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Factors Contributing to the Recent Increase in U.S. Fertilizer Prices, 2002-08

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Abstract

U.S. prices of fertilizer nutrients began to rise steadily in 2002 and increased sharply to historic highs in 2008 due to the combined effects of a number of domestic and global long- and shortrun supply and demand factors. From 2007 to 2008, spring nitrogen prices increased by a third, phosphate prices nearly doubled, and potash prices doubled. The price spike in 2008 reflects low inventories at the beginning of 2008 combined with the inability of the U.S. fertilizer industry to quickly adjust to surging demand or sharp declines in international supply. Declining fertilizer demand, disruption in fall applications, increased fertilizer imports (July to August), and tightening credit markets for fertilizer purchases contributed to the decline of fertilizer prices in late 2008. The prospect for strong fertilizer demand in early 2009, high raw material costs for the manufacture of fertilizers, production cutbacks, and decreasing supplies from fertilizer imports, however, could put upward pressure on U.S. fertilizer prices in spring 2009.

Keywords: Nitrogen, phosphate, and potash prices, price spikes, factors affecting fertilizer supply and demand

Contents

Approved by USDA's World Agricultural Outlook Board

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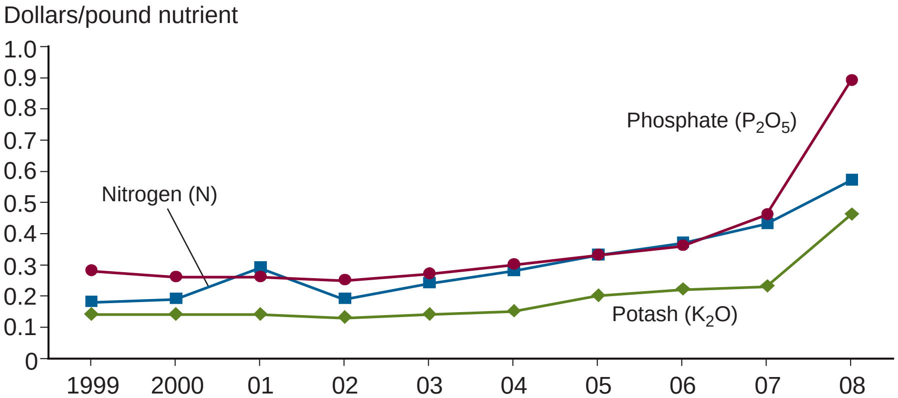
Introduction

Prices paid by U.S. farmers in April for fertilizer nutrients such as nitrogen, phosphate, and potash have risen steadily since the beginning of 2002 and increased sharply to historical highs during 2007-08 (fig. 1) (ERS (b)) (see box, “Prices Paid, Monthly Prices Paid Indexes, and Producer Prices”). In 2008, U.S. nitrogen (N) prices increased by a third to $0.57 per pound, U.S. phosphate (P_2O_5) prices nearly doubled to $0.89 per pound, and U.S. potash (K_2O) prices doubled to $0.46 per pound. Among major fertilizer products used in agricultural production, diammonium phosphate (DAP) and potassium chloride (KCL) posted the largest increases—more than 90 percent for DAP and more than 100 percent for KCL (fig. 2). The surge in prices reduced farm cash returns, raising concerns among U.S. agricultural producers.

Steady increases in fertilizer prices since 2002 and the price spike in 2008 reflect the combined effects of a number of domestic and global long- and shortrun forces. This study identifies and examines those forces, explains the causes of the fertilizer price spike in 2008, and examines the shortrun volatility in fertilizer prices and the longrun supplies of U.S. fertilizers.

Figure 1

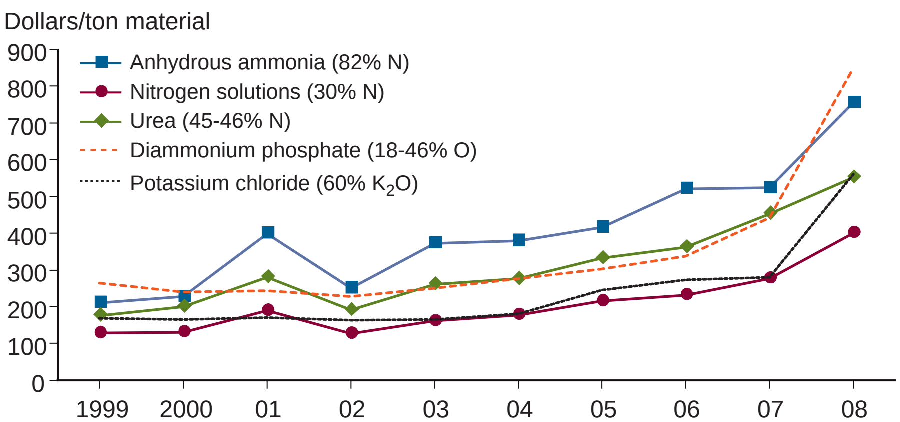
Historic U.S. April prices of fertilizer nutrients



Source: USDA, Economic Research Service using data from USDA, National Agricultural Statistics Service, *Agricultural Prices, 1999-2008*.

Figure 2

Historic April prices of major fertilizers used in the United States



Source: USDA, Economic Research Service using data from USDA, National Agricultural Statistics Service, *Agricultural Prices, 1999-2008*.

Prices Paid, Monthly Prices Paid Indexes, and Producer Prices

USDA's National Agricultural Statistics Service (NASS) conducts the Prices Paid survey for U.S. and regional average prices for fertilizer. Businesses are asked for the average price paid by farmers for recent sales. The U.S. average price is then used to calculate base month fertilizer indexes of the Prices Paid Index to measure the relative change in prices paid for fertilizers used in agricultural production. The survey is conducted every April. Indexes are updated in other months using Producer Price Indexes from the Bureau of Labor Statistics (BLS).

The target population for the Prices Paid survey is retail outlets or establishments where farmers purchase farm production inputs. The prices paid data are obtained from a survey panel of approximately 8,500 businesses in the 48 States. Survey response rates are reported to be between 75 and 80 percent. Firms are asked to report the price for specified items bought by farmers. The survey reference period for most items is 5 business days centered around the 15th of the month. Average prices reported are aggregated to the region and U.S. level using weights available from expenditure data and other sources.

Monthly Prices Paid Indexes measure the change in prices paid by farmers and ranchers for fertilizers relative to their prices during a base period (1990-92=100). Monthly Prices Paid Indexes are updated using selected BLS Producer Price Indexes. Detailed documentation of the methods used by NASS is available at: *http://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Paid_and_Paid_Indexes/index.asp*.

The producer prices for ammonia, urea, diammonium phosphate (DAP), and muriate of potash production are the FOB prices of ammonia (U.S. Gulf NOLA barge), urea (U.S. Gulf prill barge), DAP (Central Florida), and standard muriate (Saskatchewan) published weekly in Green Markets. Prices of other chemicals used for fertilizer production are also from Green Markets.

