NCCC-134
APPLIED COMMODITY PRICE ANALYSIS, FORECASTING AND MARKET RISK MANAGEMENT

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Suggested citation format:

Carlson, J., D. Bullock, J. Johnson, S. Stauber, and C. McGuire. 1993. "The Forecasting of Prices and Protein Premiums for PNW Hard Red Winter and Dark Northern Spring Wheat." Proceedings of the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. Chicago, IL. [http://www.farmdoc.uiuc.edu/nccc134].

The Forecasting of Prices and Protein Premiums for PNW Hard Red Winter and Dark Northern Spring Wheat

John Carlson, David W. Bullock, James B. Johnson, M. Steve Stauber, and Charles McGuire[1]

I. Introduction

The Pacific Northwest (PNW) wheat market is the second largest U.S. wheat export market in terms of annual volume. Most of the hard red winter and Dark Northern Spring wheats that are exported through the PNW come from Montana. A majority of this wheat is moved by rail to Portland. A small portion is moved by truck to Lewiston, Idaho, and is then shipped by barge via the Columbia River to Portland.

Japan is the largest volume buyer of PNW hard red winter and Dark Northern Spring wheat and has rigid quality requirements on its wheat imports (Wilson and Gallagher). One of the most important quality factors is the protein content of the wheat, which is used as a proxy for the gluten strength of the dough. High gluten strength of hard red winter and Dark Northern Spring wheats is desirable for bread making. A lower protein content of soft wheats is desired for chemically leavened products such as crackers and biscuits.

Recent research, using hedonic pricing models, has shown protein content to be an important factor in the pricing of wheat. Wilson (1989) examined differentiation in wheat export markets using both the Hufbauer index of differentiation and the hedonic pricing model proposed by Ladd and Martin for valuing productive input characteristics. His results indicated that the implied value of protein in the Japanese import market had been increasing gradually over the time period examined. Espinosa and Goodwin examined the value of wheat quality characteristics for Kansas hard red winter wheat domestic markets using the Ladd and Martin hedonic pricing model. Their results indicated protein premiums that averaged between 4 to 5 cents a bushel for an additional one percent of protein.

The ability to forecast both expected PNW wheat prices and protein premiums is of primary importance to Montana hard red winter and Dark Northern Spring wheat producers. Changes in production practices, such as varietal selection and fertilization level (Stauber et. al.), can influence the final protein content of the wheat when harvested. However, these decisions involve incurring additional production costs, primarily attributable to higher fertilization rates. Most of these costs must be incurred prior to knowing, with certainty, the upcoming marketing year's protein premiums. This implies a fundamental marketing and production risk management problem that Montana wheat producers must consider in their planning decisions.

In addition, the PNW futures price bases are directly influenced by the protein premiums in the PNW spot market. The local bases in Montana are directly correlated with the PNW bases by the following equation:

Montana Basis = PNW Basis - Transportation to PNW.

The ability to accurately forecast the PNW basis for a particular protein wheat is important to effective evaluation of production, management, marketing, and hedging strategies for Montana wheat producers.

Two previous studies [Bale and Ryan, Wilson (1983)] have examined the pricing structure between the different classes and protein contents for PNW wheat. Bale and Ryan used price ratios of high protein over low protein wheat in three different spot markets (PNW, Kansas City, and Minneapolis) for their dependent variables. They used ordinary least squares to estimate each equation where the independent variables were the supply of high and low protein wheat (measured by hard red spring and hard red winter respectively) and the average protein percentages of high and low protein wheat (using North Dakota and Kansas average protein percentages respectively). Their results indicated that supply and protein percentage of high protein wheat were significant factors in explaining the ratio of high protein to low protein wheat prices.

Wilson (1983) used a supply and demand model that assumed a perfectly inelastic supply of hard red winter and hard red spring wheat in any particular market-year. For the PNW model, he used market-year average prices for 12 percent hard red winter and 14 percent hard red spring wheat as the dependent variables. He used hard red winter ordinary and 12 percent hard red winter wheat prices, per capita income, and total supplies and av-

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...ein percentages (measured by Kansas and North Dakota averages) of hard red winter and hard red spring ... Wilson's results indicated that the supply of hard red spring wheat was the primary factor in explaining the ... relationships. His results also indicated that average protein percentages were of mixed statistical signifi-

The objective of this paper is to estimate and evaluate alternative forecasting models for PNW hard red ... and Dark Northern Spring wheat prices and protein premiums. The forecasting horizon of these models is ... ming marketing year. The models that give the best forecasting performance, as measured by Theil's U- ... are presented in this paper.

