Chapter 9

Government Farm Policy and Economic Incentives Affecting Quality

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Government Farm Policy and Economic Incentives Affecting Quality

Government farm policy and varying governmental economic incentives to the grain system have a significant influence on grain quality. Government farm programs in particular play an essential role in providing incentives to farmers to produce a range of crop quantity and quality. In commodities such as wheat, soybeans, and corn, where biological trade-offs exist between yield and a major quality factor like protein, farm programs potentially have important impacts on quality,

Farm programs have played a key role in U.S. agriculture since at least the mid-1930s (4). The numerous programs have shifted gradually from price supports to income supports. The constraints and incentives they provide are transmitted throughout the production and marketing system and consequently may have an impact on grain quality. Two provisions are particularly important—the loan rate program and its associated premiums and discounts for quality differentials, and the target price program, which results in higher prices associated with yield. To the extent that yield and quality are inversely related (see ch. 6), any program resulting in increased yields also has the potential to reduce quality.

This chapter looks at the impacts of farm programs on grain quality, which have historically been stronger than they are today. It reviews farm program legislation with a focus on its impacts on grain quality, analyzes the extent of and dynamics in the trade-offs between yield and quality, and considers potential impacts of higher prices on incentives to increase yields and decrease quality.

The analysis focuses on wheat because data are more easily attained. But the principle can be applied to any grain in which commercial premiums and discounts exist for particular quality characteristics, and in which measurable trade-offs exist in production between yield and quality. In the two classes of wheat discussed here—Hard Red Spring (HRS), predominantly grown in North Dakota, and Hard Red Winter (HRW), in which Kansas is the leading State—premiums and discounts play an important role in the marketing system and yield is inversely related to protein, an important quality characteristic.

GOVERNMENT PROGRAM EFFECTS ON GRAIN QUALITY

One of the main purposes of government farm policies since World War II has been to support farm incomes. Several different policies and programs have been used over time to achieve this goal. Loan rate provisions have been in effect in wheat programs since before the war. The target price/deficiency payment system has been used since 1973; it did not have major effects until 1977, however, because market prices at first exceeded the loan rate and in some cases the target price.

Wheat program participation prior to 1964 was mandatory in most years. Acreage allotments were imposed along with marketing quotas in 1951 and from 1954 to 1963 (l). The allotments were set at the amount of acreage needed to produce a crop that, together with carry-over and imports, would provide a supply equal to a normal year's domestic consumption and exports plus an allowance for reserves. Marketing quotas were used along with acreage allotments as a more stringent means of

controlling output. When expected supply for a year exceeded estimated use by a specified amount, marketing quotas had to be proclaimed by the Secretary of Agriculture. A quota became effective by a two-thirds vote of approval by wheat producers. When marketing quotas were approved, compliance with acreage allotment was mandatory; when they were not approved, the level of price supports was lowered substantially.

Beginning in 1964, farm programs no longer required mandatory participation and marketing quotas were voted out. From 1964 to 1973, loan rates were reduced and farm income was supported by domestic certificate and export certificate payments in cash, based on a percentage of production on a farmer's allotted acres.

In 1973 marketing certificates were replaced by target price/deficiency payments as a means of supporting farm income. From 1974 to 1976, wheat prices increased dramatically and were higher than loan rates. Hence, government participation in the form of income support to wheat producers, directly or via prices, was virtually nonexistent. Implementation of the target price program did not effectively begin until 1977 and is still in effect today. The per-bushel income support payment (called a deficiency payment) is the difference between the target price and the average price received by farmers in the first 5 months of the marketing year, or between the target price and the loan rate, whichever is higher. Historical loan rates, target prices, and deficiency payments are presented in table 9-1. Deficiency payments increased dramatically in 1984 and have since nearly doubled. As a result, in recent years payments that are by definition based on yield account for an increasing proportion of a producer's income.

A producer's total payment is calculated by multiplying the per-bushel deficiency payment times the program acres and then times the proven yield. Program acres are a historical average of acres planted to wheat, and proven yield is a historical, 5-year moving average of an individual producer's past yields. These historical averages change over time, meaning producers increase or decrease the program acres devoted to wheat and increase proven yield by altering variety choices or production practices. The incentive encourages them to maximize proven yields in order to achieve the highest deficiency payment possible.

The Food Security Act of 1985, the most recent major farm legislation, made several changes in the loan rate and target price provisions. The loan rate for wheat in 1986 was reduced 20 percent, from $3.30/bushel to $2.40, while the target price remained at $4.38/bushel for 1986. This meant that with market prices

Table 9-1.–Loan Rates, Target Prices, and Deficiency Payments for Wheat in the United States, 1974-86 (In dollars/bushel)

Year	National average market price	Loan rate	Target price	Actual deficiency payment	Deficiency payments as proportion of target price (percent)
1974	4.09	1.37	2.05	—	—
1975	3.56	1.37	2.05	—	—
1976	2.73	2.25	2.29	—	—
1977	2.33	2.25	2.90	0.65	22.4
1978	2.97	2.35	3.40	0.52	15.3
1979	3.78	2.50	3.40	—	—
1980	3.91	3.00/3.30	3.08/3.63	—	—
1981	3.65	3.20/3.50	3.81	0,15	3.9
1982	3.55	3.55/4.00	4.05	0.50	12.3
1983	3.53	3.65	4.30	0.65	15.1
1984	3.38	3.30	4.38	1.00	22.8
1985	3.08	3.30	4.38	1.08	24.6
1986	2.40	2.40	4.38	1.98	45.2

SOURCE: US. Department of Agriculture, Statistical Reporting Service, *Agricultural Statistics*, various issues.

near the loan rate, the deficiency payment increased from $1.08/bushel to $1.98/bushel in 1986.

Loan Rate Program Premiums and Discounts

The loan rate program was the primary mechanism for price support prior to 1973 and continues to be an important form of support. A key component of the loan rate program is the provision that allows for adjustment in the loan price a farmer receives based on quality differentials. Each year a schedule of premiums and discounts is published in the provisions for the loan rate program. In addition, the market establishes premiums and discounts reflecting the market-determined value of quality attributes. These provide incentives with the potential to influence yields and the allocation of wheat between the market and government via loan forfeitures, This allocation may take place within as well as between crop years. Administration of the loan rate program has included premiums for protein above a certain level and discounts for grade differentials. In addition, discounts originally used for loan rate adjustments have changed over time.

protein premiums as provided by the loan rate program have been relatively stable (table 9-2). The premium applicable to HRW 13 percent protein over HRW 10.5 percent protein has been 4.5 cents/bushel since 1965 with the exception of 1973 and 1974, when it decreased to 4.25 cents/bushel. From 1950 to 1965 the premium for HRW 13 percent protein rose from 3 cents to 4 cents/bushel. Throughout the 1950s and early 1960s the protein premium for HRS 15 percent protein was 6 cents/bushel; it reached 10.5 cents/bushel from 1965 to 1976; and it increased to 16 cents/bushel in 1977.