Background

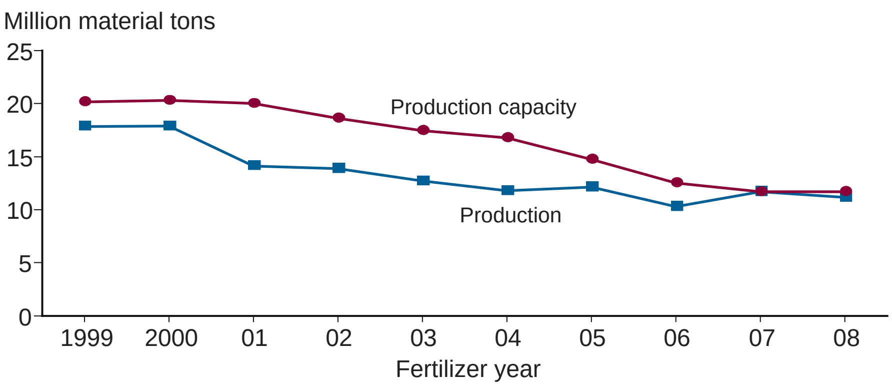
The U.S. fertilizer industry currently is not equipped to meet a surge in demand or a large decline in global supplies. Over the last decade, declining or stagnant U.S. production capacity of nitrogen, phosphate, and potassium has limited the ability of the U.S. fertilizer industry to supply the fertilizer needed for domestic agricultural production. At the same time, the U.S. has increasingly depended on imports of nitrogen and potash to meet domestic demand. In an increasingly globalized market, changes in global supply and demand of fertilizer can lead directly to the rise and fall of U.S. fertilizer prices.

U.S. fertilizer production capacity and production in decline or stagnant. Natural gas is the main input used to produce ammonia, which, in turn, is the primary feedstock used to produce nitrogen fertilizers. An increase in natural gas prices contributed to plant closures, resulting in a significant decline in production capacity and production of ammonia in the United States (Huang (a)). From 1999 to 2008, annual domestic production capacity declined 42 percent, from 20.2 million tons to 11.7 million tons (fig. 3), and annual production decreased 37 percent, from 17.9 million tons to 11.2 million tons (DOC; IFDC). During the earlier part of this period, annual capacity was underutilized, as rapidly rising natural gas costs resulted in significantly higher production costs for domestic producers. Domestic production in 2007 reached capacity in response to rising nitrogen demand from an expansion of U.S. corn and wheat acres.

Relatively low returns and declining export demand for DAP and monoammonium phosphate (MAP) have contributed to the decline in phosphate production capacity and production in the United States, the world's largest producer of phosphate fertilizers (fig. 4). From 1999 to 2008, annual U.S. production of phosphoric acid (the main feedstock for all phosphate fertilizers) declined 13 percent, from 13.8 million tons to 12.0 million tons, while production capacity decreased 23 percent, from 13.7 million tons to

Figure 3

U.S. ammonia production and production capacity



Note: Fertilizer year runs from July of the preceding year to June of the year indicated in the chart.

Source: USDA, Economic Research Service using capacity data from International Center for Soil Fertility and Agricultural Development and production data from U.S. Department of Commerce.

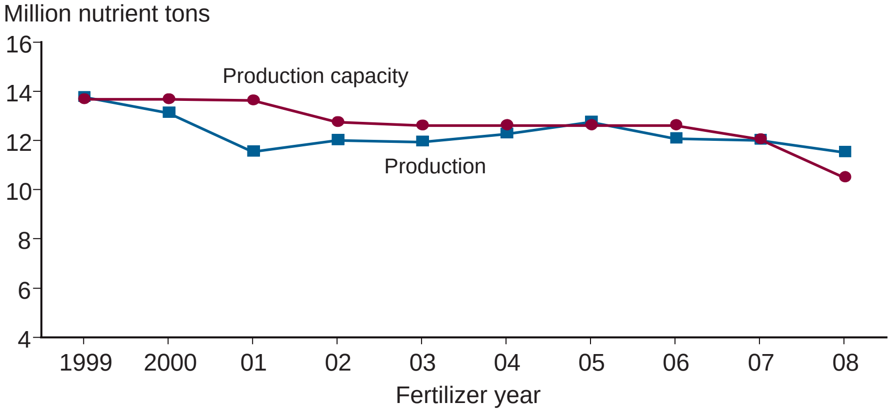
10.5 million tons (DOC; IFDC). In 2008, production exceeded production capacity, likely due to plants extending their hours of operations.

U.S. potash production accounts for less than 16 percent of the domestic potash fertilizer supply. The rest comes from imports. U.S. production capacity of potash was flat at around 1.5 million tons annually during 1999-2006, before increasing by 0.2 million tons in 2007 (USGS; IFDC) (fig. 5). U.S. production of potash also was flat at around 1.3 million tons per year.

U.S. fertilizer industry increasingly dependent on global trade. In 2007, the United States was the world's largest importer of nitrogen fertilizers, the second largest importer of potash fertilizers (behind China), and the largest exporter of phosphate fertilizers (Mosaic; PotashCorp (a); IFA; ERS (a)). The United States went from being an exporter of nitrogen fertilizer in the early 1980s to becoming the world's largest importer in the 2000s (ERS (a)). From 1999 to 2008, as

Figure 4

U.S. phosphate (P_2O_5) production and production capacity

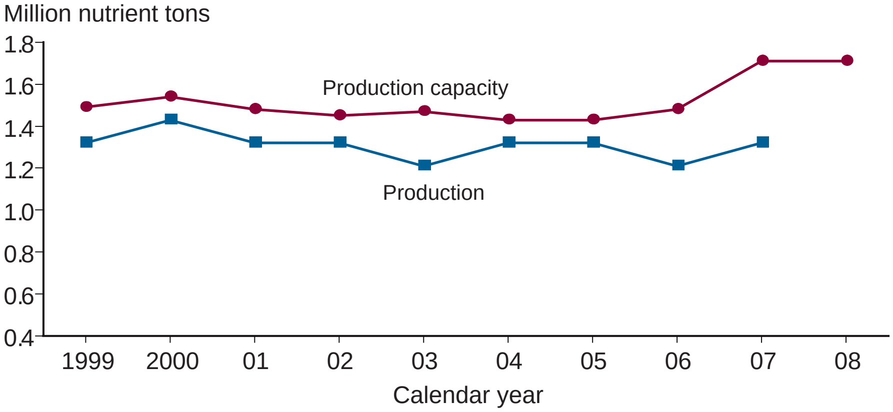


Note: Fertilizer year runs from July of the preceding year to June of the year indicated in the chart. Production capacity refers to production capacity of wet-process phosphoric acid.

