Impacts of Changes in the Prices of Energy Products on North Dakota Farmers

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Farm expenditures on fuel and nitrogen fertilizer comprised about 30 percent of variable costs (excluding labor) on North Dakota farms in 1983 (Krenz, 1984). Farmers are quite vulnerable to fluctuations in energy prices due to their high consumption of energy products, particularly diesel fuel.

A recent study by the Department of Agricultural Economics has estimated the costs and benefits a typical farmer in east-central North Dakota experienced from the fluctuations in energy product prices for the 13-year period 1972-1984. Energy products considered were bulk delivery diesel fuel and regular gasoline, anhydrous ammonia, and ammonium nitrate.

Prices

Prices of diesel and gasoline generally track together quite closely (Table 1). Gasoline prices increased 94 percent and diesel 155 percent from 1972 to 1978. This increase, though substantial, was distributed fairly evenly over this six-year period. The largest increase in that period occurred in 1974.

Table 1. Diesel, Gasoline, Anhydrous Ammonia, and Ammonium Nitrate Prices in North Dakota, 1972-84.

Year	Diesel	Gasoline	Anhydrous	Nitrate
	----($/gal)----		---- ($/ton) ----	
1972	.185	.315	79.0	61.0
1973	.223	.342	90.0	70.0
1974	.354	.466	198.0	144.0
1975	.367	.498	231.0	163.0
1976	.404	.536	179.0	127.0
1977	.452	.575	165.0	132.5
1978	.471	.611	151.0	127.5
1979	.703	.810	173.0	140.0
1980	1.004	1.160	213.0	160.0
1981	1.190	1.293	237.0	175.0
1982	1.138	1.244	235.0	177.0
1983	1.014	1.213	221.0	171.0
1984	1.030	1.202	257.0	187.0

Source: Crop Reporting Board, USDA-SRS, "Agricultural Prices" Monthly and Annual Issues, 1972-1984.

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Fuel prices increased sharply after 1978. Gasoline prices rose 112 percent and diesel prices 153 percent over 1978 levels by 1981. Prices of gasoline and diesel increased over 310 percent and 543 percent, respectively, from 1972 to the fuel price peak in 1981.

Fuel prices began to decline in 1981. Gasoline prices dropped 7 percent and diesel prices decreased over 13 percent from 1981 to 1984. Both a $.05 per gallon federal gasoline tax increase in April 1983 and a $.05 per gallon state gasoline tax increase in July 1983 played major roles in keeping gasoline prices higher. Taxes had no major effect on diesel prices because the state tax remained constant and there is no federal tax on diesel consumed on the farm. Overall, gasoline and diesel prices increased 282 percent and 457 percent, respectively, during the 13-year period.

Anhydrous ammonia and ammonium nitrate prices have also generally moved together (Table 1); however, fluctuations in anhydrous ammonia prices seem to be greater than in ammonium nitrate prices. Prices for both of these products increased sharply from 1972 to 1975, decreased from 1975 to 1978 (with the exception of a slight increase in nitrate prices in 1977) then rose again after 1978. Prices for both these products decreased in the early 1980s but then increased in 1984. Anhydrous ammonia and ammonium nitrate prices increased 225 percent and 207 percent, respectively, over the 13-year period.

Except for the slight decrease in 1983, prices for nitrogen fertilizers have not decreased over the past several years as fuel prices have. This continual increase can primarily be attributed to the rising cost of natural gas, a basic raw material used in the production of nitrogen fertilizer. Natural gas prices have increased steadily from 1978 to mid-1983. Natural gas prices dropped slightly in the latter part of 1983, then leveled off in 1984 (Energy Information Administration, 1985).

The energy prices in Table 1 were adjusted for inflation to give a better perspective of how prices relate in dollars with constant purchasing power. The Index of Prices Paid by Farmers for Commodities and Services, Interest, Taxes, and Wage Rates from 1972 to 1984 was used to adjust the fuel and fertilizer prices in Table 1 to 1984 dollars (USDA, 1985a, 1985b). By using this index, the changes in prices of energy products can be examin-

ed in comparison to changes in prices paid for goods and services farmers use in crop and livestock production and family living.