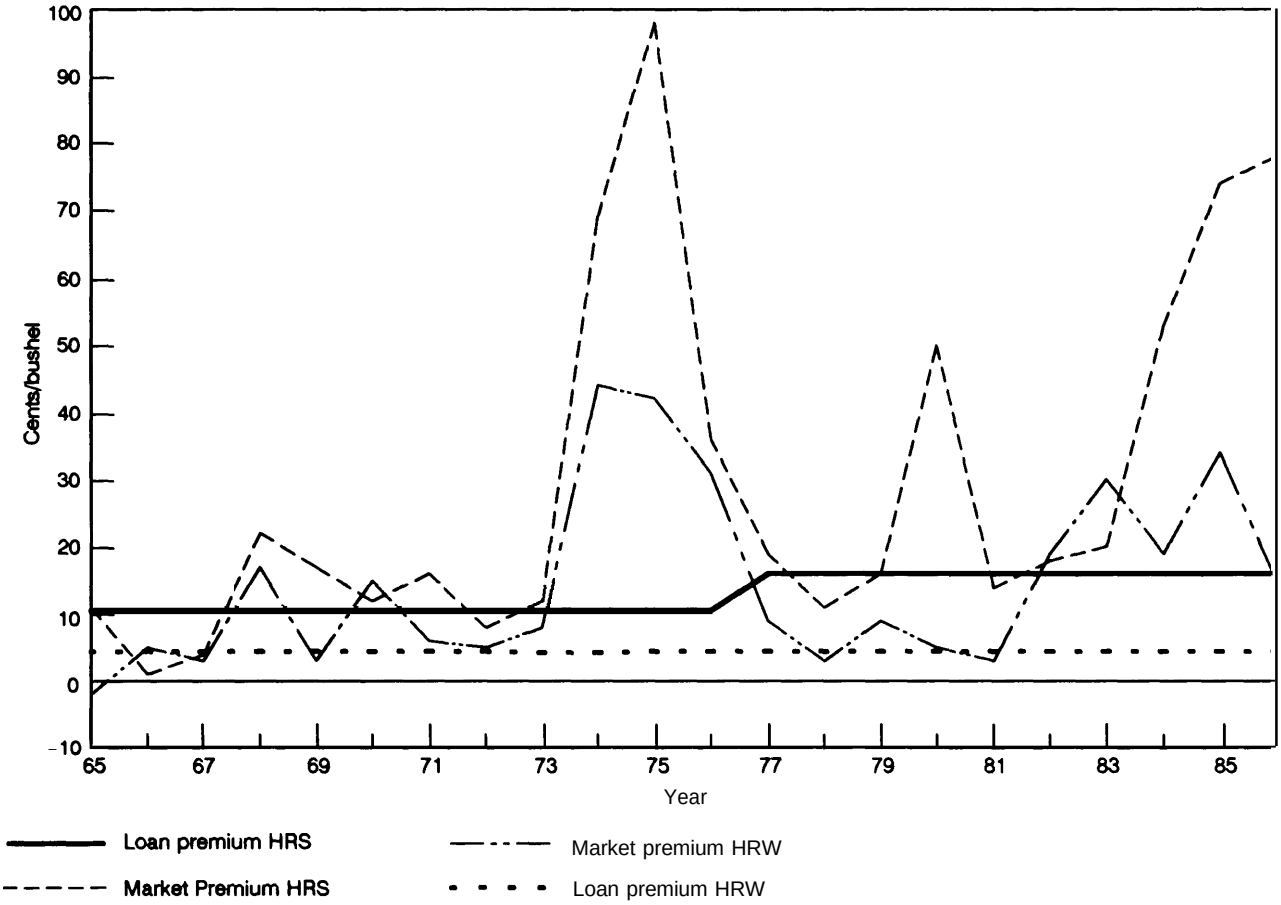
The loan rate premium has been less than the market premium in most of the past 22 years (figure 9-1). The market premium was lower in only 5 years for both HRS and HRW. The spread between the loan rate and market premiums has been increasing steadily since

Table 9-2.— Loan Rates and Market Premiums for HRS and HRW, 1965-86 (cents/bushel)

	HRW			HRS		
Market year	Loan rate premium 13% over 10.5%[a]	Market premium 13% over ordinary[b]	Difference	Loan rate premium 15% over 11.5%[a]	Market premium 15% over 12°/oc	Difference
1965	4.50	– 2	–6.50	10.50	11	0.50
1966	4.50	5	0.50	10.50	1	– 9.50
1967	4.50	3	– 1.50	10.50	*4*	–6.50
1968	4.50	17	12.50	10.50	***22***	11.50
1969	4.50	3	– 1.50	10.50	17	6.50
1970	4.50	15	10.50	10.50	12	1.50
1971	4.50	6	1.50	10.50	16	5.50
1972	4.50	5	0.50	10.50	8	–2.50
1973	4.25	8	3.75	10.50	12	– 1.50
1974	4.25	44	39.75	10.50	69	58.50
1975	4.50	42	37.50	10.50	98	87.50
1976	4.50	31	26.50	10.50	36	25.50
1977	4.50	9	4.50	16.00	19	3.00
1978	4.50	3	– 1.50	16.00	11	– 5.00
1979	4.50	9	4.50	16.00	16	0.00
1980	4.50	5	0.50	16.00	50	34.00
1981	4.50	3	– 1.50	16.00	14	–2.00
1982	4.50	19	14.50	16.00	18	2.00
1983	4.50	30	25.50	16.00	20	4.00
1984	4.50	19	14.50	16.00	53	37.00
1885	4.50	34	29.50	16.00	74	58.00
1986	4.50	15	10.50	16.00	78	62.00

[a]US Department of Agriculture (USDA), Agricultural Stabilization and Conservation Service, "Schedule of Premiums and Discounts," various issues
[b]USDA, Economic Research Service, "Wheat Outlook and Situation," various issues.
[c]Minneapolis Grain Exchange, *Statistical Annual,* various issues

Figure 9-1. - Historical Loan Rate and Market Protein Premium for HRS 15 Percent and HRW 13 Percent, 1965-86



SOURCE: Office of Technology Assessment, 1989.