Source: USDA, Economic Research Service using capacity data from International Center for Soil Fertility and Agricultural Development and production data from U.S. Department of Commerce.

Figure 5

U.S. potash (K_2O) production capacity and production



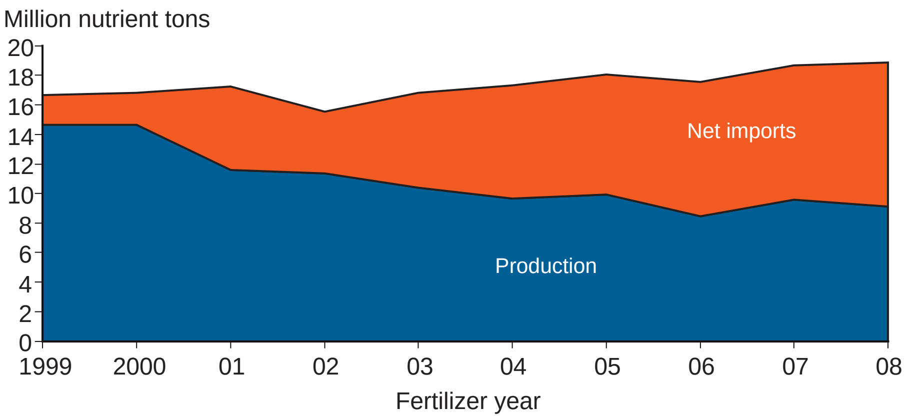
Source: USDA, Economic Research Service using capacity data from International Center for Soil Fertility and Agricultural Development and production data from U.S. Department of Commerce.

domestic nitrogen production declined by 38 percent, U.S. net imports increased 383 percent, from 2 million tons to 9.7 million tons (fig. 6). During this period, the share of U.S. nitrogen supply (production plus net import) attributed to imports increased from 12 to 52 percent. Trinidad and Tobago, Canada, Russia, and the Middle East are the major nitrogen suppliers to the United States.

The United States exported more than 6 million tons of phosphate in 1999 and less than 4.2 million tons in 2008 (ERS (a)). Although net exports of U.S. phosphate fertilizers (DAP) during the period declined continuously from 48 percent of production in 1999 to 34 percent in 2008 (fig. 7), U.S. phosphate exports provide large revenue to the U.S. phosphate industry. In 1999, about 54 percent of U.S. DAP exports went to China and 16 percent went to India. Since then, China has developed its own phosphate industry, drastically

Figure 6

U.S. nitrogen (N) supply from domestic production and net imports

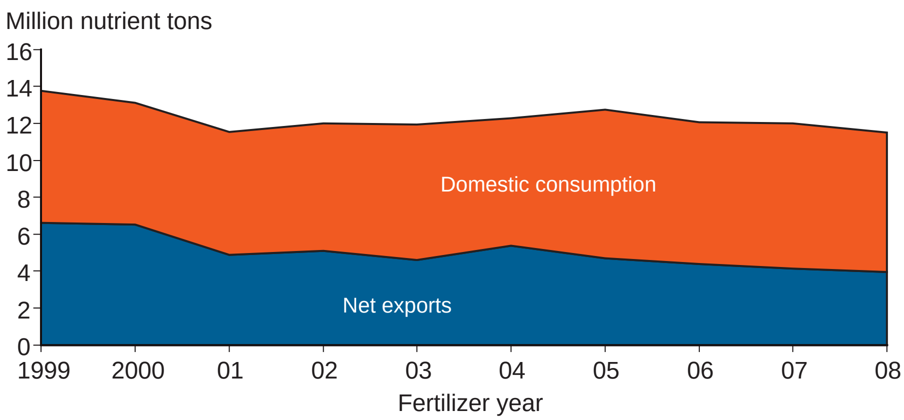


Note: Fertilizer year runs from July of the preceding year to June of the year indicated in the chart. Nitrogen production is based on quantity of ammonia produced.

Source: USDA, Economic Research Service (ERS) using data from U.S. Department of Commerce for nitrogen production and ERS trade data for net imports.

Figure 7

U.S. phosphate supply for domestic consumption and exports



Note: Fertilizer year runs from July of the preceding year to June of the year indicated in the chart. Phosphate production is based on the quantity of phosphoric acid produced. Domestic consumption = production - net exports.

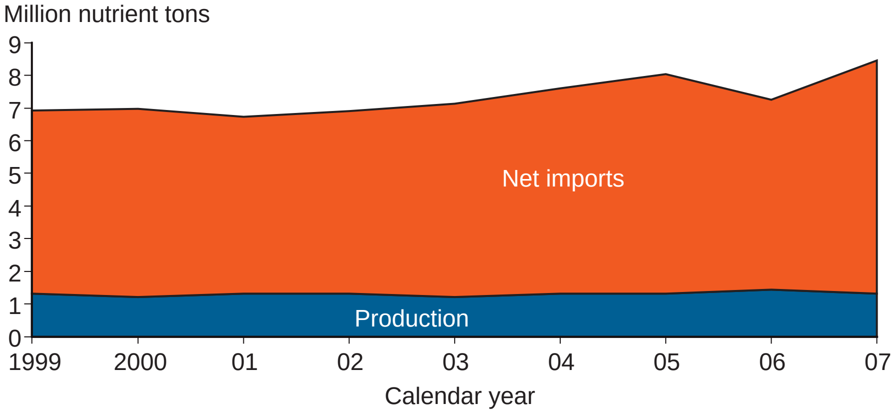
Source: USDA, Economic Research Service (ERS) using data from U.S. Department of Commerce for phosphate production and ERS trade data for net exports.

reducing demand for U.S. exports. India and Latin America are now the major markets for U.S. phosphate fertilizers, with about 31 percent of U.S. DAP exports going to India in 2007.

Annual U.S. imports of potash were around 5.9 million tons from 1999 to 2006 and jumped to 7.2 million tons in 2007 (fig. 8) (ERS (a)). The share of the U.S. potash supply from imports remained relatively constant at about 80 percent from 1999 to 2006, but it increased to 85 percent in 2007. In 2007, Canada accounted for about 90 percent of U.S. potash imports, with the remainder supplied largely from Belarus and Russia.

Figure 8

U.S. potash (K_2O) supply from domestic production and net imports



Source: USDA, Economic Research Service (ERS) using data from U.S. Department of Interior, U.S. Geological Survey for production and ERS trade data for net imports.

