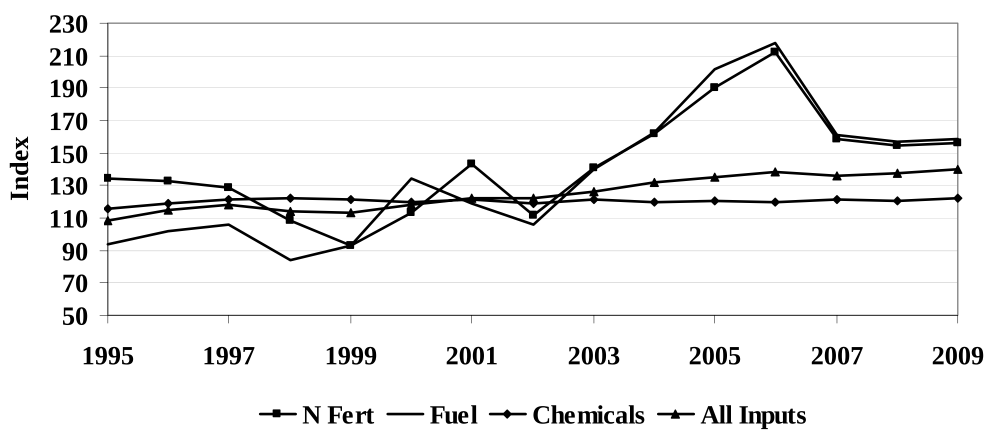
The Impact of Rising Energy Prices on Income for Representative Farms in the Western United States

J. Marc Raulston, George M. Knapek, Joe L. Outlaw, James W. Richardson, Steven L. Klose and David P. Anderson[1]

Introduction

Recent increases in prices of natural gas and fossil fuel based energy sources have had a large negative impact on the financial condition of agricultural producers across the nation. In addition to higher fuel costs for trucks, equipment, and irrigation motors, the cost of nitrogen fertilizer is closely linked to energy prices and has also increased significantly (Figure 1). Agriculture is especially vulnerable to increases in input costs due to the narrow profit margins realized for most commodities.

Figure 1. Indices of Prices Paid for Nitogen Fertilizer, Fuel, Chemicals, and All Inputs, 1995-2004, with FAPRI's Projections for 2005-2009.



This study quantifies the impacts of these increases on the economic viability of various types of agricultural producers in the western United States. Commodity-specific differences are revealed, along with differences between farms using alternative cropping practices and farms involved in various land tenure arrangements. The primary objective of this research is to evaluate the economic and financial impacts of increases in energy prices on net incomes of representative farms, dairies, and ranches located throughout ten western states (Washington, Montana, Wyoming, Idaho, Oregon, Nevada, California, New Mexico, Texas and Colorado).

Data and Methods

This study utilizes primary representative farm data coupled with a whole farm simulation model to examine the effects of rapidly increasing fuel prices on agricultural producers in the western United

[1] The authors are with the Agricultural and Food Policy Center, Department of Agricultural Economics, Texas A&M University

States. Thirty representative farms, dairies, and ranches created through a focus group interview process were analyzed assuming alternative input inflation rates using the farm level simulation model (FLIPSIM) developed by Richardson and Nixon (1986) at Texas A&M University. Each farm is representative of the farms in its region. A summary of the representative farms is included in the appendix. Included in the representative farm data set are three feedgrain farms, four wheat farms, eight cotton farms, two rice farms, six dairies, and seven cow/calf operations. The entire spectrum of non-irrigated versus irrigated cropping systems is represented across this set of farms, allowing comparison among a wide range of agricultural energy consumers (Appendix Table). The representative crop farms display a wide variety of land tenure ranging from 100% ownership to 100% leasing. Lease arrangements include both cash lease and sharecropping, allowing the quantification of the value to producers of cost sharing in categories closely linked to energy price. With the exception of three crop farms (TXNP1750, TXPG3760, and CAC2400), all of the farms share with landowners to some degree in the cost of fertilizer and/or other expenses closely tied to fuel price.

The FLIPSIM model draws random crop yields, livestock production variables, and prices from a multivariate empirical probability distribution allowing projections to incorporate production and price risk. A description of FLIPSIM is provided in Richardson and Nixon (1986) and the procedure for simulating random values is described by Richardson, Klose and Gray (2000). Each inflation rate alternative was simulated 100 times (iterations) for an eight-year (2002 to 2009) projection period using random prices, yields and livestock production for 2005-2009. Annual mean crop and livestock prices were obtained from the August 2005 Baseline reported by FAPRI (Tables 1 and 2) (FAPRI 2005).
Three general assumptions were made in this analysis: 1) long-term and intermediate-term debt beginning in 2002 is 20% of beginning asset market value for crop farms, 30% for dairies, and 1% for long-term and 5% for intermediate debt on beef cattle operations; 2) the provisions of the 2002 Farm Bill are assumed to continue throughout the entire projection period; and 3) cash rents and share lease arrangements remain constant throughout the study period.

