IISI); *Steel Statistical Yearbook, 2003* and *Monthly Crude Steel Production, Dec. 2003*.
* Total from 63 top producing steel countries, which account for 98% of all steel produced.

World Steel Market

In the steel market, like any commodity market, supply and demand interact to determine the quantity produced and the price for that level of production. The steel market is a global one in which there are numerous major producers and consumers throughout the world. Changes in production and consumption can have a significant effect on steel prices and availability. Moreover, external forces, such as domestic and foreign government policies, can have a large impact on domestic and world steel prices. This section of the paper will discuss the factors driving the steel market in recent years.

Table 2 shows the changes in world steel production and consumption from 1993 to 2003. As table 2 indicates, China has become the leading producer and consumer of steel over the last decade. In 2003, China produced nearly 23% of the total world steel supply, compared to 12.3% in 1993. Similarly, in 2003 China consumed over 27% of the world's steel production, compared to only 17% in 1993. Although China is the leading producer of steel, domestic production could not support its growing need for steel. In 2002, China imported over 22 million metric tons of steel (Table 3). This was second only to the United States, which imported over 24 million metric tons. Japan, Russia, and Ukraine were the leading exporters of steel in 2002, with 31.9, 25.5, and 25.2 million metric tons, respectively.

Demand

Consumption figures provide an indication of demand. Based on the data from tables 2 and 3, it is clear that China has become the primary driver of demand in the world steel market. World consumption of steel increased from 698.0 million metric tons in 1997 to 863.7 million metric tons in 2003 (IISI 2004). China was responsible for approximately 78% of the growth in world steel consumption. Economic theory holds that if demand increases, and all other factors remain unchanged, price would increase. Figure 1 shows

the producer price index for iron and steel (in 1982 dollars) from 1994 to April 2004. According to this generic index, steel prices rose nearly 21% from 1996 to 2004. Thus, at quick glance, it is conceivable that the recent increase in the price of steel is due to an increased demand for steel, especially from China.

Table 2. Steel Production and Consumption in 1993 and 2003

Region	Production (% of Total)		Consumption (% of Total)	
	1993	2003	1993	2003
EU	19.7	16.6	16.3	16.4
Other Europe	6.4	5.4	4.4	4.6
Former USSR	13.4	11.2	9.3	3.7
NAFTA	15.4	12.6	17.3	15.3
China	12.3	22.8	17.0	27.2
Japan	13.6	11.5	12.2	8.6
Other Asia	10.4	11.4	15.4	15.7
Others	8.8	8.5	8.2	8.5

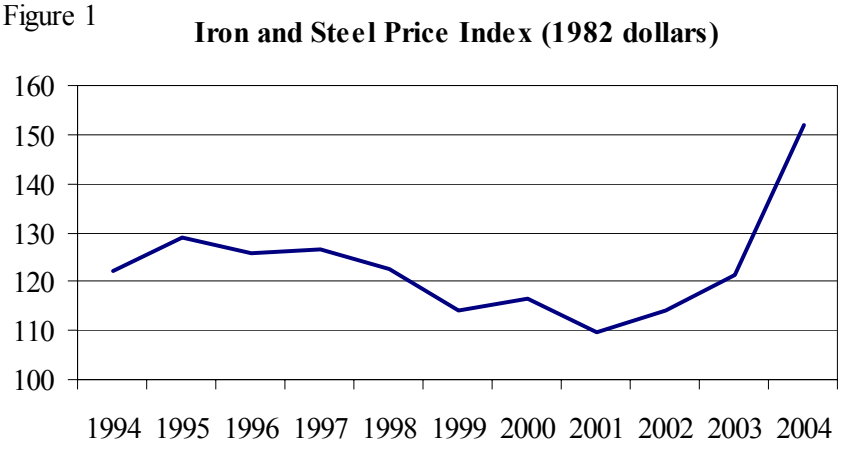
Source: IISI, *World Steel in Figures 2004*.