The adjusted prices for diesel and gasoline fuel and for anhydrous ammonia and ammonium nitrate fertilizer are illustrated in Figures 1 and 2, respectively. The sharp price increases in 1973 are accentuated when examined in real terms, because inflation was lower at that time. Price increases during periods of high inflation, such as in the late 1970s, are tempered somewhat when evaluated in real terms. However, price decreases that occur in inflationary periods such as in the early 1980s are enhanced when evaluated in real terms.

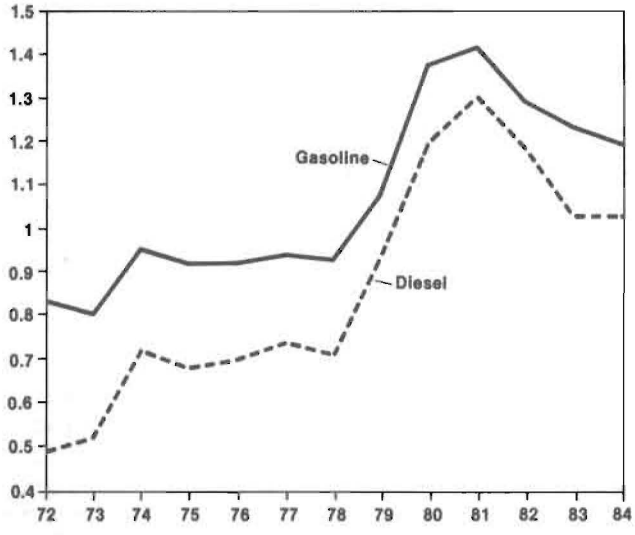

Figure 1. Fuel Prices in 1984 Dollars, 1972-1984.

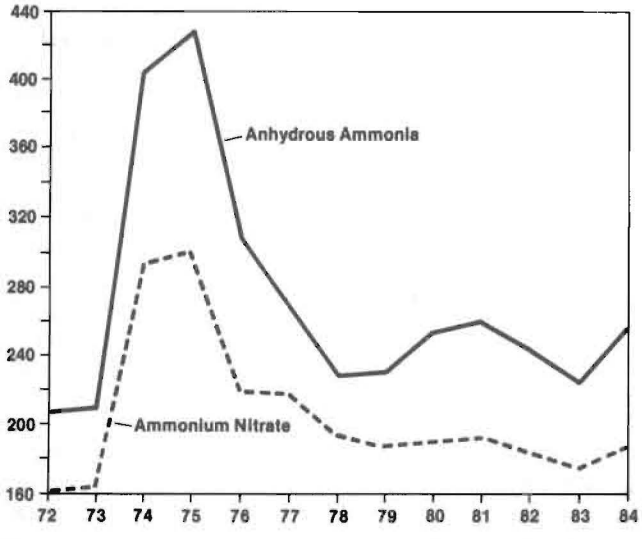

Figure 2. Nitrogen Fertilizer Prices in 1984 Dollars, 1972-1984.

Expenditures for Representative Farm

The quantities a typical farm consumed of each energy product were based on the estimates by Tsigas, for representative farms located in 16 east-central counties in North Dakota. The information used to model the farm was obtained from the 1974 **Census of Agriculture, North Dakota Crop and Livestock Statistics**, and related publications. The model farm size was 1,005 acres, including 797 acres of cropland, 116 acres of native pasture, 27 acres of native hay, and 65 acres of wasteland (Tsigas, 1981).

The gallons of diesel and gasoline required as well as the pounds of anhydrous ammonia and ammonium nitrate required in a typical year of production are presented in Table 2. These quantities are assumed to remain constant over the years studied.

Table 2. Quantities of Energy Products Required for Production on a Typical East Central North Dakota Farm.

Product	Quantity
Diesel (gal)	4,068.0
Gasoline (gal)	1,799.0
Anhydrous ammonia (lbs.)	2,431.0
Ammonium nitrate (lbs.)	6,182.0

Source: Tsigas, 1981.