II. Conceptual Considerations

Protein premiums are determined by the relative supply and demand for wheat protein. When supply is ... ve to demand, wheat buyers will bid higher protein premiums to draw in the scarce supply of protein. ... pply is high relative to demand, wheat buyers will bid lower premiums to reflect the relative abundance of ... As with wheat itself, producers have some control over the supply of protein available at any one time on ... t through the use of storage facilities.

This paper will consider two alternative conceptual models of how supply and demand interact to deter- ... ein premiums. The first model (Model 1) assumes that protein premiums are determined by the explicit ... demand of physical wheat protein in the market. Figure 1 below illustrates how prices and premiums ... mined under this approach. The second model (Model 2) assumes that protein premiums are determined ... tive supplies and demands for a high protein wheat versus a low protein wheat. This is the same ap- ... sed by Bale and Ryan, and Wilson (1983). Figure 2 illustrates how premiums are determined under this

Under Model 1, an equilibrium price (P_b) is determined by the intersection of supply and demand for a ... n wheat (left diagram in Figure 1). This base wheat, for example, could be hard red winter ordinary. In ... market, the protein premium (P_p) is determined by the intersection of supply and demand for wheat pro- ... diagram in Figure 1). In this study, protein is quantified on a weight basis.

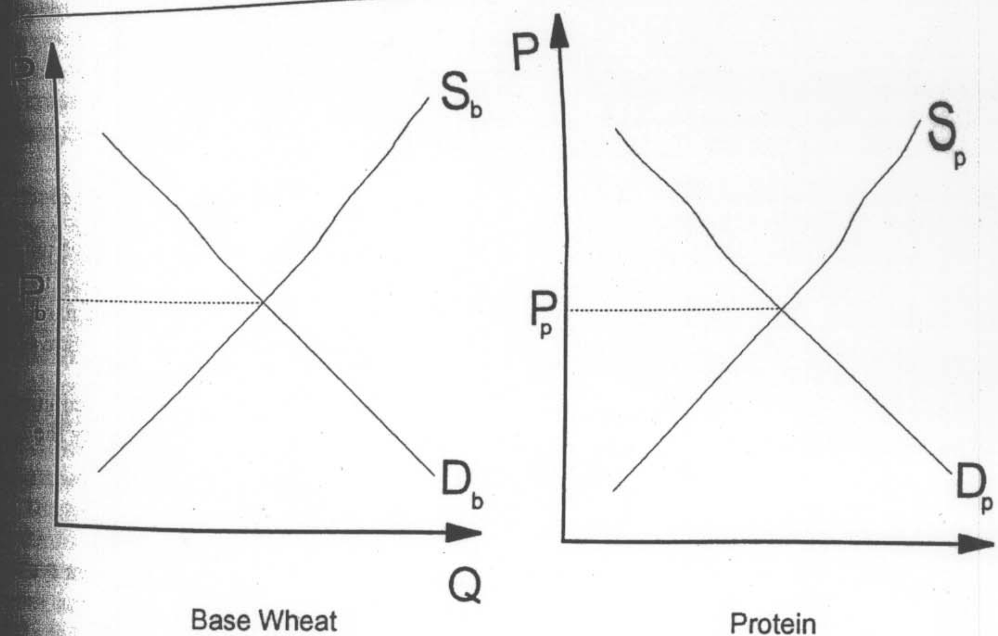

Figure 1. Determination of the protein premium under model 1.