1982. In general, the loan rate premiums for protein have not reflected market fundamentals, and this spread has been increasing in recent years in both the HRW and HRS market. This situation has a potential to distort production decisions of variety choice and fertilizer application to the extent that a trade-off exists between yield and protein. Storage decisions are also likely distorted by the disparity in government and market protein premiums. Producers have the incentive to put low-protein wheat under loan and to forfeit the loan if market prices for that type of wheat do not appreciate. The market premium is typically high enough to encourage commercial sales of higher protein wheat. Consequently, the program spreads relative to the market result in isolating lower protein wheat from the market, and may to some extent discourage development and adoption of lower protein varieties.

Other features of the loan rate program have changed over time. Prior to 1973, two other measures were used to reflect quality in program prices. The first was called a sedimentation test, which measures the quality of protein content in wheat (5). This testis performed by suspending ground wheat in water and treating it with lactic acid. The portion that within 5 minutes settles to the bottom of a graduated cylinder is the sedimentation value. Values range from 3 for very weak wheat to 70 for very

strong wheat. Premiums and discounts for different sedimentation values were used during 1963 and 1964 (table 9-3).

The second measure was the discounts associated with varieties, which was used throughout the 1960s and up through 1972. Discounts were applied on varieties in each class of wheat deemed "undesirable" due to poor quality characteristics. (The term "undesirable" was used in the schedule of premiums and discounts,) The varieties and number of varieties changed over time to reflect newly released wheats. Generally, a half-dozen varieties were subject to discount in any given year. Examples of "undesirable" HRW varieties in the early 1970s included Blue Jacket, Purkof, Cache, Red Chief, Staffor, and Yogo. Examples of "undesirable" HRS varieties included Red River 68, Era, and Neepawa. The discount was 20 cents/bushel throughout this period. This discount ended in 1973 and is no longer used.

Wheat is subject to other premiums and discounts under the loan program. These are applied by grade and not on an individual factor basis as long as the grade is "sample" or better (table 9-4). Additional discounts based on factors do apply on test weight and damage if the wheat is No. 4, No. 5, or sample grade in specific years (tables 9-4, 9-5, and 9-6). The discounts applied to damaged kernels were substantially reduced beginning in 1980.

Table 9-3.—Sedimentation Value Premiums and Discounts Provided by Loan Rate Program, 1963 and 1964

Sedimentation value, 1963	Premium or discount, 1963 (cents/bushel)	Sedimentation value, 1964	Premium or discount, 1964 (cents/bushel)
21 and below	–9	22 and below	–6
22-23	–8	23-25	–5
24-25	–7	26-28	–4
26-27	–6	29-31	–3
28-29	–5	32-34	–2
30-31	–4	35-37.	–1
32-33	–3	38-42	0
34-35	–2	43-45	+1
36-37	–1	46-48	+2
38-42	0	49-51	+3
43-44	+1	52-54.	+4
45-46	+2	55-57	+5
47-48	+3	58-60	+6
49-50	+4	61-63	+7
51-52	+5	64-66	+8
53-54	+6	67 and above	+9
55-56	+7		
57-58	+8		
59-60	+9		
61-62	+10		
63-64	+11		
65 and over	+12		

SOURCE: U S Department of Agriculture, Agricultural Stabilization and Conservation Service, "Schedule of Premiums and Discounts," various issues.

Market premiums and discounts for grade factors are measured differently than those in the loan rate provisions. In market transactions, discounts are normally taken for individual factors such as test weight, damaged kernels, or foreign material (table 9-7).

It is difficult to compare market discounts with loan rate discounts because they are not quoted on the same basis. In general, the loan rate discounts by grade while the market discounts on the individual factors that determine grade. Individual wheat factors that determine grade are presented in table 9-8, Comparisons must be tentative when using the quoted market discounts and premiums because they are for a particular point in time and, even though they may represent the market as a whole, they do change.

Damage has been one of the more limiting factors in recent years in grade determination in HRS and is used here for comparison. The market discount for a sample with 4 percent damage would be 10 cents assuming no other factor discounts. For comparison, 4-percent-damaged kernels would be graded No. 2 and would result in a 2 cents/bushel discount from the loan rate. Thus, market discounts are substantially greater than those in the loan rate program; if other factor discounts were also included (e.g., test weight or foreign matter), the comparison would be even more dramatic,

Annual surveys of country elevators in North Dakota on discounting practices suggest that, in general, market premiums and discounts have increased in the past 3 years (table 9-9). For example, the discount for 4-percent-damaged kernels (i. e., No. 2) rose from an elevator average of 2 cents in 1984 to 8.9 cents in 1986.

The individual factors for discount in table 9-4 are the factor levels allowable in order for

Table 9-4.—Loan Rate Premiums and Discounts on Wheat by Grade (cents/bushel)

Year	No. 1	No. 2	No. 3	No. 4[a]	No. 5[a]	No. 4 No. 5[b]
1954-61	+1[c]	−1	−3	−6	−9	−6
1962	+1[c]	−1	−3	([d])	([d])	−6
1963	+1[c]	−1	−3	−6	−9	−6
1964	+1[c]	−1	−2	([d])	([d])	−6
1965-76	+2[e]	−1	−3	−6	−9	N/A
1977-86	0	−2	−4	−6	−9	N/A

[a]On test weight otherwise No. 3.
[b]No. 4 or No. 5 because containing Durum and erred Durum.
[c]$0.01 premium for No. 1 heavy.
[d]Test weight discount for No.4, No. 5, or sample.
[e]No. 3 or better heavy.

SOURCE: U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, "Schedule of Premiums and Discounts," various issues.

Table 9.5.—Additional Loan Rate Discounts on Wheat for Test Weight[a] (cents/bushel)

Test weight	1962	1964
53 to 54.9	–6	–4
50 to 52.9	–9	–6
49	–13	–9
48	–17	–12
47	–21	–15
46	–25	–18
45	–29	–21
44	–35	–25
43	–41	–29
42	–47	–33
41	–53	–37
40	–59	–41

[a]Applicable if wheat is No. 4, No, 5, or sample grade.

SOURCE: US. Department of Agriculture, Agricultural Stabilization and Confervation Service, "Schedule of Premiums andDiscounts,"varlous issues.

wheat to grade No. 2. In adding up the discounts for each factor except protein, the total possible discount for wheat (i.e. on all factors to the limit) that grades No. 2 by the market according to the survey was 36 cents/bushel in 1986. The discount for wheat grading No. 2 by the loan rate program is 2 cents/bushel. Wheat must meet the limit of only one of the factors listed in table 9-8 (except moisture and protein) in order to grade No. 2. In reality wheat would not likely be discounted by all factors, and only one or two factors would be limiting for discount purposes. Generally, damaged kernels have been one of the more limiting factors in grade determination in this time period. The discount for 4-percent-damaged kernels was 8.9 cents in 1986, assuming all other factor discounts would apply, while the loan program discount No. 2 wheat would have been 2 cents/bushel.