Given the assumption that the quantity of energy products consumed is constant over time and using the price information previously presented, the farm's total expenditures on diesel, gasoline, and nitrogen fertilizer (both types combined) can be estimated (Table 3). The total expenditures on energy products increased $6,428 (350 percent) from 1972 to 1984. The average annual increase over that time period was over $714 per year.

Table 3. Estimated Diesel, Gasoline, and Nitrogen Fertilizer Expenditures by a Typical East Central North Dakota Farm, 1972-1984.

Year	Diesel	Gasoline	Nitrogen Fertilizer	Total
		dollars		
1972	$ 753	$ 567	$304	$1,623
1973	907	615	348	1,870
1974	1,440	838	731	3,010
1975	1,493	896	836	3,225
1976	1,643	964	650	3,258
1977	1,839	1,034	652	3,525
1978	1,916	1,099	618	3,633
1979	2,860	1,457	687	5,004
1980	4,084	2,087	804	6,975
1981	4,841	2,326	884	8,051
1982	4,629	2,238	889	7,756
1983	4,125	2,182	851	7,158
1984	4,190	2,162	949	7,302

However, total expenditures on energy products decreased $893, or $446.5 per year, from 1981 to 1983. Total expenditures then increased again in 1984.

Farmers received the greatest benefit from the decreases in diesel prices that occurred between 1981 and 1983; expenditures dropped $716 over that time period. Expenditures on gasoline dropped $164 between 1981 and 1984. The $144 increase in expenditures on energy products in 1984 was primarily the result of a jump in nitrogen fertilizer prices and a rise in diesel prices.

The expenditures on these energy products were adjusted for inflation to 1984 dollars using the index of prices paid by farmers (USDA, 1985a, 1985b). The adjusted expenditures on diesel fuel, gasoline, and nitrogen fertilizer and the adjusted total expenditures on energy products are illustrated in Figure 3. Perhaps the most significant point that can be made from Figure 3 is that the decrease in total expenditures that occurred after 1981 is more pronounced when examined in real dollars than in actual dollars. The benefits of energy price decreases in real dollars are greater than an evaluation of only the actual dollar amounts would reveal.

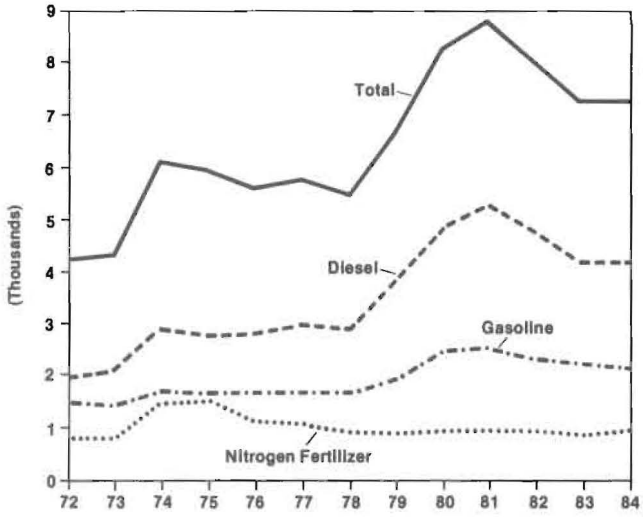

Figure 3. Energy Expenditures in 1984 Dollars, 1972-1984.

Examining the expenditures on gasoline, diesel fuel, and nitrogen fertilizers as percentages of total expenditures on energy products is one way of estimating how price changes for a given product affect how much money is spent on that product relative to other products purchased (Table 4). Expenditures on gasoline as a percentage of total energy expenditures appear to be the most stable, especially after 1976. Most of the shifting occurred between diesel fuel and nitrogen fertilizer expenditures. The rise in expenditures on nitrogen fertilizer as a percentage of total energy expenditures from 1973 to 1975 corresponds to the sharp increases in fertilizer prices during those years. The percentage of total energy expenditures spent on diesel fuel increased

Table 4. Expenditures on Diesel, Gasoline, and Nitrogen Fertilizer as Percentages of Total Expenditures on Energy Products on a Typical East Central North Dakota Farm, 1972-1984 (In Percent).