Supply Factors Affecting the U.S. Price of Fertilizers

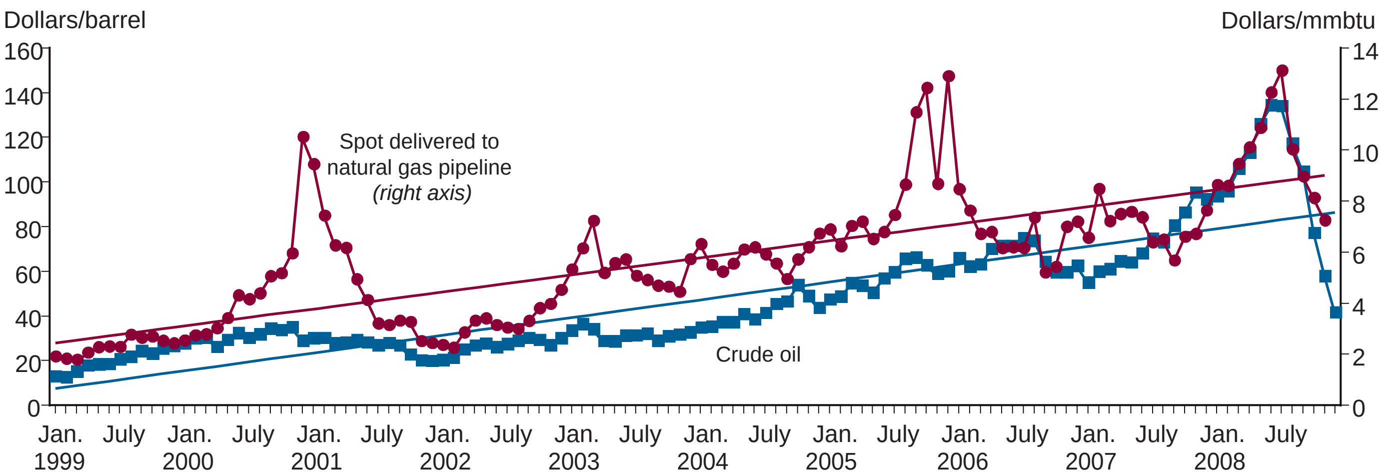
Rising energy costs. Commercial fertilizer production is an energy-intensive process and requires large amounts of energy to produce and deliver to end users (Sittig). About 74 percent of total energy used to manufacture fertilizers comes from natural gas (Twaddle). Natural gas is the main input used to produce ammonia, which, in turn, is the main input used to produce all nitrogen fertilizers. Thus, increases in natural gas prices often lead to increases in the prices of all nitrogen fertilizers. Electricity and petroleum are the other major sources for manufacturing fertilizers. Petroleum is the main source of energy used to deliver fertilizer products through pipelines, barges, railways, and trucking systems. Increases in electricity and crude oil prices can lead to higher production costs and prices of phosphate and potash fertilizers.

While the prices of oil and natural gas exhibited remarkable stability prior to 2000, both have since become volatile while trending upward. Indeed, the prices of oil and natural gas have exhibited strong positive correlation (an increase in oil prices is accompanied by an increase in natural gas prices) (fig. 9) (Villar). Between January 1999 and June 2008, natural gas prices increased by more than 550 percent, and oil prices increased by more than 970 percent. More recently, from June 2007 to June 2008, prices increased by more than 98 percent for oil and by more than 65 percent for natural gas. But by August 2008, prices of oil and natural gas had fallen back to their historic longrun trends.

Rising transportation costs. Fertilizer materials are bulky in either solid or liquid form and contain not only plant nutrients (NPK) but also other filler materials. In 2007, 57.6 million tons of fertilizer materials, containing 22.9 million tons of plant nutrients, were delivered from domestic and global fertilizer plants to agricultural producers in the United States (AAPFCO). The cost to transport fertilizers is a significant component of total fertilizer

Figure 9

Historic prices of crude oil and natural gas in United States



Note: mmbtu = million British thermal units.

Source: USDA, Economic Research Service using data from U.S. Department of Energy and The Fertilizer Institute.

costs. For example, transportation costs account for 22 percent of the cost of ammonia shipped from Trinidad and Tobago to the U.S. Gulf and more than 50 percent of the cost of ammonia shipped from Russia Togliatti to the Gulf (PotashCorp (a)). Ammonia fertilizer is a hazardous material that must be transported in refrigerated vessels or in pressurized containers, which further increases transportation costs. For example, the cost to ship ammonia by rail is 44 percent higher than the cost to ship urea (Klindworth).

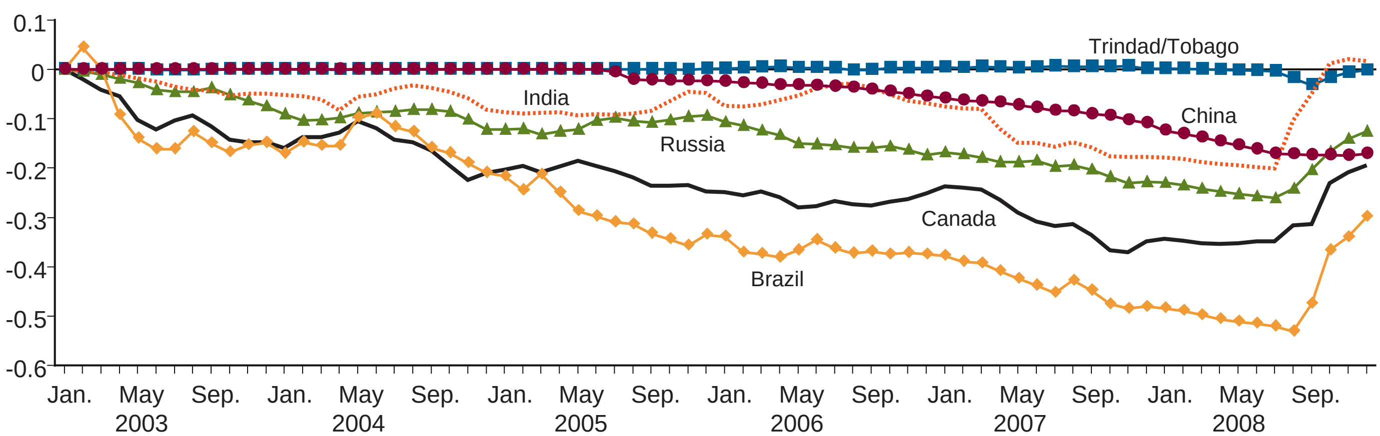
Rising energy costs, combined with the high demand for, and the tight supply of, freight service stemming from increasing global trade have contributed to high transportation costs. Between January 2005 and January 2008, rail rates (per ton mile) to transport ammonia increased 63 percent from about 8.7 cents/ton mile to about 14.2 cents/ton mile. In addition, a 44-percent fuel surcharge was added to rail transport costs in July 2008 (BNSF). The Baltic ocean freight rate index increased 400 percent between September 2005 and January 2008. After reaching a historic high in December 2007, the rate index has since declined (PotashCorp (a)).