The differential between the loan rate and the market premiums and discounts—a differential that is apparently growing—has a significant impact. Most important is the allocation of wheat with different qualities between the loan program and market. In general, this differential results in higher quality wheat being sold commercially, while the poorer quality wheat, being subject to greater market discounts, is put under loan and stored since the applicable discounts would be substantially lower. (Domestic millers have methods of determining where the higher quality wheats are located and can purchase by location. Millers can also specify other factors such as falling numbers, pesticide residue, and sedimentation before shipment.) With market prices hovering around loan levels, this wheat has the potential of being stored for an extended time and of being released to the market only gradually.

For comparison, if loan rate premiums or discounts reflected or exceeded those of the market, the incidence of relatively poor quality wheat would likely not be reduced due to much of it being weather-related. Rather, it would result in poor quality wheat being sold to the market directly, rather than being put under loan and stored. In this case the loan rate would support prices of the higher quality grain, rather than that of lower quality, as is currently the case.

Table 9-6.—Additional Loan Rate Discounts for Damaged Kernels in Wheat (in cents/bushel)

Total percent damage	1951 No. 4 or No. 5	1962 No. 4, No. 5 or sample	1977 & 1978 sample	1980-86 sample
7.1 to 8.0	–1	–1	N/A	N/A
8.1 to 9.0	–2	–2	N/A	N/A
9.1 to 10.0	–3	–3	N/A	N/A
10.1 to 11.0	–4	–4	N/A	N/A
11.1 to 12.0	–5	–5	N/A	N/A
12.1 to 13.0	–6	–6	N/A	N/A
13.1 to 14.0	–7	–7	N/A	N/A
14.1 to 15.0	–8	–8	N/A	N/A
15.1 to 16.0	N/A	–10	–10	–2
16.1 to 17.0	N/A	–12	–12	–4
17.1 to 18.0	N/A	–14	–14	–6
18.1 to 19.0	N/A	–16	–16	–8
19.1 to 20.0	N/A	–18	–18	10
20.1 to 21.0	N/A	–20	–20	–12
21.1 to 22.0	N/A	–22	–22	–14
22.1 to 23.0	N/A	–24	–24	–16
23.1 to 24.0	N/A	–26	–26	–18
24.1 to 25.0	N/A	–28	–28	–20
25.1 to 26.0	N/A	–30	–30	–22
26.1 to 27.0	N/A	–32	–32	–24
27.1 to 28.0	N/A	–34	–34	–26
28.1 to 29.0	N/A	–36	–36	–28
29.1 to 30.0	N/A	–38	–38	–30
over 30.1	N/A	–60	3 cents each percent over 30.0	3 cents each percent over 30.0

N/A = not available

SOURCE: U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, "Schedule of Premiums and Discounts," various issues

Table 9-7.—Market Discounts for HRS, February 1987

Item	Discounts
Test weight	2¢ each ½# 58-56#, 3¢ each ½# 56-54#, 5¢ each ½# 54-56
Moisture	1¢ each ¼# 13.5-14.0% maximum
Foreign material	1¢ ½% 0.5-5% maximum
Damage	2¢ each 1% 0-3% (0.9 allowed)
	4¢ each 1% 3-5%
	6¢ each 1% 5-7%
Sprout damage	2¢ each 0.5% over 0.5-5% maximum
Shrunk and broken	1¢ each 1% 3-5%
	2¢ each 1% 5-15%
Total defects	1¢ over 3-5%
Wheat of other classes	2¢ each 1% over 3-10% maximum
Contrasting classes	1¢ each 1% 1-10% maximum

SOURCE: Continental Grain Co., 1988.

Farm Programs and Variety Seduction

One impact of farm programs is that they may distort producers' choices regarding variety selection. Given an inverse relationship between yield and quality characteristics (protein in this case), any farm program not adequately discounting for quality deviation will have an effect on agronomic practices. This section presents a budget analysis of the impacts of loan rate protein premiums and deficiency pay-

Table 9-8.—Wheat Quality Factors Determining Grade Standards

Grade	Minimum limits of— Test weight per bushel: Hard Red Spring wheat or White Club wheat[a] (pounds)	Minimum limits of— Test weight per bushel: All other classes and subclasses (pounds)	Maximum limits of— Damaged kernels: Heat-damaged kernels (percent)	Maximum limits of— Damaged kernels: Total[b] (percent)	Maximum limits of— Foreign material (percent)	Maximum limits of— Shrunken and broken kernels (percent)	Maximum limits of— Defects[c] (percent)	Maximum limits of— Wheat or other classes[d]: Contrasting classes (percent)	Maximum limits of— Wheat or other classes[d]: Total[e] (percent)
U.S. No. 1	58.0	60.0	0.2	2.0	0.5	3.0	3.0	1.0	3.0
U.S. No. 2.	57.0	58.0	0.2	4.0	1.0	5.0	5.0	2.0	5.0
U.S. No. 3.	55.0	56.0	0.5	7.0	2.0	8.0	8.0	3.0	10.0
U.S. No. 4.	53.0	54.0	1.0	10.0	3.0	12.0	12.0	10.0	10.0
U.S. No. 5.	50.0	51.0	3.0	15.0	5.0	20.0	20.0	10.0	10.0

U.S. Sample grade:

U.S. Sample grade is wheat that:

a. Does not meet the requirements for the grades U.S. Nos. 1, 2, 3, 4, or 5; or
b. Contains 32 or more insect-damaged kernels per 100 grams of wheat; or
c. Contains 8 or more stones or any number of stones which have an aggregate weight in excess of 0.2 percent of the sample weight, 2 or more pieces of glass, 3 or more crotalaria seeds **(Crotalaria** spp.), 2 or more castor beans (Ricinus communis L.), 4 or more particles of an unknown foreign substance(s) or a commonly recognized harmful or toxic substance(s), 2 or more rodent pellets, bird droppings, or equivalent quantity of other animal filth per 1,000 grams of wheat; or
d. Has a musty, sour, or commercially objectionable foreign odor (except smut or garlic odor); or
e. Is heating or otherwise of distinctly low quality.