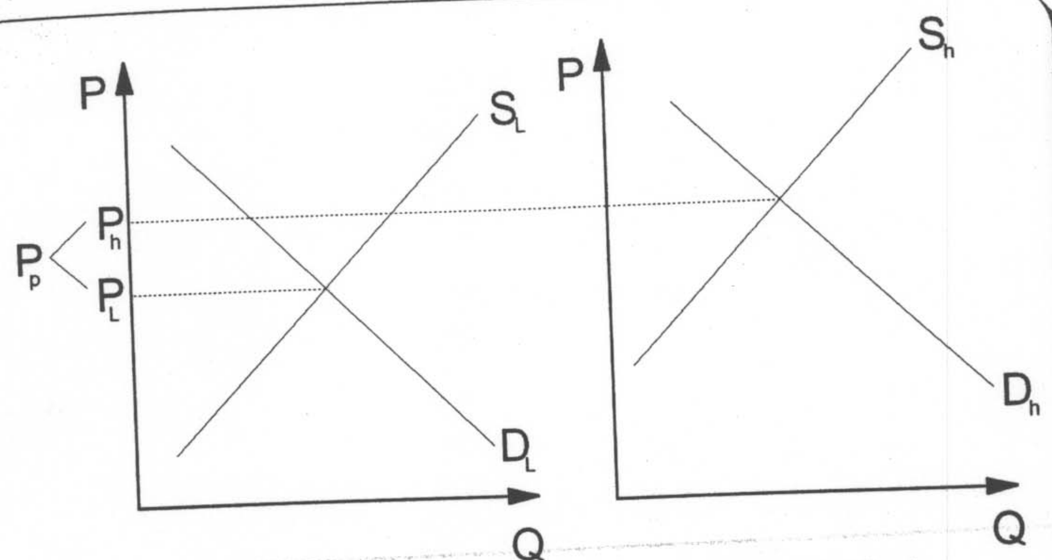

Figure 2. Determination of the protein premium under model 2.

Note that the primary driving assumption behind Model 1 is that the premium (price) for protein is determined in a market that is separate from the market for the wheat itself. For a wheat with protein level *i*, the market price is:

$$P_i = f(P_b(S_b, D_b), P_p(S_p, D_p), \delta_i), \tag{1}$$

where δ_i equals the difference in protein content between wheat *i* and the base wheat. Equation (1) can be represented by the following two equation system since P_b is an endogenous variable:

$$P_b = f_1(S_b, D_b),$$
$$P_i - P_b = f_2(S_p, D_p, \delta_i), \tag{2}$$

where f_1 and f_2 are expected to have positive partial derivatives with respect to D_b and D_p, and negative partial derivatives with respect to S_b and S_p. Also, f_2 is expected to have a positive partial derivative with respect to δ_i.

Under Model 2, an equilibrium price (P_L) is determined by the intersection of supply and demand for a low protein wheat (left diagram in Figure 2). An equilibrium price (P_h) is determined by the intersection of supply and demand for a high protein wheat (right diagram in Figure 2).

The primary driving assumption of this model is that the protein premium is determined in conjunction with the wheat prices and is therefore, not a separable market. The protein premium is determined by the following relationship:

$$P_p = g(P_h(S_h, D_h), P_L(S_L, D_L)). \tag{3}$$

Substitution of (3) into the base pricing model of (1) and (2) gives the following two equation system:

$$P_b = f_1(S_b, D_b),$$
$$P_i - P_b = f_3(S_h, S_L, D_h, D_L, \delta_i), \tag{4}$$

where f_3 is expected to have positive partial derivatives with respect to S_L, D_h, and δ_i; and negative partial derivatives with respect to S_h and D_L.

III. Data and Empirical Procedures

The price data used in this study were no.2 Montana Dark Northern Spring (13 and 14 percent protein) and no.1 hard red winter (ordinary and 12 percent protein) monthly average wheat prices for coastal delivery in Portland. The price data was obtained from *Livestock and Grain Market News.* Market-year average prices, from 1965-66 through 1991-92, were obtained by taking a simple average of the monthly prices over the marketing year.

Balance table data for hard red winter and other spring wheat, for market years 1960-61 to 1991-92, was obtained from past issues of *Wheat Situation* and *Wheat Situation and Outlook Yearbook*. Balance table data for Canadian spring wheat production (spring wheat other than durum) and carryover stocks (all wheat) for market years 1964-65 to 1991-92 was obtained from the Canada Grains Council.

The Canadian-United States monetary exchange rate data (Canadian dollars per U.S. dollar) was obtained from the 1992 edition of the *Economic Report of the President*. The data was obtained for calendar years 1967 to 1991.

The North Dakota hard red spring average protein content was used as a proxy for the average protein content of all U.S. spring wheat. The Kansas hard red winter wheat average protein content was used as a proxy for the average protein content for all U.S. hard winter wheat. The North Dakota data, from years 1962 to 1991, was obtained from North Dakota State University's Department of Cereal Science and Food Technology. The Kansas data, from years 1960 to 1991, was obtained from Kansas Agricultural Statistics Service. All average protein contents were converted to a 12 percent moisture basis.