Rising raw material input costs. Phosphate rock, sulfur, and ammonia are the three raw input materials for production of DAP. In 2007, Moroccan phosphate rock contract prices tripled, international contract prices of sulfur increased more than 170 percent (PotashCorp (a); Mosaic), and the Tampa prices of ammonia (also an important raw material for all nitrogen) doubled (Mosaic). The costs of these raw materials continually moved upward early in 2008 before declining late in the year. The increase in prices of raw materials particularly affected nonintegrated producers (those who purchase phosphate rocks, sulfur, and ammonia to produce DAP and account for almost a third of the world's phosphate supply). The marginal production cost for those high-cost producers often determines DAP market prices when supplies are tight (Mosaic).

Falling value of the U.S. dollar. The value of the U.S. dollar relative to the currencies of most major U.S. fertilizer trade partners declined in recent years (fig. 10) (ERS (c)). From January 2003 to January 2008, the U.S. dollar depreciated 48 percent against the Brazilian real. Declines in the dollar's

Figure 10

Value of U.S. dollar relative to foreign currencies



Source: USDA, Economic Research Service, "Agricultural Exchange Rate Data Set," www.ers.usda.gov/data/exchangerates/

value also occurred relative to the Canadian dollar (34 percent), the Russian ruble (23 percent), the Indian rupee (18 percent), and the Chinese yuan (13 percent). A consequence of the falling value of the dollar is that fertilizer imports have become more expensive and U.S. fertilizer exports have become cheaper to the importing country. The resulting increased foreign demand for phosphate fertilizers may have affected the U.S. supply.

Strength of export fertilizer associations. Global phosphate and potash trade largely are controlled by a few fertilizer associations or companies. Existing laws in North America shield producers of potash and phosphate from certain antitrust rules in pricing fertilizer exports (Markham; Philpott; Tierney). For example, in the United States, an export association (Phosphate Chemical Export Association) is empowered by the 1918 Webb-Pomerene Act to talk with competitors about pricing exports of phosphate fertilizers. In Canada, a potash export association (CANPOTEX) is protected by an exemption in Canada's Competition Law. In Russia, an export association controls potash exports. Under these protections, manufacturer associations have a strong influence in setting the fertilizer prices in global markets, establishing a benchmark for the price of fertilizers sold in the United States This effect is particularly felt in the U.S. potash market. About 80-90 percent of potash consumed in the United States is imported. The world potash market, thus, has a strong influence on U.S. potash prices.

Increasing concentration in fertilizer industries. Global phosphate and potash fertilizer marketing power is increasingly concentrated in the hands of a small group of countries. Canada, Russia, and Belarus control most of the global supply of potash fertilizers, and the United States and China dominate the global supply of phosphate fertilizers. In the United States, the number of companies producing phosphoric acid dropped from 12 to 7, mainly through mergers. Three companies control 80 percent of the production capacity of phosphoric acid in the United States (IFDC). As a result, production decisions made by these companies may have a direct effect on phosphate prices. Over the last 10 years, the number of companies producing muriate of potash (KCL) fell by half, and two companies currently own 100 percent of the U.S. production capacity of KCL. However, because the U.S. potash industry is small and imports account for 80-90 percent of the potash consumed in the United States, the U.S. industry's influence on potash prices is limited. On the other hand, a group of companies in Canada, Russia, and Belarus has a strong influence on potash prices in the United States.

Demand Factors Affecting the U.S. Price of Fertilizers

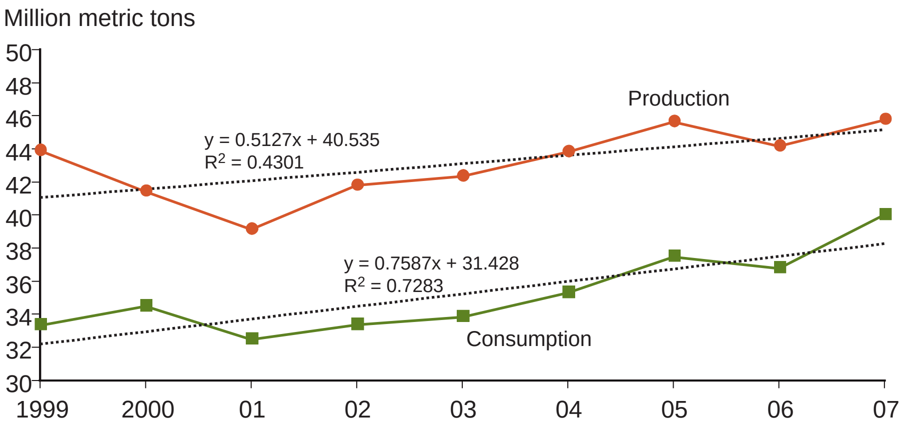
Global population and economic growth. Global fertilizer nutrient consumption increased at a compound annual growth rate of 4.2 percent during the 3 years 2006-08, which is more than double the 1.7 percent rate from 1995 to 2005 (Mosaic; Vroomen). Increased global demand for fertilizers is the result of global population and economic growth. The global population currently grows at 75 million per annum, and more people need to be fed every year (IDB). More fertilizer is required to grow crops to meet rising food demand. The rate of increase in demand for food has outstripped the rate of population growth because of economic growth in developing countries (Babcock). Economic growth in developing countries is typically characterized by an increase in per capita calorie consumption and a higher consumption of meat, dairy products, and vegetable oils, which in turn, amplifies the increase in production of feed grains and oilseed. Because of economic growth, China and India imported large quantities of fertilizer raw materials and fertilizer products in 2008 to meet rising food demand, and their fertilizer contract prices set a benchmark for the prices of fertilizers sold in the world market and in the United States.

The current (2008) weak economic conditions have dampened global fertilizer demand. But, over the long run, population and income growth will continue to put upward pressure on demand for fertilizers.

Increased global consumption of phosphate and potash. From 1999 to 2007, the increase in world consumption of phosphate and potash outpaced the increase in production (figs. 11 and 12). The gap between production and consumption is due to other uses of fertilizers, such as industrial uses. For phosphate, production increased at an annual rate of 0.51 million tons, while consumption increased at an annual rate of 0.76 million tons. For potash, production rose at a rate of 0.74 million tons per year, while consumption rose at a rate of 0.90 million tons per year. For nitrogen, however, the increase in production (2.0 million tons per year) was higher than the increase in consumption (1.82 million tons per year)

Figure 11

World phosphate (P_2O_5) production and consumption



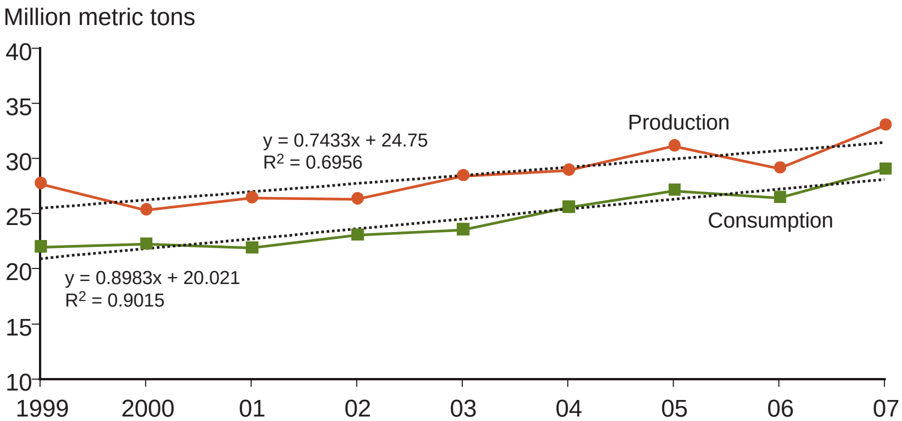
Source: USDA, Economic Research Service using data from International Fertilizer Industry Association and U.S. Department of Interior, U.S. Geological Survey.