[a] These requirements also apply when Hard Red Spring or White Club wheat predominate in a sample of Mixed wheat
[b] Includes heat-damaged kernels
[c] Defects Include damaged kernels (total), foreign material, and shrunken and broken kernels The sum of these three factors may not exceed the limit for defects for each numerical grade
[d] Unclassed wheat of any grade may contain not more than 100 percent of wheat of other classes
[e] Includes contrasting classes

SOURCE: Federal Grain Inspection Service, U S Department of Agriculture, 1988

Table 9-9.—Average Price Adjustments for Each Factor Among North Dakota Country Elevators, Fall 1984, 1985, and 1986 (cents/bushel)

Commodity (base grade)	Factor	1984 average	1985 average	1986 average
HRS	57 lbs. test weight.	– 1.9	–1.8	–2.9
#1 DNS	14.5% moisture	–5.9	–6.8	–6.5
140/0 Protein	16% protein	41.0	63.4	62.6
	12% protein	–38.0	–67.4	–43.9
	4% damaged kernels	–2.0	–6.6	–8.9
	1% foreign material	–1.4	–1.3	–1.7
	5% shrunken and broken kernels	–2.2	–3.0	–4.2
	2% contrasting classes	–1.6	–3.2	–3.5
	5% wheat of other classes	—	–7.0	–8.6

SOURCE: B Clew, W. Wilson, and RHielman, "Pricing and Marketing Practices for North Dakota Durum and H RS Wheat 1986 Crop Year, " Department of Agricultural Economics, North Dakota State University, Fargo, ND, 1987.

ments. Typical producer situations are posed for a North Dakotan and a Kansan wheat producer from 1965 to 1986.

The measure used in this analysis is total revenue. Costs per acre are assumed the same across varieties. The protein premiums used for HRS were the government loan rate premium and the market premium for 14 percent and 15 percent protein; for HRW, the premiums used were for 13 percent and 11 percent protein. Government program impacts were incorporated into the analysis in that target price instead of market price was used to calculate total revenue. This assumes 100 percent participation in government programs, Yield used in the analysis was 30 bushels/acre for HRS 14 percent protein and 25 bushels/acre for HRS 15 percent protein in order to reflect a typical yield/protein trade-off. For HRW, the figures used were 35 bushels/acre for 13 percent protein and 41 bushels/acre for 11 percent protein. Total revenue was calculated by adding the market protein premium or government premium to target price and multiplying this sum by the yield per acre.

Total revenues under the market premium condition and the government premium condition would be relatively similar in these hypothetical cases except for two brief periods (tables 9-10 and 9-11). In the mid-1970s and 1980s, when market premiums were much higher, total revenue would be greater under them than under the government premium.

Of particular interest is the revenues per acre achievable under the loan program. The farm programs have always favored higher yielding wheats, but the difference increased during the 1980s. In 1969 the difference in North Dakota was $9/acre; in 1979 it was $16/acre. Since then the spread favoring production of higher yielding wheats has increased to $20/acre. Similar results were observed in Kansas.

The shift toward higher yielding varieties forces the market premium to increase in order to achieve a certain level of protein, To analyze the potential impacts, the producer budgets just described were calculated under various yield scenarios in order to determine the protein premiums necessary for a producer to be indifferent about using high- or low-yielding wheat. In the case of North Dakota, the total revenue was equated to $144/acre, which corresponds with production of 30 bushels/acre and 14 percent protein in table 9-10.

The results are shown in table 9-12 for various yield levels, but in each case protein was 15 percent and total revenue was constrained to $144/acre. For example, if a producer could achieve an increase of 1 percent protein with a decrease in yield of 1 bushel/acre, the premium necessary for $144/acre is 53 cents/bushel. A more realistic situation is where 3 bushels/acre would be foregone to increase protein 1 percent. In this case the protein premium would have to increase to 75 cents/bushel per 1 percent of protein.

The protein premium needed to neutralize a producer's decision to produce 14 percent or 15 percent protein wheat increases rapidly as the yield difference increases. This is caused

Table 9-10.—Theoretical Revenue for a One-Acre Farm in North Dakota, 1965-86

Year	Target price[a]	25 bushel/acre/15% protein: Protein premium (dollars/bushel) Market	Loan rate	Revenue per acre (dollars/acre) Market[b]	Loan rate[c]	30 bushel/acre/14°A protein: Protein premium (dollars/bushel) Market	Loan rate	Revenue per acre (dollars/acre) Market[b]	Loan rate[c]
1965	1.69	0.11	0.105	45	45	0.060	0.075	**53**	**53**
1966	1.84	0.01	0.105	46	49	0.010	0.075	**56**	**57**
1967	1.73	0.04	0.105	44	46	0.040	0.075	**53**	54
1968	1.80	0.22	0.105	51	48	0.100	0.075	**57**	56
1969	1.89	0.17	0.105	52	50	0.070	0.075	**59**	59
1970	2.00	0.12	0.105	53	53	0.020	0.075	**61**	62
1971	1.79	0.16	0.105	49	47	0.150	0.075	**58**	56
1972	1.72	0.08	0.105	45	46	0.080	0.075	**54**	54
1973	1.47	0.12	0.105	40	39	0.120	0.075	**48**	46
1974	2.05	0.44	0.105	62	54	0.280	0.075	70	64
1975	2.05	0.71	0.105	69	54	0.440	0.075	75	64
1976	2.29	0.36	0.105	66	60	0.230	0.075	76	71
1977	2.90	0.19	0.160	77	77	0.110	0.090	90	90
1978	3.40	0.11	0.160	88	89	0.035	0.090	103	105
1979	3.40	0.16	0.160	89	89	0.010	0.090	102	105
1980	3.63	0.50	0.160	103	95	0.220	0.090	116	112
1981	3.81	0.14	0.160	99	99	0.060	0.090	116	117
1982	4.05	0.18	0.160	106	105	0.090	0.090	125	125
1983	4.30	0.20	0.160	113	112	0.150	0.090	134	132
1984	4.38	0.53	0.160	123	114	0.300	0.090	140	134
1985	4.38	0.74	0.160	128	114	0.420	0.090	144	134
1986	4.38	0,78	0.160	129	114	0.430	0,090	144	134

[a]Prior to 1973 target price is blended average price to program participants reflecting national average price received by farmers and the marketing certificate value averaged for participant's total production. Post-1973 target price is loan rate plus deficiency payment
[b]Revenue is market premium plus target price times yield.
[c]Revenue is government premium plus target price times yield.

SOURCE: U.S. Department of Agriculture, Statistical Reporting Service, *Agricu/tura/Statistics,* various issues.

by the target price deficiency payment program, which pays a producer $1.98/bushel more than the market. Thus the opportunity cost of decreasing yield and increasing protein is $4.38 (target price) This creates a high-protein premium needed to render a producer indifferent between producing 14 percent and 15 percent protein wheat. Similar results are shown in table 9-13 for HRW wheat in Kansas.