Tables 1 and 2 in Appendix A provides a summary of all dependent and independent variables used in the forecasting analysis. All prices are measured in cents per bushel, wheat balance table data is in million bushels, average protein content is measured in percentage terms, and protein is measured in million pounds.

To measure explicit protein supply and demand (Model 1), a recursive balance table approach was used to generate approximate values. Table 3 in Appendix A illustrates the recursive formulas used to generate the balance table data.

Hard red winter ordinary and Dark Northern Spring 13 percent were used as the base protein models for their respective wheat classes. For both base protein models, the independent variable specification is identical to the wheat price outlook models used by Kansas State University Department of Agricultural Economics in their *AgUpdate* price outlook publications.

Within class price differences were used to measure protein premiums within each class of wheat. In addition, cross-class price differences were also examined as proxies for the protein premium. Note that the cross-class differences may capture other quality factors, in addition to protein, that differentiate spring from winter wheat.

Both the within-class and cross-class price difference models were estimated using the assumptions of Model 1 and Model 2 of the previous section. The protein balance table data was used to examine forecasting performance under Model 1. The hard red winter, other spring, and Canadian wheat supply and demand data was used to examine forecasting performance under Model 2. It was postulated that the Canadian and U.S. other spring wheat data represented the supply and demand for high protein wheat and the U.S. hard red winter data represented the supply and demand for low protein wheat.

All of the forecasting models were initially estimated using ordinary least squares (OLS). If the Durbin-Watson statistic was located in the inconclusive range, the model was reestimated using the Cochrane-Orcutt procedure to correct for first-order serial correlation. If the value of the AR(1) term was statistically significant at the 90 percent confidence level, it was left in the model. Otherwise, the OLS estimation results are reported.

To evaluate forecasting performance, the regression models were recursively estimated from 1965-66 through the 1986-87 to 1990-91 market years and out-of-sample, one-step ahead market-year forecasts were produced. Theil's U-statistic was used as the indicator of forecasting accuracy. This statistic, unlike the root mean square error and other traditional measures of forecasting performance, is a unit-free measurement and evaluates the model's forecasting performance relative to a "naive" forecasting procedure of using the current value of the forecasted variable as its future value. If the U-statistic is exactly equal to one, then the forecasting model performs the same as the "naive" model. If the U-statistic is less than one, then the forecasting model performs better than the "naive" model. If the U-statistic is greater than one, then the forecasting model performs worse than the "naive" model. Other forecasting diagnostics, such as root mean square error and the percentage of correct directional forecasts are provided.

IV. Estimation and Forecasting Results

Tables 4 through 6 in Appendix A present the estimation results for each of the best performing forecasting models from 1965-66 through 1991-92. The forecasting diagnostics for each model are from the recursive one-step ahead forecasts for 1987-88 through 1991-92.

Table 4 presents the estimation and forecasting results for the base model and within-class protein premium models for hard red winter wheat. The base model, using Tierney's specification, has coefficients that are statisically significant and of the expected sign. The Theil U-statistic is below one which indicates that the model performs better than the "naive" forecasting model. However, the root mean squared error and percent correct direction statistics do indicate that the model has some potential weakness as a forecasting model.

None of the hard red winter within-class price difference models [(1) through (4)] have Theil U-statistics less than two which indicates very poor forecasting performance. The percent correct direction is 50 percent for each model, which is the worst that a forecasting model can perform, since a model that is correct less than 50 percent of the time can have its directional forecasts reversed and perform at greater than 50 percent reliability.

Table 5 provides the regression estimates and forecast diagnostics for the base price and within-class price difference models for Dark Northern Spring wheat. The base model has statistically significant coefficients that are of the expected sign. The Theil U-statistic is less than one which indicates that the model performs better than the "naive" model. However, as with the hard red winter base model, the values for the root mean square error and percent turning points lend some skepticism to the forecasting performance of the model.

The results for the within-class price difference models [(1) through (4)] show better forecasting performance than the models for hard red winter wheat. All of the models have Theil U-statistics less than one which indicates better performance than the "naive" specification. The best performing model is (3) which is based upon specification of conceptual Model 2. As with the base model, the values of the root mean square error and percent correct direction lend some skepticism to the performance of the model.