Year	Gasoline	Diesel	Nitrogen Fertilizer
		percent	
1972	35	46	19
1973	33	48	19
1974	28	48	24
1975	28	46	26
1976	30	50	20
1977	29	52	19
1978	30	53	17
1979	29	57	14
1980	30	59	11
1981	29	60	11
1982	29	60	11
1983	30	58	12
1984	30	57	13

steadily from 1975 to 1981, then declined. The marked increase in percentage of diesel fuel expenditures between 1978 and 1980 corresponds to the sharp diesel price increases in that period. The percentage of total expenditures spent on diesel fuel decreased after 1982. This was due primarily to the decreases in diesel fuel prices, and also to the increases in nitrogen fertilizer prices.

Summary and Conclusions

A farm's expenditures on energy products constitutes a substantial percentage of its variable costs of production. A farmer's demand for these energy products cannot vary much in response to price changes. A certain amount of each product is required to perform necessary farm operations, regardless of price levels. As a result, farmers are vulnerable to price fluctuations, especially with products that have volatile prices, such as diesel fuel. During a period of rising energy prices when few alternative sources are available, capital may be diverted from other areas to purchase energy products to maintain farm operations. The result can be decreased liquidity. Conversely, when energy prices decrease, as was the case between 1981 and 1984, farmers stand to benefit considerably, either because capital used to purchase energy products would become available for use elsewhere in their operations, or because short-term borrowing requirements could be reduced.

Changes in energy prices have mixed effects on North Dakota's economy as a whole. As has been demonstrated, decreases in energy prices, especially fuel prices, provide a boost to the farming industry and other sectors of the economy that have high levels of energy consumption. At the same time, price decreases are detrimental to the energy-producing sectors of the state as well as to state tax revenues based on oil and gas production. Potential macro effects of changes in the prices of energy products are, however, beyond the scope of this analysis.

References

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CORRECTION

R.G. Timian, author of "An Update on Wheat Streak Mosaic Virus in North Dakota" which appeared in the March-April 1985 issue, has discovered some errors were made in preparation of the manuscript and not detected until after publication. The table below contains the correct figures.

Table 1. The yield and thousand kernel weight of virus free and WSMV infected spring and durum wheat cultivars in field trials at Fargo, ND, 1984.

Cultivar	Yield bu/A virus free control	Yield bu/A WSMV inoculated	Yield reduction %	1000 K W (gm) virus free control	1000 K W (gm) WSMV inoculated	Weight reduction %
SPRING WHEAT						
Butte	59.2	40.4**	32 a[1]	29.5	26.6**	10 a[1]
Oslo	61.0	40.4**	34 a	31.0	26.2**	15 b
PR 2369	64.9	35.5**	45 b	29.4	25.0**	15 b
Olaf	56.0	29.6**	47 bc	31.2	28.2**	10 a
Guard	63.3	32.9**	48 bc	30.7	27.4**	11 a
Marshall	54.4	26.3**	52 bc	25.1	20.8**	17 bc
Alex	65.4	28.5**	56 bc	30.9	28.5*	8 a
Stoa	67.0	28.5**	58 c	29.3	24.1**	18 c
	LSD for yield 5% - 10.2 1% - 13.9			LSD for Kernel weight 5% - 1.89 1% - 2.557		
DURUM WHEAT						
Ward	65.4	50.8**	22 a[1]	38.9	36.0**	8 a[1]
Vic	66.4	47.5**	29 a	44.5	40.5**	9 a
Cando	63.3	36.2**	43 b	39.6	35.2**	13 a
Lloyd	70.0	36.6**	48 b	30.8	26.6**	14 a
	LSD for yield 5% - 7.5 1% - 10.6			LSD for Kernel weight 5% - 1.98 1% - 2.774		

[1] Means separated by a different letter differ significantly (P = .05).

*,** Significant at the .05 and .01 level, respectively, as indicated by the paired t test.