Government Storage Policies

The Commodity Credit Corporation (CCC) of the U.S. Department of Agriculture (USDA) enters into agreements with commercial warehouses to handle and store grain. This covers grain owned by CCC, pledged to the agency as collateral under the price support program, delivered to the warehouse for purchase by CCC under a price support program, delivered to the warehouse in liquidation of a price support loan, or held by CCC for any other reason. The contractual agreement is referred to as the Uniform Grain Storage Agreement (UGSA). It covers areas such as standards for approving warehouses, inspection requirements, load out and delivery requirements, and settlement procedures (3).

Warehouses, for the purpose of applying the UGSA, are defined on the basis of whether inspections sponsored by the Federal Grain Inspection Service (hereafter referred to as "official inspection'') and UGSA-approved weights are available. Country elevators are those locations where official inspections and UGSA weights are not available, while terminal elevators do have these available. Within the UGSA, different rules apply to country and terminal warehouses.

Inspection requirements obviously differ since the distinction between country and terminal elevators is based on whether official inspection is available. In general, grain shipped into and out of terminal elevators must be officially inspected. However, CCC retains the right to have quality determined at other points

Table 9-11 .—Theoretical Revenue for a One-Acre Farm in Kansas, 1965-86

		25 bushel/acre/15% protein				30 bushel/acre/14% protein			
		Protein premium (dollars/bushel)		Revenue per acre (dollars/acre)		Protein premium (dollars/bushel)		Revenue per acre (dollars/acre)	
Year	Target price[a]	Market	Loan rate	Market[b]	Loan rate[c]	Market	Loan rate	Market[b]	Loan rate[c]
1965	1.69	–0.02	0.0450	**58**	61	—	—	69	**69**
1966	1.84	0.05	0.0450	**66**	66	—	—	75	**75**
1967	1.73	0.03	0.0450	**62**	62	—	—	71	**71**
1968	1.80	0.17	0.0450	**69**	65	—	—	74	**74**
1969	1.89	0.03	0.0450	**67**	68	—	—	77	**77**
1970	2.00	0.15	0.0450	**75**	72	—	—	82	**82**
1971	1.79	0.06	0.0450	**65**	64	—	—	73	**73**
1972	1.72	0.05	0.0450	**62**	62	—	—	71	**71**
1973	1.47	0.08	0.0425	54	53	—	—	60	**60**
1974	2.05	0.44	0.0425	87	73	—	—	84	**84**
1975	2.05	0.42	0,0450	86	72	—	—	84	**84**
1976	2.29	0.31	0.0450	91	81	—	—	94	**94**
1977	2.90	0.09	0.0450	105	103	—	0.005	119	**119**
1978	3.40	0.03	0.0450	120	121	—	0.005	139	**139**
1979	3.40	0.09	0.0450	122	120	—	0.005	139	**139**
1980	3.63	0.05	0.0450	129	129	—	0.005	149	**150**
1981	3.81	0.03	0.0450	134	135	—	0.005	156	**156**
1982	4.05	0.19	0.0450	148	143	—	0.005	166	**166**
1983	4.30	0.30	0.0450	161	152	—	0.005	176	**177**
1984	4.38	0.19	0.0450	160	155	—	0.005	180	**180**
1985	4.38	0.34	0.0450	165	155	—	0.005	180	**180**
1986	4.38	0.15	0.0450	159	155	–	0.005	180	180

[a]Prior to 1973 target price is blended average price to program participants reflecting national average price received by farmers and the marketing certificate value averaged for participant's total production. Post-1973 target prices is loan rate plus deficiency payment.
[b]Revenue is market premium plus target price times yield.
[c]Revenue is government premium plus target price times yield.

SOURCE: U.S Department of Agriculture, Statistical Reporting Service, "Agricultural Statistics," various issues,

Table9-12.—Implied Premium Necessary for HRS Producers To Be Indifferent About Growing 14 or 15 Percent Protein Wheat

Yield (bushel/acre)	Protein (percent)	Premium[a] (dollars/bushel)	Loan rate (dollars/bushel)	Revenue[b] (dollars/acre)
29	15	0.53	2.40	144
28	15	0.64	2.40	144
27	15	0.75	2.40	144
26	15	0.87	2.40	144
25	15	1.00	2.40	144

[a]Premiums are derived from equating TR to $144/acre.
[b]Revenue (TR) is derived as TR = Y_p • Dp + (f_a po) + a* Premium
where Y_p is proven yield (30 in this case), DP is the deficiency payment, Y_a is actual yield (29. .25), P. is market price or loan rate.

SOURCE: Office of Technology Assessment, 1989.

and as agreed to by the warehouse operation and CCC. The quality of producer deliveries for liquidating price support loans at terminal elevators is determined as agreed to by producer and warehouse receiver.

Quality determination on grain received into country elevators is based on agreement either between the warehouse and CCC or between producer and the warehouse. For grain loaded out of country elevators by truck, quality is determined on the basis and at a point specified in the CCC loading order. For all other carriers, it is obtained at destination or at a point specified in the loading order.

When grain is accepted for storage, the warehouse operator must issue negotiable warehouse receipts that show results for all factors contained in the grain standards and furnish

Table 9-13.—Implied Premium Necessary for HRW Producers To Be Indifferent About Growing 11 or 13 Percent Protein Wheat

Yield (bushel/acre)	Protein (percent)	Premium[a] (dollars/bushel)	Loan rate (dollars/bushel)	Revenue[b] (dollars/acre)
39	13	0.10	2.40	179
37	13	0.24	2.40	179
35	13	0.39	2.40	179
33	13	0.56	2.40	179
31	13	0.75	2.40	179

[a] Premiums derived from equating TR to $179/acre
[b] Revenue (TR) is derived as TR = (Yn + DP + Ya) P0
where Yn is proven yield (41 in this case), DP is the deficiency payment, Ya is actual yield (39 31), P0 is market price or loan rate.

SOURCE" Office of Technology Assessment, 1989

all weight and quality certificates to CCC. These receipts are then used to determine the quantity and quality of the grain being stored for CCC and as the basis for issuing loading orders. CCC uses the individual factor results reported on the various warehouse receipts for computerized blending to arrive at weighted average grade and factor results. These averages then serve as the grade and weighted average quality that appears on the loading order. In some cases, this has resulted in a higher grade than is represented by any of the warehouse receipts (2). For example, grain at grade Nos. 2,3, and 4 can be blended to arrive at a weighted average grade of No. 1 even though no individual warehouse receipts have been issued for No. 1.