Table 1. FAPRI August 2005 Baseline Projections of Crop and Livestock Prices, 2002-2009

	2002	2003	2004	2005	2006	2007	2008	2009
Crop Prices								
Corn ($/bu.)	2.32	2.42	2.07	2.04	2.10	2.18	2.25	2.31
Wheat ($/bu.)	3.56	3.40	3.40	3.09	3.20	3.32	3.40	3.47
Cotton ($/lb.)	0.4450	0.6180	0.4280	0.4361	0.4788	0.5038	0.5146	0.5224
Sorghum ($/bu.)	2.32	2.39	1.75	1.89	1.92	1.98	2.05	2.11
Soybeans ($/bu.)	5.53	7.34	5.80	5.98	5.44	5.34	5.33	5.37
Barley ($/bu.)	2.72	2.83	2.48	2.38	2.53	2.59	2.64	2.66
Oats ($/bu.)	1.81	1.48	1.48	1.47	1.52	1.57	1.61	1.65
Rice ($/cwt.)	4.49	8.08	7.30	7.31	7.30	7.30	7.29	7.40
Soybean Meal ($/ton)	173.19	244.22	176.45	179.82	166.33	164.46	162.04	160.06
All Hay ($/ton)	92.40	85.50	89.70	95.49	94.93	95.04	96.17	97.51
Peanuts ($/ton)	364.00	386.00	378.00	309.72	334.27	364.62	377.57	386.64
Cattle Prices								
Feeder Cattle ($/cwt)	86.34	95.21	111.79	115.14	107.50	101.92	96.49	91.89
Fat Cattle ($/cwt)	67.04	84.69	84.75	84.93	82.27	80.54	77.52	75.18
Culled Cows ($/cwt)	39.23	46.62	52.35	53.22	52.06	50.32	48.60	46.53
Milk Price								
U.S. All Milk Price ($/cwt)	12.11	12.55	16.13	15.02	13.72	13.41	13.17	13.08

Source: Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri-Columbia and Iowa State University.

Table 2. FAPRI August 2005 Baseline Assumed Rates of Change in Input Prices and Annual Changes in Land Values, 2003-2009

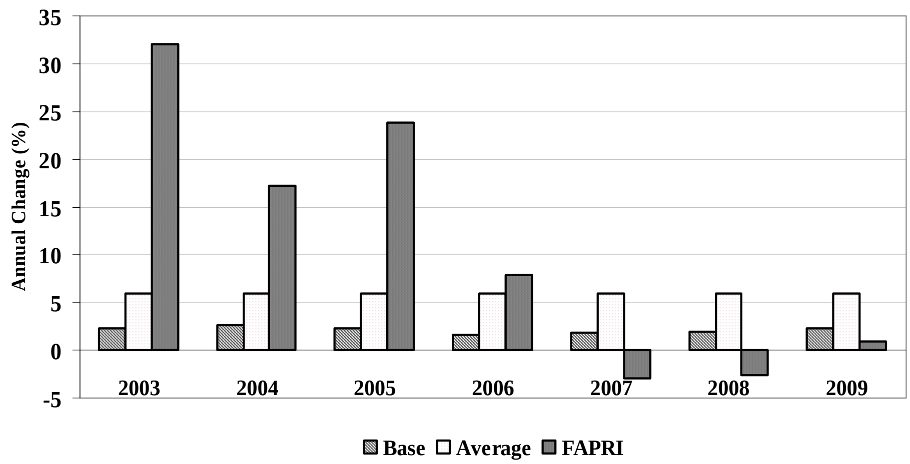
	2003	2004	2005	2006	2007	2008	2009
Annual Rate of Change for Input Prices Paid							
Seed Prices (%)	8.45	2.44	1.18	1.10	1.39	1.16	1.69
N Fertilizer Prices (%)	25.89	13.83	17.63	11.34	-3.27	-2.69	1.1
P & K Fertilizer Prices (%)	1.87	11.01	6.06	3.46	2.1	1.87	2.07
Herbicide Prices (%)	0.00	0.89	0.56	-0.29	-1.07	-0.58	0.80
Fungicide Prices (%)	-0.85	-0.64	2.7	1.01	1.32	1.68	2.36
Insecticide Prices (%)	4.29	-1.78	-1.01	-1.71	-0.47	0.22	1.38
Custom Application (%)	32.08	17.26	23.83	7.89	-2.93	-2.58	0.93
Scouting (%)	2.5	0.61	1.91	1.28	2.16	2.81	3.18
Irrigation Fuel (%)	32.08	17.26	23.83	7.89	-2.93	-2.58	0.93
Fuel and Lube Prices (%)	32.08	17.26	23.83	7.89	-2.93	-2.58	0.93
Drying & Hauling (%)	32.08	17.26	23.83	7.89	-2.93	-2.58	0.93
Ginning (%)	2.5	0.61	1.91	1.28	2.16	2.81	3.18
Machinery Prices (%)	-1.96	7.87	2.38	1.28	2.49	3.05	3.49
Wages (%)	2.61	1.91	1.93	2.61	2.64	2.70	2.48
Supplies (%)	1.63	1.80	1.63	-1.78	-0.97	-0.33	1.06
Repairs (%)	2.99	3.02	3.48	1.53	1.68	1.9	2.06
Services (%)	2.50	0.61	1.91	1.18	2.16	2.81	3.18
Taxes (%)	1.59	1.56	2.80	-0.17	1.43	1.15	1.85
PPI Items (%)	4.20	5.24	0.59	0.25	1.10	1.35	1.91
PPI Total (%)	3.28	4.43	1.12	0.59	1.32	1.54	1.96
Annual Change in Consumer Price Index (%)	2.27	2.66	2.28	1.63	1.83	1.98	2.29
Annual Rate of Change for U.S. Land Prices (%)	4.96	7.09	11.00	3.28	0.07	0.25	1.34