Table 6 presents the regression and forecasting results for the cross-class price difference models. The Theil U-statistics for all of the models are less than or equal to 0.5 which indicates that they perform considerably better than the "naive" specification. In particular, the models for 14 percent Dark Northern Spring [(3) and (4)] provide exceptional forecasting performance. Note that the conceptual specification of Model 2 provides better forecasting performance than Model 1.

From the preceding results, three general observations can be made. First, it appears that the conceptual specification of Model 2 provides better forecasting performance than Model 1. An possible explanation for this is that the relative dispersion of protein in wheat (i.e., the supply of high protein wheat versus the supply of low protein wheat) is more important than the explicit supply of protein in determining protein premiums. If a large explicit supply of protein is dispersed among a large volume of wheat, the buyers must bid the premium higher to secure that protein than in the case where the same explicit supply of protein is concentrated in a smaller volume of wheat. The estimates of the explicit protein supply were relatively constant from year to year while the estimates of wheat supply were more variable.

The second observation is that apparently it is easier to forecast protein premiums within Dark Northern Spring than for hard red winter. A possible expanation for this is that Dark Northern Spring is used more often in blending for a higher protein content than the higher protein hard red winter wheats. Another explanation for this observation, is that the market for hard red winter includes less quality and more price conscious export buyers than the market for Dark Northern Spring since hard red winter usually sells at a discount to Dark Northern Spring.

The third observation is that the cross-class price difference models provide better forecasting performance than the within-class price difference models under conceptual Model 2. This is most likely the result of the independent variable specification of Model 2, which uses Dark Northern Spring as a proxy for the high protein wheat and hard red winter as a proxy for the low protein wheat.

V. Summary

This paper evaluates the forecasting performance of various models for prices and protein premiums in the Pacific Northwest (PNW) hard red winter and Dark Northern Spring wheat markets. Two conceptual specifications were examined. The first (Model 1) assumes that the premium for protein is determined by the explicit supply and demand for protein. The second (Model 2) assumes that the protein premium is determined by the relative supplies and demands for high and low protein wheat.

The empirical results support Model 2 as the better conceptual specification. In particular, this specification performed best in forecasting within-class price differences for Dark Northern Spring wheat and cross-class price differences between Dark Northern Spring and hard red winter wheat. None of the models provided acceptable forecasting results for within-class price differences on hard red winter wheat.

The empirical findings of this paper support the notion that the dispersion of protein in the supply of wheat is the most important factor in determining protein premiums. The more dispersed the protein among the supply of wheat, the higher the premiums must be bid in order to secure the supply of protein needed in the export blends. The opposite holds true when protein is dispersed among a relatively small supply of wheat.

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Appendix A
Tables

Table 1

Dependent Variables Used in Forecasting Models

Variable	Description
Prices (cents per bushel):	
HRWORD	Average market year price for PNW hard red winter wheat (ordinary protein).
HRW12	Average market year price for PNW hard red winter wheat (12 percent protein).
DNS13	Average market year price for PNW Montana Dark Northern Spring wheat (13 percent protein).
DNS14	Average market year price for PNW Montana Dark Northern Spring wheat (14 percent protein).
Within-Class Price Differences:	
S14S13	= DNS14 - DNS13.
W12Word	= HRW12 - HRWORD.
Across-Class Price Differences:	
S14Word	= DNS14 - HRWORD.
S14W12	= DNS14 - HRW12.
S13Word	= DNS13 - HRWORD.
S13W12	= DNS13 - HRW12.

Table 2

Independent Variables Used in Forecasting Models

Variable	Description
Wheat Supply Factors (million bushels):	
SPRPROD	Total U.S. production of spring wheat.
SPRCARR	Total U.S. carry-in stocks of spring wheat.
SPRSUP	Total U.S. supply of spring wheat.
HRWPROD	Total U.S. production of hard red winter wheat.
HRWCARR	Total U.S. carry-in stocks of hard red winter wheat.
HRWSUP	Total U.S. supply of hard red winter wheat.
CANPROD	Total Canadian production of spring wheat.
CANCARR	Total Canadian carry-in stocks of spring wheat.
CANSUP	Total Canadian supply of spring wheat.
USSUP	= SPRSUP + HRWSUP.
NASUP	= USSUP + CANSUP.
NASPRSUP	= SPRSUP + CANSUP.