Recently CCC amended the UGSA regarding load out and delivery requirements for terminal elevators in order to restrict computerized blending to three broad categories. Factor results for grade Nos. 1, 2, and 3 will be blended together as one category, factor results from grade Nos. 4 and 5 as the second category, and results from sample grade as the third. The amendment also specifies that blending should not result in a weighted average quality of a higher grade than reported on at least one-third of the warehouse receipts used as the basis for determining quality.

Load out and delivery requirements contained in the UGSA call for the warehouse to deliver the grain ordered shipped by CCC. At both country and terminal elevators, the qualities represented by the warehouse receipts serve as the basis for the load out quality requirements. When CCC surrenders receipts representing a specific grade with weighted average quality to a terminal elevator, each shipment must meet the specific grade and weighted average results. CCC can request a unit shipment (a minimum 10 railcars shipped on the same bill of lading to comply with a tariff that offers rate incentive). When unit shipments are called from a terminal elevator, individual railcars will be accepted if they do not grade more than one grade below the weighted average grade and no lower than the lowest grade warehouse receipt.

CCC may reject shipments of grain loaded out of terminal elevators if:

1. the quality is lower than the weighted average quality or specific quality called for even though it meets the specific grade,
2. if it does not meet the unit shipment requirement, or
3. if it is not fairly representative of the quality ordered.

At country elevators, the warehouse operator must load a grade and quality that is fairly representative of the quality described by warehouse receipts. Unit shipments can be loaded from country elevators under the terms spelled out for terminal elevators when that is agreeable to the warehouse and CCC. On grain delivered from country elevators, the grain may be rejected if it does not meet the requirements specified in the loading order. CCC, however, will not reject individual railcars, except those grading sample grade, in a unit shipment from country elevators as long as the whole shipment is fairly uniform in terms of the quality called for in the loading order.

Settlement for load out is based on the value of the grain delivered and the grain ordered shipped by CCC using premium and discount schedules established by the agency. On grain delivered from terminal elevators that is accepted by CCC, settlement will be based on the value of the net deficiencies for all grain in the loading order. No discounts will be applied on unit shipments if the quality in all railcars equals the weighted average quality called for in the loading order, The warehouse operator must pay CCC for the value of underdeliveries in quality, but CCC will not pay for the value of overdeliveries. This is not the case for grain shipped from country elevators, as CCC will pay for the value of their overdeliveries.

When grain is rejected at terminal elevators, the warehouse will not be given credit for loading out that quantity. The rejected grain must be replaced even though additional grain must be obtained to meet the loading order issued by CCC. The agency can accept rejected grain if agreement is reached between both parties on a discount prior to CCC's authorization to ship.

At country elevators, the warehouse operator replaces the rejected grain at CCC's option. If rejected grain is not replaced, however, CCC sells it for their account. In determining values for grain shipped from country elevators, special provisions have been included for sample grade shipments not required by the loading order and a ***10*** cents/bushel charge is included for rejected grain that is not replaced.

The differences in CCC rules as they pertain to country versus terminal elevators creates some unusual problems for grain quality. The fact that CCC does not apply the same rules is a negative influence on the quality of CCC grain. Given that CCC premiums and discounts do not always reflect the market, the possibility therefore exists for quality deterioration of grain stored by country elevators and to some degree by terminal elevators.

USDA publishes figures for State average UGSA handling and storage rates for country and terminal elevators. In Iowa, for example, country elevators handling corn charge on average **7.92** cents/bushel for handling inbound truck deliveries and *8.79* cents/bushel for outbound by rail. The average storage charge there is 37.74 cents/bushel. Based on these figures, a country elevator that takes in corn, holds it for ***1*** year, and then loads it out receives 54,45 cents/bushel for handling and storing,

The USDA premiums and discounts for corn do not completely reflect the market discount levels. For example, USDA for June, *1988* assessed a 1-cent discount for corn damaged between 5.0 and *6.0* percent. A 2-cent discount was assessed for every l-percent increase above ***6.1*** percent. Yet, market discounts for corn arriving in Kansas City on June ***15, 1988*** were ***3*** cents per percentage point above ***5,0*** percent, Thus corn containing 7.4 percent damage is assessed a 9 cents/bushel discount by the market, but only 5 cents/bushel by CCC.

All these considerations–the fact that CCC accepts grain below the quality represented by warehouse receipts, the costs of maintaining quality while in storage, the revenue received from handling and storage, and the less-than-market discounts that are applied—combine to create a situation in which the benefits of maintaining quality must be weighed against the economic benefits of delivering grain of poorer quality than indicated on warehouse receipts. Furthermore, the economics of this situation are more dynamic at country than at terminal elevators.

As noted, grain shipped from country elevators can be rejected if it does not meet the quality specified in the loading order, but country elevators do not have to replace the grain, in contrast to terminal elevators. When country elevators request unit shipments, the quality of individual railcars shipped as part of a unit will not be discounted as long as the average for the unit is fairly representative of the quality ordered. For unit shipments from terminal elevators, on the other hand, individual railcars are discounted. CCC policies therefore allow movement from country to terminal elevators of grain that is inferior in quality to what must be shipped from the terminal elevators, plac-

ing more responsibility on them to maintain quality.

Impacts of Markets, Farm Programs, and Technology on Quality

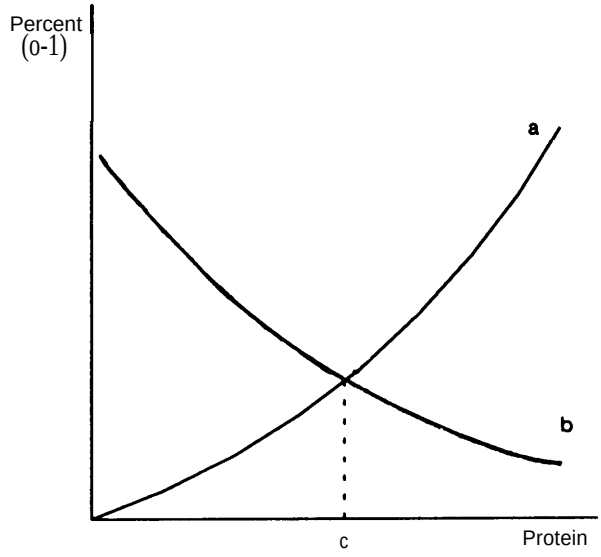
Agronomic practices and variety choice influence both the quantity and quality of production despite the uncertainties of biological processes. For example, the physical relationship between fertilizer and yield is well known, and there is some evidence that producers adjust yields in response to changing economic conditions. It is also plausible that quality characteristics adjust with changing economic and technological conditions. Changes in farm programs and market prices influence producer decisionmaking regarding yield versus quality. This section examines the extent of and potential for adjustments in quality content (via wheat protein) in reaction to economic variables.