Table 3. The Major Importers and Exporters of Steel, 2002 (million metric tons)

Rank	Country	Net Exports	Rank	County	Net Imports
1	Japan	31.9	1	United States	24.6
2	Russia	25.5	2	China	22.6
3	Ukraine	25.2	3	Thailand	8.2
4	Brazil	10.9	4	Hong Kong	5.4
5	Belgium-Luxembourg	9.4	5	Italy	5.2
6	Germany	6.9	6	Vietnam	4.6
7	Turkey	4.3	7	Iran	4.5
8	South Africa	3.7	8	Spain	4.1
9	Kazakhstan	3.0	9	United Arab Emirates	2.9
10	Slovakia	2.6	10	Portugal	2.5
11	Austria	2.4	11	Indonesia	2.4
12	Romania	2.4	12	Singapore	2.4
13	Argentina	2.2	13	Malaysia	2.3
14	Venezuela	2.0	14	United Kingdom	2.2
15	France	1.8	15	Egypt	2.1

Source: IISI, *World Steel in Figures 2004*.

Figure 1



Supply

In supply and demand theory, supply is graphically illustrated as a "curve" that represents the relationship between price and quantity supplied. In other words, firms will supply a given amount of product at a given price level. As the price of that product increases, firms would be willing to supply more of the product. A firm's supply curve is derived from its marginal cost curve. Marginal cost is the cost to produce one additional product unit. Thus, the amount of product a firm will supply at a given price level is dependent on the cost to produce that product.

The primary resources required to produce steel are iron ore, coke, and scrap iron and steel. Table 4 shows regional production of iron ore in 1993 and 2002. The major iron ore producing regions are Asia, South America, and Oceania, with China, Brazil, and Australia being the primary producers in each region. Although worldwide iron ore production has increased by nearly 100 million tons from 1993 to 2002, the increased demand for steel has tightened iron ore supplies, causing annual contract prices to rise over 18% earlier this year (Marcus and Kirsis).

Table 4. World Iron Ore Production (thousand metric tons)

Region	1993	2002
European Union	26,787	22,181
Other Europe	9,952	5,550
Former USSR	154,608	158,725
North America	99,782	100,700
South America	179,885	272,400
Africa	45,617	51,010
Middle East	3,300	11,300
Asia	292,638	317,704
Oceania	123,729	188,919
World	936,298	1,128,489

Source: IISI, *Steel Statistical Yearbook 2003*.

Shortages of raw materials are not limited to iron ore. Coke and scrap steel shortages have developed as well. Tight coke supplies have developed from two primary causes. First, China's increased steel production has led them to use domestic coke instead of exporting it. This reduced supply in the world market caused export prices of coke to more than double over the past year. The second factor causing tight supplies and thus higher prices was a fire that closed a West Virginia coal mine. The reopening of the mine should help to alleviate the short term coke shortages, but the increased demand for coke in China may be a structural (more or less permanent) change to the raw material side of the steel industry (Bradford).

Scrap steel has become an increasingly important material for steel producers in the United States. EAF steel mills are now responsible for over 50% of the steel production in the U.S. With the recent increased demand for steel, scrap steel prices, the primary material used by EAF steel mills, have soared. Table 5 shows the monthly prices for No. 1 Heavy Melting Scrap. As the table shows, scrap prices more than doubled from February 2003 through March 2004. Industry analysts expect scrap steel prices to recede in the coming months, but still remain above recent levels (Anton 2004a).

Table 5. Composite Prices for No. 1 Heavy Melting Steel Scrap

Period	Price ($/ton)
2003	
February	114.08
March	118.52
April	117.91
May	107.32
June	104.45
July	109.45
August	121.37
September	126.32
October	128.61
November	141.76
December	157.35
2004	
January	174.67
February	220.55
March	246.10
April	205.46

Source: U.S. Geological Survey (USGS), *Mineral Industry Surveys—Iron and Steel Scrap,* April 2004.

Non-Market Factors

While many may not immediately draw parallels between the two, the steel and production agriculture industries have much in common. Each industry has a large number of firms that produce large quantities of non-differentiated goods (i.e. commodities). Each industry has experienced increased output per worker. Each

industry has been characterized by overcapacity. Finally, each industry has sufficient political power to receive protection and support.