(fig. 13). Although the differences in the rate of increase between production and consumption are not statistically significant, these findings indicate that global production of potash and phosphate is not increasing as fast as global production of nitrogen in response to global consumption, at least in the short run. In particular, dramatic increases in consumption of phosphate and potash in China and India were observed in recent years (PotashCorp (b)).

Foreign trade policies. Trade policies of major fertilizer exporters and importers can affect fertilizer prices worldwide. For example, anticipating short supplies of fertilizers, China announced a special tariff rate (export tax) of 100 percent on fertilizers effective April 20, 2008, to ensure that domestic production remained in China. This action effectively raised the export tariff rates on urea, DAP, and MAP to 135 percent. The higher tariff originally applied through September 30, 2008, on urea and phosphate fertilizers; however, the tariff rate for urea was increased to 185 percent effective September 1, while the tariff rates for all fertilizer materials were extended through December 31, 2008 (Piken). China was the world's second largest exporter of phosphate in 2007 (accounting for about 18 percent of global phosphate traded), and the largest exporter of urea (about 17 percent of

Figure 12

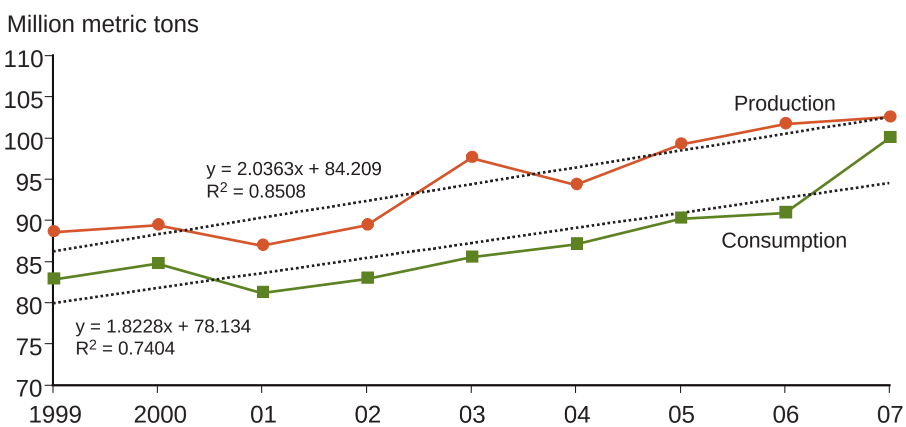
World potash (K_2O) production and consumption



Source: USDA, Economic Research Service using data from International Fertilizer Industry Association and U.S. Department of Interior, U.S. Geological Survey.

Figure 13

World nitrogen (N) production and consumption



Source: USDA, Economic Research Service using data from International Fertilizer Industry Association and U.S. Department of Interior, U.S. Geological Survey.

global urea traded). The announcement of higher export tariffs tightened the global supply of phosphate and urea and is likely to result in higher phosphate and nitrogen prices than would otherwise be expected in 2009.

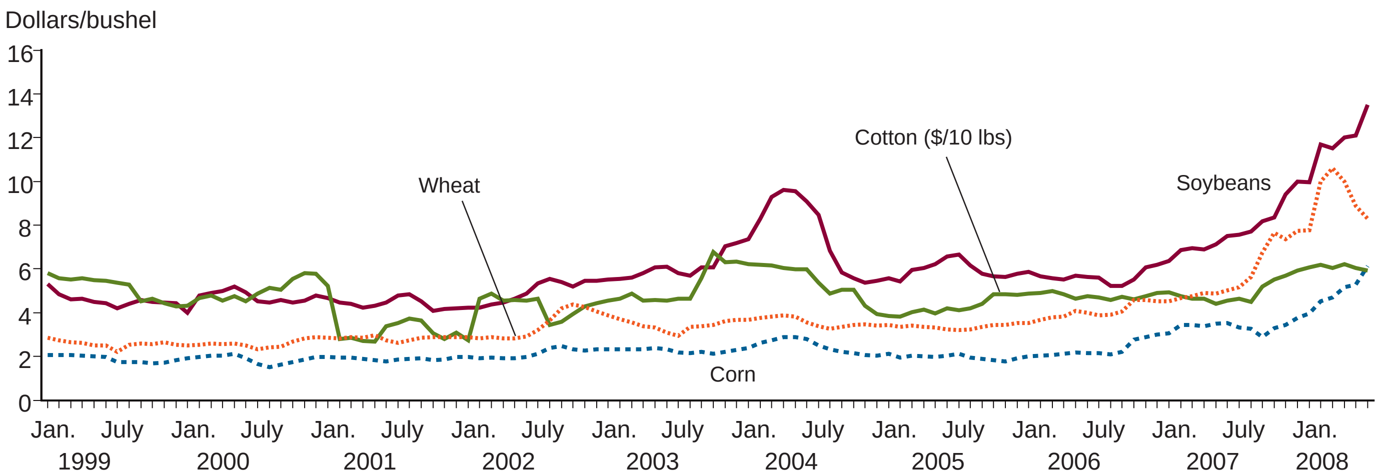
Subsidization of fertilizers in some countries. Import decisions are often based on a country's need to ensure that sufficient fertilizers are available for crop production and to avoid the risk of food shortages. Such decisions may attach a high marginal value to imported fertilizers, encouraging purchases of large quantities of fertilizers despite higher prices. Meanwhile, when a country heavily subsidizes fertilizers (such as in India), or caps fertilizer prices (such as in China), farmers in these countries may not reduce fertilizer application rates in full response to rising global prices. Consequently, global use of fertilizers may not decline as much as might be expected when global fertilizer prices increase.