Table 2 (Continued)

Variable	Description
USSUPPRATIO	= SPRSUP / HRWSUP.
NASUPPRATIO	= NASPRSUP / HRWSUP.
Wheat Demand Factors (million bushels unless otherwise indicated):	
NDPROT	North Dakota average protein content for spring wheat (percent of weight, 12 percent moisture basis).
KSPROT	Kansas average protein content for hard red winter wheat (percent of weight, 12 percent moisture basis).
PROTRATIO	= NDPROT / KSPROT.
SPRDOM	Total domestic use for U.S. other spring wheat.
HRWDOM	Total domestic use for U.S. hard red winter wheat.
SPREXP	Total U.S. exports of other spring wheat.
HRWEXP	Total U.S. exports of hard red winter wheat.
CANEXP	Total Canadian exports of spring wheat.
EXPRATIO	= SPREXP / HRWEXP.
NAEXRATIO	= (CANEXP + SPREXP) / HRWEXP.
USCAN	Canadian - U.S. monetary exchange rate (Canadian dollars per U.S. dollar).
Wheat Supply and Demand Factors (decimal format):	
SPRRATIO	Ending stocks to use ratio for U.S. other spring wheat.
HRWRATIO	Ending stocks to use ratio for U.S. hard red winter wheat.
TOTRATIO	Ending stocks to use ratio for all U.S. wheat.
Protein Supply Factors (million pounds, see Table 3 for formulas):	
SPRPROTSUP	Total U.S. supply of protein in other spring wheat.
HRWPROTSUP	Total U.S. supply of protein in hard red winter wheat.
TOTPROTSUP	= SPRPROTSUP + HRWPROTSUP.
SPRPROTCAR	Total U.S. carryover stocks of protein for other spring wheat.
HRWPROTCAR	Total U.S. carryover stocks of protein for hard red winter wheat.
TOTPROTCAR	= SPRPROTCAR + HRWPROTCAR.
Protein Demand Factors (million pounds, see Table 3 for formulas):	
SPRPROTUSE	Total U.S. use (domestic and exports) of protein in other spring wheat.
HRWPROTUSE	Total U.S. use (domestic and export) of protein in hard red winter wheat.
TOTPROTUSE	= SPRPROTUSE + HRWPROTUSE.
Protein Supply and Demand Factors (decimal format, see Table 3 for formulas):	
SPRPROTRATIO	Ending stocks to use ratio for U.S. other spring wheat protein.
HRWPROTRATIO	Ending stocks to use ratio for U.S. hard red winter wheat protein.
TOTPROTRATIO	Ending stocks to use ratio for U.S. spring and hard red winter wheat protein.
Miscellaneous Factors:	
LOAN	U.S. farm program loan rate for wheat (cents per bushel).
TREND	Linear trend variable (ex: 1965-66 = 1965).

Table 3

Formulas for Protein Supply and Demand Balance Table

Variable	Formula
Base Year Values:	
$SPRPROTSUP_{1962}$	$= SPRSUP_{1962} * NDPROT_{1962} * .6$
$HRWPROTSUP_{1960}$	$= HRWSUP_{1960} * KSPROT_{1960} * .6$
$SPRPROTUSE_{1962}$	$= (SPRDOM_{1962} + SPREXP_{1962}) * NDPROT_{1962} * .6$
$HRWPROTUSE_{1960}$	$= (HRWDOM_{1960} + HRWEXP_{1960}) * KSPROT_{1960} * .6$
$SPRPROTCAR_{1962}$	$= SPRPROTSUP_{1962} - SPRPROTUSE_{1962}$
$HRWPROTCAR_{1960}$	$= HRWPROTSUP_{1960} - HRWPROTUSE_{1960}$
Data Series:	
$SPRPROTSUP_t$	$= SPRPROTCAR_{t-1} + (SPRSUP_t * NDPROT_t * .6)$
$HRWPROTSUP_t$	$= HRWPROTCAR_{t-1} + (HRWSUP_t * KSPROT_t * .6)$
$SPRPROTUSE_t$	$= (SPRDOM_t + SPREXP_t) * NDPROT_t * .6$
$HRWPROTUSE_t$	$= (HRWDOM_t + HRWEXP_t) * KSPROT_t * .6$
$SPRPROTCAR_t$	$= SPRPROTSUP_t - SPRPROTUSE_t$
$HRWPROTCAR_t$	$= HRWPROTSUP_t - HRWPROTUSE_t$
$SPRPROTRATIO_t$	$= SPRPROTCAR_t / SPRPROTUSE_t$
$HRWPROTRATIO_t$	$= HRWPROTCAR_t / HRWPROTUSE_t$
$TOTPROTRATIO_t$	$= (SPRPROTCAR_t + HRWPROTCAR_t) / (SPRPROTUSE_t + HRWPROTUSE_t)$