Source: Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri-Columbia and Iowa State University.

The following fuel cost scenarios are analyzed and changes are reported relative to the **Base** situation:

- **Base** - Assumed the percent change in Consumer Price Index from the FAPRI 2005 Baseline is the annual inflation rate for fuel related expenditures (custom application cost, irrigation fuel, tractor fuel and lube, drying and hauling) and nitrogen fertilizer, i.e., fuel and fertilizer prices increased 1.6 to 2.3% per year (Figure 2);
- **Average** - Used historical inflation rates for fuel from a more favorable era, 1996-1999, to calculate an average inflation rate (5.97%) as the assumed inflation rates for fuel related expenses and nitrogen fertilizer throughout the 2003-2009 study period (Figure 2);
- **FAPRI** - Utilized inflation rates for fuel related expenses and nitrogen fertilizer from the FAPRI August 2005 Baseline (Figure 2).

Figure 2. Three Assumed Rates of Inflation for Fuel, Fuel Related Expenses, and Nitrogen Fertilizer, 2003-2009.



The effect of each alternative is evaluated based on the projected 2005-2009 average net cash farm income (NCFI). Net cash farm income is defined as total cash receipts minus cash expenses. The NCFI was used to show the impact of higher energy costs on the net income available to service debt, family living, and replace machinery.

Results

Net Cash Farm Income (NCFI) was calculated under three inflation rate assumptions for thirty representative farms and reported as an average NCFI for 2005-2009 or a change from the **Base** (Table 3). Impacts of each inflation rate assumption are described in this section as the decreases in NCFI due to the higher inflation rate scenarios relative to the **Base**.

The representative farm operations are grouped into six categories based on the primary commodity produced. Changes in NCFI for each scenario were averaged by commodity group for comparison. Wheat farms experience the smallest reduction in NCFI due to higher energy costs under the **Average** and the **FAPRI** inflation rates for fuel. Their average NCFI would decrease $10,700 for the **Average** inflation rate scenario relative to the **Base** and $17,700 for the **FAPRI** projection scenario. The wheat farms are 100% non-irrigated and all participate in at least some form of input cost sharing. The cotton farms are disadvantaged the most when energy prices rise, based on NCFI decreases. On average, annual NCFI for cotton farms decreases $55,300 for the **Average** scenario and $208,100 for the **FAPRI** scenario. If energy prices increased at their historical average rates, NCFI for the California cotton farm (CAC2400) would decline $122,600; but, given the higher inflation rates projected by FAPRI, NCFI declines $449,200 per year for 2005-2009. The next largest decrease in NCFI due to energy price increases was experienced by the feedgrain farms, followed by the rice, dairy, and beef farms. The dairies and beef ranches spend much less on fuel and fuel-related inputs than do the crop farms, thereby reducing the adverse impacts of higher fuel and energy prices on NCFI.