High commodity prices and cash returns. In 2007, U.S. food and feed grain prices began to move sharply upward, driven in part by strong government support for biofuel programs and strong global demand for U.S. agricultural commodities. Prices reached historic highs in 2008 (fig. 14). From January to May 2007, corn prices increased 100 percent to $6.12 per bushel, wheat prices rose 83 percent to $8.28 per bushel, and soybean prices jumped 112 percent to $13.50 per bushel (NASS). High commodity prices in the United States resulted in large net cash returns for agricultural producers (Huang (b)). Large profit margins encouraged producers to expand crop acres and increase fertilizer application rates to achieve maximum crop yields, resulting in increasing demand for fertilizers and higher fertilizer prices. Higher commodity prices also insulated most farmers from the effects of higher fertilizer prices during the 2008 crop year. As a result, 2008 net farm income is expected to remain high, despite higher input costs.

Crop and fertilizer prices have fallen from the peak levels observed earlier in 2008. However, fertilizer prices may not fall as much as, or in tandem with, commodity prices (see box, "Fertilizer Prices Do Not Always Move in Tandem With Commodity Prices").

Figure 14

Historic prices of corn, wheat, soybeans, and cotton



Source: USDA, Economic Research Service using data from USDA, National Agricultural Statistics Service, *Agricultural Prices, 1999-2008*.

Fertilizer Prices Do Not Always Move in Tandem With Commodity Prices

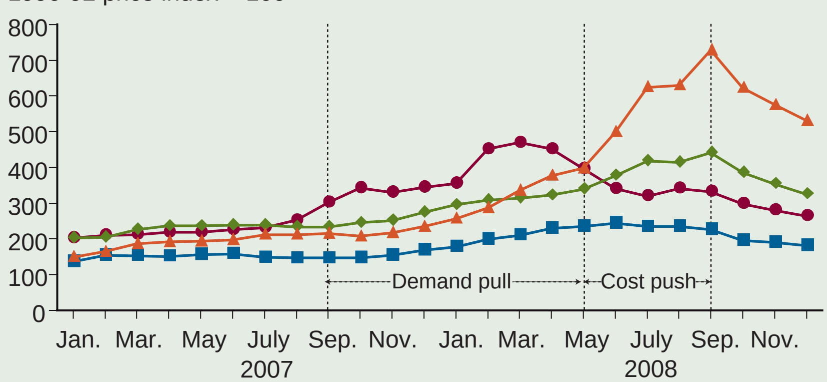
The recent behavior of market prices demonstrates that rising fertilizer prices in the United States do not necessarily move in tandem with food and feed grain prices. The fertilizer price increase from September 2007 to May 2008 was primarily caused by increased fertilizer demand as farmers responded to high commodity prices by increasing plantings. In contrast, the fertilizer price increase from May 2008 to September 2008 was primary influenced by increased input costs used to produce fertilizers.

From 2000 to 2006, rising energy costs led to an increase in fertilizer prices. During this period, fertilizer prices increased by more than the increase in food (wheat) and feed (corn) prices (NASS). From September 2007 to May 2008, however, the increase in the monthly prices of wheat outpaced the increase in monthly prices of fertilizers (nitrogen, phosphate and potash), while the monthly corn price moved in tandem with fertilizer prices. Rising fertilizer prices were pulled upward mainly by increased fertilizer demand. During this period, the price of natural gas, the main raw material used to produce nitrogen, was relatively flat (around $8.61 per thousand cubic feet) (EIA (a)). The prices of phosphate rock, sulfur, and ammonia, the main raw inputs used to produce DAP and MAP, the main phosphate fertilizers consumed in the U.S., were also relatively flat (Green Markets). In 2007, U.S. farmers planted an additional 16 million acres of corn (relative to 2006) and an additional 4 million acres of wheat in response to high corn and wheat prices, driven by growing ethanol demand and strong export sales (NASS). As a result, more than 1.5 million additional tons of nutrients (relative to 2006) were used in 2007 (AAPFCO). Increased demand for fertilizer was the main factor behind rising fertilizer prices.

However, after May 2008, prices of input materials for fertilizers rose sharply, while the prices of wheat declined and the price of corn was flat. The price of phosphate rock reached $450 per metric ton, ammonia $868 per ton, and sulfur $740 per metric ton in September 2008 (Green Markets). Prices increased 525 percent for phosphate rocks, 148 percent for ammonia, and 410 percent for sulfur from January levels. These increases in input costs to produce fertilizers are the main factor for rising fertilizer prices between May and September 2008.

Indexes of prices received for corn and wheat grain sales, and indexes of prices paid by farmers for nitrogen, and phosphate and potash fertilizers

1990-92 price index = 100



Source: USDA, Economic Research Service using data from USDA, National Agricultural Statistics Service, *Agricultural Prices, 1999-2008*.

Volatile Fertilizer Markets

Prices surge in 2008. The U.S. fertilizer industry currently is not equipped to meet a surge in domestic fertilizer demand or a large decline in global fertilizer supply. Low fertilizer inventories triggered a U.S. price surge in early 2008 (see figs. 1 and 2). The low inventories were caused by an increase in fertilizer use from planting an additional 15.3 million corn acres and an additional 3.3 million acres of wheat in 2007 (relative to 2006). As fertilizer demand increased in 2007, U.S. nitrogen inventory fell from 1.04 million tons in 2006 to 0.88 million tons at the end of the 2007 fertilizer year—a 15-percent decline; U.S. phosphate inventories fell from 0.81 million tons in 2006 to 0.59 million tons at the end of 2007—a 27-percent decline; and potash inventories in North America fell from 1.9 million tons in 2006 to 0.9 million tons at the end of 2007—a 49-percent drop (TFI; Mosaic). Low inventories in 2007, coupled with the inability of domestic and foreign fertilizer producers to quickly adjust production to meet strong fertilizer demand, contributed to the high fertilizer prices observed in early 2008.

Shortrun price outlook. Monthly average fertilizer prices paid by U.S. farmers continually increased in early 2008 and were 36 percent higher in September than they were in April. Phosphate and potash prices jumped 93 percent, and the nitrogen price was up 36 percent. Prices began to decline in October (NASS). Nitrogen, phosphate, and potash prices were 26 percent lower in December than their peak in September. The decline in monthly prices might be attributed to several factors: (1) softening global fertilizer demand in reaction to the fertilizer price spike and declining crop prices; (2) a disruption in U.S. fertilizer demand for fall applications because of a short application window (caused by late crop harvests following delayed planting in the spring due to wet weather); (3) an increase in fertilizer supplies (from July to August) from imports (ERS (b)); (4) a decline in fertilizer feedstock prices (such as natural gas, sulfur, and phosphate rock (Green Markets)); (5) a recent disruption in financial markets for fertilizer purchases, and (6) congested distribution supply chains due to farmers' postponing purchases in anticipation of a further decline in prices (McKinney).