U.S. government involvement in the steel industry began in 1952 when President Truman seized the steel industry to prevent a strike. A subsequent series of wage and price increases in the 1950s eventually resulted in increased imports and increased prices. Further government involvement, whether in the form of negotiations or protective trade measures, has repeatedly occurred since 1962. The latest round of intervention in the steel marketplace occurred in March, 2002 when President Bush imposed tariffs of up to 30% on about a third of U.S. steel imports. In exchange for this protection from imports, the steel industry agreed to consolidate to remove excess production capacity (Stundza). The tariffs were scheduled to last for three years, with a mid-term review. Although praised by the domestic steel industry, the tariffs resulted in severe criticism from foreign exporting countries and domestic steel importers and users. In light of these tariffs, two main questions come to mind. Why were the tariffs instituted? What impact did these tariffs have on the U.S. steel industry?

Like production agriculture, the steel industry often faces difficult financial times—usually for many of the same reasons listed above. These tough financial times have been fairly constant over the last few decades, but 1999-2001 was especially difficult (Hufbauer and Goodrich 2003a). According to the United Steelworkers of America (USWA), 42 steel companies have filed for bankruptcy since 1998, with 17 of those companies having liquidated. Although all the bankruptcies and liquidations did not result in 100% layoffs, as many of these firms were purchased by other firms, undoubtedly, steel production employment has decreased. Over the last forty years, the loss in steel production jobs has been huge. Hufbauer and Goodrich (2003a), quoting Bureau of Labor Statistics data, report that the number of steel production workers have decreased from 515,600 in 1964 to 161,800 in 2001. (On a percentage basis, the steel industry had a 69% reduction in jobs from 1964 to 2001, compared to a 38% reduction in the number of farms over that same time period.) Recently, the failure of companies and loss of jobs has been blamed on unfair competition from imports. This complaint resulted in tariffs being imposed on imported steel.

Tariffs, or duties, were not imposed on all steel imports, however, in this latest round of protective actions. Almost immediately after the protective measures were announced in March 2002, foreign exporters and domestic consumers started to complain. Consequently, exclusions were announced for products in which domestic firms could not produce in sufficient quantities. Likewise exemptions were granted for free trading partners (Canada and Mexico) and developing countries whose imports were below an established level (i.e., less than 3 percent of the U.S. market). Table 6 shows the scheduled duty rates for steel products that were subject to protective measures.

Table 6. Original and Reduced Safeguard Duty Rates (percent)

Product	First year	Second year	Third year
Flat-rolled	30	24	18
Tin mill	30	24	18
Hot rolled bar	30	24	18
C-F bar	30	24	18
Rebar	15	12	9
Welded tubular	15	12	9
Fittings/flanges	13	10	7
SS bar	15	12	9
SS wire	15	12	9
SS rod	8	7	6

Source: Hufbauer and Goodrich 2003b.

As a result of the duties imposed on steel products from foreign exporting counties, relief was sought through the World Trade Organization (WTO). The WTO dispute panel ruled in May 2003 that the steel tariffs imposed by the United States were illegal (Hufbauer and Goodrich 2003b). In November, the WTO rejected an appeal by the United States to overturn the previous ruling. The subsequent WTO ruling opened the door for the European Union to impose $2.2 billion in retaliatory duties on U.S. exports (Plungis and Garsten). In response to the unfavorable WTO ruling and complaints from domestic steel consumers, on December 4, 2003, the Bush Administration announced that "these safeguard measures have now achieved their purpose, and as a result of changed economic circumstances it is time to lift them" (CNN.com).

Now to the second question: What impact did the tariffs have on the steel market and steel industry? Concerning the steel market, the relevant measure of impact is price. Stated another way, did the protective tariffs boost domestic steel prices? In a sense, that question is easy to answer, but in another sense, it is not. News of the recent increase in steel prices has been widespread, but the exact impact the tariffs had on the price increases is difficult to determine. For instance, current "spot" prices may not adequately reflect the average price paid by consumers. Many major consumers of steel, like the auto industry, negotiate long term contracts, thus smoothing out ups and downs in the market. Moreover, with the wide variety of steel products manufactured, some products may have experienced larger price increases than others. Because of these issues, the best indicator of the actual rise in steel prices is the Producer Price Index (PPI) from the Bureau of Labor Statistics. Table 7 shows the PPI for iron and steel and steel mill products from 1994 through April 2004.