Much of the cost of irrigation, especially for those farms irrigating from wells rather than surface water, is associated with fuel to run the power units for pumping water; thus the irrigated operations are more negatively impacted by rising fuel costs. For the **Average** energy inflation rate scenario, dryland farms experience a $17,000 decrease in NCFI relative to the **Base** scenario. These dryland farms can expect a $51,200 annual decrease in NCFI under the higher energy inflation rate projections in the **FAPRI** scenario. For the irrigated farms, a far greater decrease is observed; a $67,800 decrease in NCFI results under the **Average** scenario and a $214,000 decrease in NCFI occurs as a result of the higher inflation rates associated with energy in the **FAPRI** scenario.

Table 3. Average Annual Net Cash Farm Income for Representative Farms in the Western United States Under Three Assumed Inflation Rates for Fuel, 2005-2009.

		Change in NCFI from Base	
	Base NCFI[1]	Average[2]	FAPRI[3]
	--$1,000--	--$1,000--	--$1,000--
Irrigated	185.6	-67.8	-214.0
Non-Irrigated	142.1	-17.0	-51.2
No Cost Share	303.9	-98.8	-280.8
Cost Share	135.4	-32.2	-106.7
Feedgrain	125.1	-61.8	-144.4
TXNP1750	192.4	-50.8	-190.1
TXWG1400	86.2	-11.7	-40.2
TXPG3760	96.7	-122.8	-203.0
Wheat	140.6	-10.7	-17.7
COW3000	151.7	-7.4	-15.6
MTW4500	155.1	-13.0	-19.1
ORW4000	142.4	-9.7	-15.8
WAW1725	113.1	-12.8	-20.3
Cotton	234.9	-55.3	-208.1
CAC2400	622.7	-122.6	-449.2
TXSP2239	160.0	-43.8	-171.1
TXRP2500	84.9	-8.4	-33.4
TXCB1850	136.3	-21.6	-79.0
TXVC4500	274.1	-71.9	-272.5
TXPC2500	173.6	-53.1	-201.1
TXMC3500	267.1	-51.8	-186.1
TXEC5000	160.3	-69.2	-272.7
Rice	-4.6	-37.9	-83.3
CAR550	-19.4	-51.5	-124.8
TXR1350	10.2	-24.4	-41.7
Dairy	819.6	-30.5	-75.0
TXCD500	38.2	-16.6	-62.2
CAD1710	1198.8	-77.5	-178.5
NMD2125	1396.7	-21.4	-50.6
IDD1000	383.5	-14.7	-34.7
TXED1000	669.4	-16.4	-38.8
TXND2400	1230.9	-36.2	-85.0
Beef	34.9	-5.6	-19.8
MTB500	116.9	-4.8	-19.2
WYB500	11.2	-5.8	-23.0
NMB240	-14.3	-2.0	-8.1
CAB500	-52.0	-10.8	-44.4
SDB450	66.4	-4.4	-16.8
NVB700	41.0	-8.3	-19.4
TXRB500	75.0	-3.1	-7.5

1 Base NCFI: Increase fuel and nitrogen fertilizer prices using annual change in Consumer Price Index.

2 Average: Increase fuel and nitrogen fertilizer prices using historical average annual fuel inflation rate, 1996-1999.

3 FAPRI: Increase fuel and nitrogen fertilizer prices using annual fuel inflation rates from FAPRI 2005 August Baseline.

A similar pattern is revealed in the comparison between the farms with landlords who share in input costs versus those operations that are either entirely cash leased or do not share input costs. A $32,200 decrease in NCFI is observed under the **Average** alternative and a $106,700 decrease in annual NCFI occurs as a result of the **FAPRI** scenario for the farms that share some costs with landowners. For farms that do not practice input cost sharing, a $98,800 decrease in NCFI occurs with the **Average** scenario and a $280,800 decrease in NCFI results from the **FAPRI** scenario. As expected, farms sharing the cost of fertilizer and other input costs closely related to fuel prices are less affected by the rising cost of energy. Cash leases that are increasingly tied to farm program direct payments leave producers more vulnerable to energy related cost increases.

Conclusions

This paper illustrates how rising energy costs adversely affect the financial health of farms across the western United States. As expected, farms with less energy consumption and farms that share a portion of the energy costs with landowners are less vulnerable to the rising costs, but no one is completely insulated from this trend. The results suggest that farmers will likely face increasing cashflow pressures that may accelerate their adoption of energy conserving crop rotation patterns and production systems. Further study may be necessary to determine if higher energy prices will push farmers to no-till and reduced tillage farming systems as they seek to reduce fuel expenses.