The currently observed large decline in U.S. fertilizer prices, however, may not be sustainable for several reasons: (1) many of the causes of the recent spike in fertilizer prices, such as natural gas price movements and expected growth in global demand, could still place upward pressures on fertilizer prices in spring 2009; (2) in response to low fertilizer prices, the U.S. fertilizer supply is expected to decline due to production cutbacks by manufacturers (Yara, Terra, Agrium, PotashCorp, and Mosaic, for example (Green Markets)) and worker strikes in potash plants in Canada; (3) U.S. fertilizer imports are expected to decline given the current low prices and congested distribution supply chains in the United States (ERS (a)); and (4) fertilizer demand will likely stay high. Current (January 2009) low fertilizer prices, projected relative crop prices and the government's continuing ethanol mandate may favor corn planting in the spring (Green Markets; OCE; WAOB). Expected reductions in fertilizer supplies, lags in adjusting supply to upward price movements, and expected high demand for fertilizers in spring 2009 are likely to put upward pressure on fertilizer prices. Unless demand is disrupted by unforeseen extreme weather events, changes in global fertilizer trade, or a deepening global economic slowdown, the prices of U.S. fertilizers, in general, are likely to rebound during spring 2009.

Price volatility in the United States will differ among fertilizer nutrients because of fundamental differences in various nutrient markets of the fertilizer industry. Nitrogen markets are likely more volatile than potash markets because of volatile natural gas prices.

Nitrogen prices. In 2008, U.S. nitrogen prices started to rise in April and reached record-high levels in September before falling in October (NASS). At the end of December 2008, producers' prices of ammonia and urea were near or below their production costs in the United States (Green Markets). The nitrogen supply is expected to be reduced for spring crops as a result of China's export tax (Mosaic), production cutbacks by some fertilizer firms (Green Markets), and declining imports (a 21-percent decline from July to November, compared with similar months in 2007) (ERS (a)). Additionally, because of continued strong fertilizer demand expected from feed and food grain production, tighter nitrogen supplies are expected in spring 2009, and there could be some additional upward pressure on nitrogen prices.

Phosphate prices. The sharp increases for sulfur, phosphate rock, and ammonia prices between January 2007 and September 2008 pushed the prices of phosphate fertilizers (DAP and MAP) to historic highs. While sulfur prices have fallen from their 2007 price levels, the price of phosphate rock remained higher in October 2008 than its price in 2007 (Green Markets). The fall in sulfur prices that began in October has reduced the cost of producing DAP and MAP (Chauhan), which has led to a softening of DAP and MAP prices (Green Markets). Recent decisions by a few firms dominating the U.S. phosphate market to reduce phosphate production by as much as 1 million tons, in response to recent softening demand, and similar cutbacks by Morocco and other major producing countries will likely put upward pressure on future prices (Mosaic; PotashCorp (a)). In addition, the expected decline in phosphate exports from China (due to its higher export tax) could also tighten global supplies. Tight supplies due to limited U.S. production of DAP and MAP, coupled with high production costs and expected strong global demand (Mosaic), may keep phosphate prices above their historic trend levels this spring.

Potash prices. U.S. potash prices, which started to rise in April and reached an historic high in October, show little signs of declining (NASS; Green Markets). Increases in global demand for potash from China, India, Brazil, and other countries, exacerbated by the loss of a potash mine in Russia and by a worker strike at three mines in Canada, have created an extremely tight global supply situation for potash (Mosaic). Most of the potash consumed in the United States (about 85 percent) is imported from Canada, which is the largest potash exporter in the world. Canada has the capacity to increase potash production but may not be able to produce enough to meet strong shortrun demand. Furthermore, recent production cutbacks by producers in Canada may reduce the supply to the United States. Canpotex, the export marketing association in Canada, signed a new contract to supply potash to Japanese customers at a delivered price of just over $900 per metric ton ($817 per short ton) in November (Tierney), which is double the April price. This will likely become the benchmark price for potash marketed in 2009.

Longrun Supply Outlook

A continuing increase in world population and returning global economic growth should increase global demand for fertilizers. At the same time, the expected long-term rise in fossil energy prices will increase the cost of supplying fertilizers. Rising energy costs would increase both the cost to produce fertilizers and the cost of delivery to agricultural producers. A strong positive correlation between energy prices and fertilizer prices can be expected in the long run.

U.S. agricultural producers are in a favorable position to acquire fertilizers in the long run. The United States has the third largest reserve of phosphate rock in the world and was the largest producer of phosphate fertilizers in 2007 (USGS). Because the United States shares a border with Canada, it has a competitive advantage in purchasing potash from Canada, which has the largest potash reserve in the world and is also the largest producer of potash fertilizers (USGS). Also, because of its location advantage, the United States will be very competitive for nitrogen fertilizers from Canada, Trinidad and Tobago, and Venezuela, which have large reserves of natural gas for nitrogen production in the Western Hemisphere. In addition, the United States could obtain nitrogen from coal gasification. Currently two plants are in operation (IFDC). The United States has the largest coal reserve in the world. Recent advances in using coal to produce ammonia have increasingly made this technology economically feasible, especially at high natural gas prices. Domestic ammonia production based on coal may play a larger role in the U.S. nitrogen supply if economic conditions and environmental considerations are favorable.

Conclusions

Steady increases in U.S. fertilizer prices since 2002 and the price surge in 2008 were the result of a complex interplay between growth in global demand and a decline in domestic supplies. A large expansion in world fertilizer demand and rising energy and raw material input and transportation costs over the past several years drove up international fertilizer prices. Until recently, the falling value of the U.S. dollar also contributed to the rising cost of nutrients imported into United States. And, the rising cost of ocean freight, barge, rail, and truck transportation added further to the delivered prices paid by the U.S. farmer. The United States is the world's largest importer of nitrogen and potash nutrients and the largest exporter of phosphate nutrient. As a consequence, U.S. farmers are directly affected by global prices, which have been volatile in recent years.

The production capacity of the U.S. fertilizer industry is limited. Nutrient production from the industry currently can not respond to a surge in demand or a large decline in global supplies. Low fertilizer inventories in the United States at the beginning of the 2008 planting season triggered the price surge in 2008. The low inventories were caused by a large increase in fertilizer use in 2007 as planting of corn and wheat expanded. Low inventories, coupled with the inability of domestic and foreign fertilizer producers to quickly adjust production and supply in response to strong fertilizer demand, contributed to high fertilizer prices in 2008.

Fertilizer prices, like crop prices, reflect market conditions. And, like crop prices, they are sensitive to and react quickly to a change in demand and supply. Price volatility in the United States, however, will differ among fertilizer nutrients because of fundamental differences in various nutrient markets. Nitrogen prices are more volatile than phosphate and potash prices (NASS; Green Markets). Unless fertilizer demand is disrupted by unforeseen extreme weather events, changes in global fertilizer trade, or a deepening global economic slowdown, phosphate and potash prices in 2009 are expected to stay high relative to their pre-surge prices in 2007. Given the long-term increase in global fertilizer demand, fossil energy prices could be the dominating factor shaping longrun fertilizer prices in the United States.

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