The trade-offs governing yield and protein choices are somewhat imprecise biological relationships. In particular, yield and fertilizer are positively related because soil nutrients stimulate grain production. Also, yield and protein are inversely related because varieties may be chosen with relatively high yield and low protein or vice versa.

Producers are faced with a conflict between incentives and trade-offs, or between improving quality and reducing production. Production on a given parcel of land can be expanded either through more intensive farming practices or through reduction in crop quality. Resolution of these alternatives requires evaluation of contributions to profits by small changes in fertilizer and protein content. The profit contribution of a l-point increase in protein consists of an increase in revenue due to the higher price and a decrease in revenue due to reduced yields. Profits can no longer be increased when the revenue gain from increased yield and the loss from reduced protein offset each other.

The functions influencing the producer's choice of protein level are illustrated in figure 9-2. The yield loss function is upward sloping,

Figure 9-2. - Producers' Protein Choice for Wheat



a: Percent yield loss from higher protein

b: Percent price gain from **a** protein increase

c: Protein level that would maximize profits

SOURCE: Office of Technology **Assessment,** 1989

reflecting the reduced yields that accompany increases in protein. The shape of the percentage price gain function depends on the characteristics of the protein premium schedule. For demonstration purposes, it is a downward sloping function of protein content. However, it could be flat, which would imply the percentage price gain is constant across protein levels. The protein level that would maximize producer profits occurs where the percentage price gain and yield loss are equal. From the producer's perspective, this would be the most desirable protein level.

Thus, the producer's choice between expanding yield or protein entails evaluation of the trade-off of the economic returns associated with each alternative. As protein premiums change (e.g., due to a change in the market), the percentage price gain function (b) shifts, resulting in a different optimal protein level. Similarly, if target prices increase, at a given protein premium level in cents/bushel, the protein premium as a percent of target price diminishes, resulting in a reduction in the desired

protein level. Likewise, as technology changes, the yield loss function would change, also resulting in a different desired protein level,

This conceptual framework suggests that producers can and do respond to protein premiums in their production decisions. An analysis of the extent to which producers have responded to changes in the market in variety choice and therefore protein levels in Kansas and North Dakota showed that protein levels have been decreasing in Kansas since 1978. Protein levels in North Dakota have been more variable, with a reduction from 1979 to 1985, followed by a slight increase in 1986 (4).

This study found overall only a small and occasional protein response to market incentives. In North Dakota, a change in the protein premium from historical minimum to maximum resulted in a 0.3 percent change in the average protein content. There is no evidence of any protein response in Kansas. Both States registered a long-term downward trend in protein level. One explanation is that in both cases, but especially Kansas, only a narrow range of protein choices is available from plant breeders, thereby limiting producers' ability to respond to economic variables (4).

A decline in protein content of 0.2 to 0.5 percent has occurred in Kansas and North Dakota during the last 20 years (4). This decline coincides with the adoption of new generations of technology; semidwarf varieties released since the 1970s have included varieties with lower protein levels than those previously available. Producers' choices among varieties include several factors in addition to protein content, such as yield advantage and disease resistance, that may be the primary influences on seed selection. Decisions about yield advantage and disease resistance may have indications for protein levels, but it does not appear that protein incentives have a strong influence on the average protein content of the Great Plains wheat crop.

FINDINGS AND CONCLUSIONS

Farm programs have played an important role in U.S. agriculture. Because they send incentives throughout the system, they have the potential to affect quality. Two farm program provisions are generally applicable: the loan rate program and its associated premiums and discounts for deviations from a specified quality, and the target price/deficiency payment program, which bases payments on yield. To the extent that yield and quality are inversely related, incentives to increase yield put pressure on producers to reduce quality indirectly. Analysis of these two aspects of farm programs resulted in the following findings.

- The administration of loan rate values for wheat has changed over time. In the 1960s two additional premiums/discounts for quality were available in addition to those for grade: one based on sedimentation tests and another for variety discounts. These were discontinued in the early 1970s.
- Substantial differences exist between loan rate premiums and discounts relative to those of the market. The spread of premiums and discounts for protein has nearly always been less than that for market premiums/discounts, and this difference has been increasing in recent years. The signals transmitted via the loan rate thus do not provide incentives for quality improvement and, because of these spreads, inferior quality wheat will have a tendency to go to the loan program.
- There is a distinct trade-off in production between yield and protein. In recent years this trade-off has been increasing, suggesting the opportunity costs of maintaining a certain protein level in terms of yield foregone is rising.
- The target price program provides an incentive to increase yields because of a higher price level per bushel. From a producer perspective the optimum protein level decreases as target prices increase. As target prices stimulate higher yields and therefore lowered protein levels, pressure

to increase protein premiums in the market has escalated due to a shortage of high protein wheat.

Given these findings, a combination of policy and institutional factors may inhibit producer response to quality incentives. Public information about the yield and quality consequences of particular variety selections is not generally available. Further, in some regions of the country the first point of receipt in the market channel typically does not apply to individual producers premiums and discounts for quality. And finally, the range of protein or quality choices available to producers from the plant breeders is small and may preclude adjustment.

Farm programs potentially have important impacts on quality in commodities such as wheat, corn, and soybeans in which the loan rate program is an important feature and where trade-offs exist between yield and a major quality factor such as protein. When the loan rate program is less than market premiums and discounts, it results in distortions. The most important one is that the incidence of inferior quality is not reduced. Given the amount of carryover storage of grain in the United States between crop years compared with other exporting countries, inferior quality grain is distributed over several subsequent years.

The target price program has longer term impacts. Incentives are transmitted throughout the production sector to increase yields. The transmission of signals from producers to plant breeders and ultimately to variety development is along, dynamic process. The target price program causes underlying pressure for reduced protein levels in the market and thus fundamental pressure on protein premiums. There has been little response in the past to variability in protein premiums. This could be due in part to constraints of technology and variety development, and in part to release programs that have been given persistent signals over the years for increased yield.

Results of this analysis of farm programs were presented in testimony before the Senate Committee on Agriculture, Nutrition and Forestry and the House Agriculture Committee. Congress then amended the U.S. Grain Standards Act in Public Law 100-518 to direct the Secretary of Agriculture to establish a pilot project for the 1989 wheat, soybeans, and feed grains crops to determine a method of requiring the Commodity Credit Corporation to determine a schedule of premiums and discounts on grain offered as loan so as to encourage the marketing of high-quality grain.

CHAPTER 9 REFERENCES

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