References

Food and Agricultural Policy Research Institute. 2005 (August). FAPRI 2005 U.S. Baseline Update. University of Missouri, Columbia, MO.

Richardson, J. W. and C. J. Nixon. 1986 (July). Description of FLIPSIM V: A General Firm Level Policy Simulation Model. Texas Agricultural Experiment Station, Bulletin B-1528.

Richardson, J.W., S.L. Klose and A.W. Gray. 2000. An Applied Procedure for Estimating and Simulating Multivariate Empirical (MVE) Probability Distributions in Farm-Level Risk Assessment and Policy Analysis. Journal of Agricultural and Applied Economics 32(2):299-315.

Appendix Table of Characteristics of Representative Crop, Dairy, and Beef Cattle Farms.

Farm[1]	Acres	Irrigated Land	State	County	Sales	Corn	Sorghum	Wheat	Cotton	Rice	Other	Dairy	Beef
		--%--			--$1,000--	--Acres--	--Acres--	--Acres--	--Acres--	--Acres--	--Acres--	--Cows--	--Cows--
TXNP1750	1750	79	Texas	Moore	580.2	640	240	870	0	0	0	0	0
TXWG1400	1400	-	Texas	Williamson	291	900	250	100	150	0	0	0	50
TXPG3760	3760	87	Texas	Castro	1890.1	1344	0	0	1472	0	380	0	0
COW3000	3000	-	Colorado	Washington	262.3	600	0	970	0	0	905	0	0
MTW4500	4500	-	Montana	Chouteau	467.7	0	0	2475	0	0	0	0	0
ORW4000	4000	-	Oregon	Morrow	296.4	0	0	1600	0	0	400	0	0
WAW1725	1725	-	Washington	Whitman	485.4	0	0	1121	0	0	604	0	0
CAC2400	2400	83	California	Kings	2188.7	0	0	0	1000	0	1400	0	0
TXSP2239	2239	34	Texas	Dawson	682.9	0	0	0	1616	0	453	0	0
TXRP2500	2500	-	Texas	Jones	258.1	0	0	825	1122	0	0	0	12
TXCB1850	1850	-	Texas	San Patricio	560.1	150	775	0	925	0	0	0	0
TXVC4500	4500	16	Texas	Willacy	1352.1	0	1888	0	2388	0	225	0	0
TXPC2500	2500	78	Texas	Deaf Smith	910.7	125	308	883	1184	0	0	0	0
TXMC3500	3500	-	Texas	Jackson	1313.5	875	875	0	1750	0	0	0	0
TXEC5000	5000	58	Texas	Crosby	1265.8	0	300	400	4300	0	0	0	0
CAR550	550	100	California	Sutter	448.7	0	0	0	0	500	0	0	0
TXR1350	1350	100	Texas	Colorado	321.8	0	0	0	0	450	0	0	0
TXCD500	500	-	Texas	Erath	1635.3	0	0	0	0	0	500	500	0
CAD1710	1100	-	California	Tulare	6123.9	0	0	0	0	0	1100	1710	0
NMD2125	0	-	New Mexico	Chaves	7576.7	0	0	0	0	0	0	2125	0
IDD1000	0	-	Idaho	Twin Falls	3989.3	0	0	0	0	0	0	1000	0
TXED1000	750	-	Texas	Lamar	3529.2	0	0	0	0	0	750	1000	0
TXND2400	180	-	Texas	Bailey	8463.6	0	0	0	0	0	180	2400	0
MTB500	640	-	Montana	Custer	313.5	0	0	0	0	0	640	0	500
WYB500	300	-	Wyoming	Washakie	285.2	0	0	0	0	0	300	0	500
NMB240	0	-	New Mexico	Union	127.1	0	0	0	0	0	0	0	240
CAB500	0	-	California	Tehama	301.4	0	0	0	0	0	0	0	500
SDB450	960	-	South Dakota	Meade	274.1	0	0	0	0	0	960	0	450
NVB700	1300	-	Nevada	Elko	358.2	0	0	0	0	0	1300	0	700
TXRB500	0	-	Texas	King	333.6	0	0	0	0	0	0	0	500

[1] The farm name indicates the state (first two letters) and farm size in acres or number of cows (numbers). The remaining letters in the name indicate the region or crop (G for grains, W for wheat, C for cotton, R for rice, D for dairy, and B for beef).