Table 7. Producer Price Index for Iron and Steel and Steel Mill Products

Year	Iron and Steel	Steel Mill Products
1994	122.0	113.4
1995	128.8	120.1
1996	125.8	115.6
1997	126.5	116.4
1998	122.5	113.8
1999	114.0	105.3
2000	116.6	108.4
2001	109.7	101.3
2002	114.1	104.8
2003	121.5	109.5
2004	151.9	135.4

Source: Bureau of Labor Statistics

Although the PPI clearly shows that steel prices have risen after the tariffs were put in place in March 2002, it is not clear the extent of the impact the tariffs had. A study by the United States International Trade Commission (USITC) estimated that the safeguard tariffs raised domestic steel price by 0.94 percent. Another study by Hufbauer and Goodrich (2003a) estimated that the tariffs raised domestic steel prices by about 3.3 percent between the first and third quarters of 2002. However, neither study indicates that the tariffs were responsible for 100% of the price increase. Interestingly, the largest price increases came in the first four months of 2004—after the tariffs were discontinued. Undoubtedly, this indicates that there are other factors driving steel prices in the US.

According to US Trade Representative Robert Zoellick, the steel tariffs were instituted to give the steel industry some "breathing space" to "get back on its feet" (CNN.com). The Bush Administration and many in the steel industry claimed that the tariffs did indeed help the steel industry. But much like determining the impact the tariffs had on prices, it is difficult to determine the impact on the problems that have been plaguing the US steel industry. As previously mentioned, one of the biggest problems the steel industry faces is overcapacity. Those in favor of the tariffs argued that the "breathing space" allowed the steel industry to consolidate and reduce overcapacity. Without question, consolidation has occurred. International Steel Group (ISG) purchased the assets of LTV Steel, Acme Metals, and Bethlehem Steel; US Steel purchased the assets of National Steel; and Nucor acquired Trico Steel and Birmingham Steel (Hufbauer and Goodrich 2003b). However, consolidation does not mean much if old capacity is not reduced at the same time. In addition, consolidation would have taken place even if the tariffs were not imposed. In fact, by establishing trade barriers to raise the price of steel, consolidation may have actually been slowed, as some financially troubled firms may have been kept afloat longer than they would had the safeguards not been imposed.

Overall, the impacts of the safeguard tariffs were mixed. Without question, the steel industry reaped some benefits. Prices rose, profits improved, and likely some jobs were saved. However, as Table 8 indicates, there were some negative consequences as well. Capacity was not reduced, profits were still negative, and steel user employment fell at a

faster rate than steel producer employment. Finally, the USITC estimated that the steel tariffs resulted in an annual reduction of US welfare of $42 million.

Table 8. Steel Industry Before and After Safeguards

Statistic	March 2002	July/August 2003	Change
After-tax profit as share of sales (%)	-3.8	-2.3	+1.5
Steel producer price index	97	105	+7.6%
Capacity (base 1997)	109	110	+0.5%
Average hourly earnings ($)	22	23	+6.0%
Steel producer employment (1,000)	107	101	-5.2%
Steel user employment (1,000)	4,016	3,766	-6.2%
Bankruptcies since 1997	33	40	+7

Source: Hufbauer and Goodrich 2003b.

Steel Forecast

With the recent volatility in the global steel market, it is difficult to predict what may happen to steel prices in the near and distant future. Will the current high price levels be maintained or will the steel market fall back into a period of depressed prices brought about by overcapacity? While the steel industry has gone from boom to bust in short periods of time in the past, according to industry analysts, there are indications that the current high price cycle may last longer than previous market peaks. Following are some of the reasons steel prices may remain high.

1. *Demand*. As stated previously in this paper, China has become the dominant consumer of steel. China's hunger for steel has been necessitated by an economy that is growing at rates of over 8% in recent years. Forecasts generally indicate that similar growth will continue in the near future (IISI, *Short Range Outlook for 2004-05*). However, there are some indications that the Chinese government may be attempting to slow down building projects to prevent the economy from overheating (DTN AgDayta; Foster). Demand in the US and other regions is improving as well, although it has not reached previous highs (Anton 2004b). By these indications, it appears that steel prices will continue to be influenced by a demand driven environment.

2. *Raw Materials*. In previous high price cycles, the steel industry has increased production to take advantage of those prices. However, prices often dropped quickly as the increased production was not met with increased demand. In this high price cycle, steel companies have been prevented from increasing production because of tight raw material supplies (Anton; Foster). The relative abundance of iron ore, coke, and scrap steel has largely been absorbed by China's steel expansion. Although some short term supply issues have been resolved, the expansion of the Chinese steel industry will likely continue to push prices above historical levels.

3. *Capacity*. Unless the global steel industry expands, it is likely that the steel market will undergo a long term structural change. Given the tight raw material supplies, it may be difficult to expand to a large degree, but some in the steel industry estimate that Chinese steel capacity will outpace consumption significantly in the coming years (Mori). If this occurs, the steel industry could find itself once again in financially difficulty. If it does not occur, consumers could find themselves paying higher prices for steel products.

Impact on Agriculture

Because of the uncertainty regarding the future of the steel market and the vast differentiation of steel products and pricing methods, determining the impact of high steel prices on agriculture is difficult. Certainly, higher steel prices have already had some impact. Many common steel supplies are considerably more expensive. However, because of the wide variety of smaller steel products and markets for those products, this section will focus on the impact steel prices may have on big ticket steel items such as autos, machinery, and buildings.

The National Agricultural Statistics Service (NASS) of USDA provides historical price indexes for numerous farm inputs. Figure 2 shows the price index for several classes of farm machinery. The figure clearly indicates that prices have steadily risen for tractors, self-propelled machinery, and other machinery over the last decade. On the other hand, prices for autos and trucks have generally remained constant, or have even decreased. Over this same period of time, steel prices have fluctuated significantly, but have generally been low (i.e., low enough to institute safeguard tariffs in 2002). With that said, tractor prices were up 9 points from one year ago while self-propelled equipment costs were up 17 points. Based on the fact that both the steel and the tractor/self-propelled indexes increased from 2003 to 2004, an argument could be made that the increase in prices associated with big ticket farm machinery was due to the rise in steel prices. However, that hypothesis has some flaws. First, the other machinery index only increased 2 points from 2003 to 2004. Second, as already mentioned, the auto and truck indexes were basically constant. Third, since large consumers of steel, such as the auto industry, typically have long term contracts for steel, it is likely that the farm machinery industry does as well. In fact, statistical models indicate that there is no statistical relationship between the steel price index and selected farm machinery prices over the 1995-2004 time frame. Therefore, a more likely explanation for the rise in the tractor and self-propelled machinery indexes is the continued implementation of more sophisticated technologies and larger capacities in tractors and self-propelled farm machinery.

Price indexes for supplies, repairs, and building materials are shown in Figure 3. Each index shows prices that grew steadily over the last 10 years. Repairs grew most rapidly. Building materials grew at the slowest rate—until 2004. From 2003 to 2004, the building material index increased by 13 points, or 10.6%. Although all the items that comprise the building material index are not steel, it is likely that steel prices had a positive impact on the index.

Figure 2

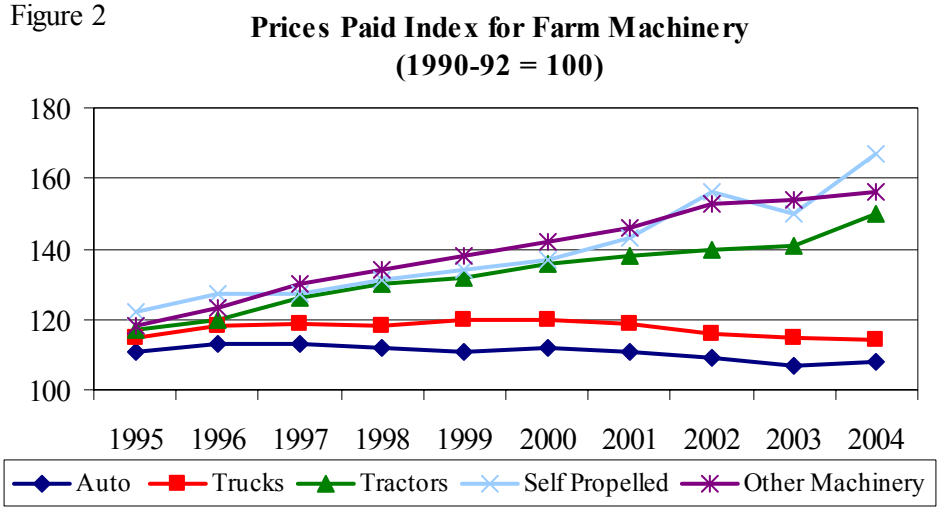
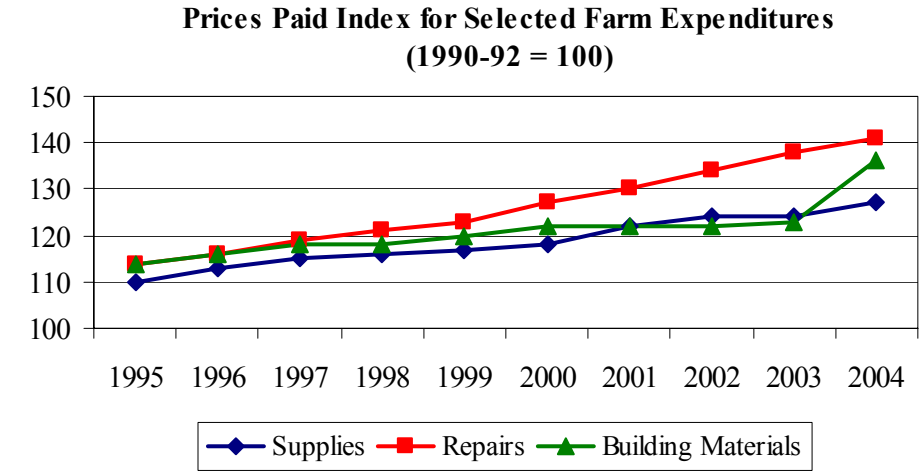


Figure 3



Determining the impact that higher steel prices will have on farm income is difficult. Likely, the higher steel prices will put downward pressure on farm income, but the magnitude of the downward pressure is difficult to quantify. For instance, a comparison of Kansas Farm Management Association (KFMA) machinery investment per acre values with the farm machinery price index from 1995-2003 indicates that there is a strong statistical correlation (Table 9). The statistical measure used to estimate the correlation is the correlation coefficient. Correlation coefficients can be interpreted as follows. A value of "1" means that there is a perfect, positive correlation between the two sets of data being compared. A value of "–1" means that there is a perfect, negative correlation between the two data sets. A value of "0" means there is no correlation between the data sets. The machinery investment and machinery price index data yielded a correlation coefficient of 0.85.

When the correlation between those two data sets is calculated for 1999-2003, there is virtually no relationship (correlation coefficient = -0.09). Moreover, as seen in table 9, there is actually a negative correlation between the iron and steel index and the KFMA machinery investment data. While there are potentially many valid reasons why there is a weak relationship between farm machinery investment and steel prices, (i.e., farmers holding on to machinery longer or spreading machinery over more acres, or the steel industry doing the same with steel inventories) it illustrates the difficulty in predicting the effect steel prices will have on farm income. Depending on the individual farm, higher steel prices could have a significant or negligible impact on income. Farms that could defer purchases of high priced steel goods to a potentially more favorable future date or use less expensive substitutes will be hurt little. Farms that need to purchase certain steel goods will obviously be worse off than they would be with lower prices. There is a bright side, however. The current tax incentives and low interest rates may encourage producers to make some capital investments—weighing the current advantages against future price changes.

Table 9. Machinery Investment per Acre, Machinery Price Index, and Iron and Steel Price Index

	Machinery Investment/Acre	Farm Machinery Price Index	Iron and Steel Price Index
1995	$97.48	119	129
1996	101.64	124	126
1997	108.22	128	127
1998	114.98	132	123
1999	118.89	135	114
2000	116.33	139	117
2001	121.19	143	110
2002	117.19	151	114
2003	118.51	150	122
Correlation Coefficient		0.85	-0.85

Summary

Steel is a major component of most farm operations. Prices for many steel items have risen dramatically during the past year. The increase in prices is due to increased demand (mainly from China) and tight raw material supplies. Protective trade measures also put upward pressure on domestic steel prices. The global steel industry, historically dominated by overcapacity, may be experiencing a structural change in which prices remain higher than historical levels. Prices for primary steel farm inputs, such as machinery and building materials, have not historically closely mirrored steel prices. However, prices for each rose rather sharply along with steel prices in 2004. The impact the higher steel prices have on farm income will likely be slightly negative, depending on needs, circumstances, and management of individual farms.

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