Table 4

Regression and Forecasting Results For Base Price and Protein Premium Models for Hard Red Winter Wheat (t-statistics in parentheses)

Independent Variable	Dependent Variable				
	(Base) HRWORD	(1) W12Word	(2) W12Word	(3) W12Word	(4) W12Word
Constant	203.89*** (5.04)	8.69* (1.72)	8.61* (1.84)	8.64 (0.61)	11.86 (0.86)
$HRWORD_{t-1}$	0.45*** (3.48)	--	--	--	--
TOTRATIO	-2.76*** (-4.82)	--	--	--	--
LOAN	.5610*** (2.91)	--	--	--	--
HRWRATIO	--	5.66 (0.67)	--	--	--
TOTPROTRATIO	--	--	6.61 (0.90)	--	--
HRWSUP	--	--	--	--	0.0086 (1.14)
NASUP	--	--	--	0.00093 (0.22)	--
$USSUPPRATIO_{t-1}$	--	--	--	--	-29.44 (-1.18)
Diagnostics:					
AR1	--	0.52** (2.68)	0.52* (2.63)	0.55*** (2.74)	0.43* (1.75)
Durbin-Watson	1.70	2.13	2.12	2.12	2.07
Adjusted R^2	0.80	0.26	0.27	0.25	0.26
Root Mean Square Error	61.44	5.50	5.32	6.53	5.85
Theil's U-Statistic	0.69	2.40	2.32	2.85	2.55
Percent Correct Direction	75%	50%	50%	50%	50%

*Statistically significant at the 90% confidence level.
**Statistically significant at the 95% confidence level.
***Statistically significant at the 99% confidence level.

Table 5

Regression and Forecasting Results For Base Price and Protein Premium Models for Dark Northern Spring Wheat (t-statistics in parentheses)

Independent Variable	**Dependent Variable**				
	(Base) DNS13	(1) S14S13	(2) S14S13	(3) S14S13	(4) S14S13
Constant	208.46*** (4.71)	-10.16 (-1.34)	-17.90* (-1.79)	-30.80** (-2.57)	-18.70 (-1.45)
$DNS13_{t-1}$	0.51*** (3.91)	--	--	--	--
TOTRATIO	-2.83*** (-4.55)	--	--	--	--
LOAN	.5394** (2.58)	--	--	--	--
SPRPROTSUP	--	0.0056*** (3.37)	--	--	--
TOTPROTSUP	--	--	0.0021*** (3.26)	--	--
NASUP	--	--	--	0.014*** (3.82)	--
NASPRSUP	--	--	--	--	0.026*** (3.77)
NASUPPRATIO	--	--	--	--	-10.03 (-1.20)
<u>**Diagnosics:**</u>					
AR1	--	0.50** (2.76)	0.46** (2.46)	0.56*** (3.20)	0.59*** (3.35)
Durbin-Watson	1.65	1.47	1.72	1.62	1.53
Adjusted R^2	0.78	0.49	0.47	0.53	0.52
Root Mean Square Error	77.78	11.47	11.36	10.22	10.91
Theil's U-Statistic	0.77	0.66	0.66	0.59	0.63
Percent Correct Direction	75%	50%	75%	75%	75%

*Statistically significant at the 90% confidence level.
**Statistically significant at the 95% confidence level.
***Statistically significant at the 99% confidence level.

Table 6

Regression and Forecasting Results for Price Difference Models
(t-statistics in parentheses)

Independent Variable	Dependent Variable			
	(1) S13Word	(2) S13W12	(3) S14Word	(4) S14W12
Constant	245.78***	169.94**	148.08***	124.24***
	(2.95)	(2.46)	(5.95)	(6.53)
USSUPPRATIO	-380.58***	-308.62***	-297.95***	-259.68***
	(-4.18)	(-4.10)	(-3.80)	(-4.42)
EXPRATIO	93.97*	78.27*	64.90	54.49
	(1.92)	(1.93)	(1.41)	(1.58)
PROTRATIO	-70.92	-39.21	--	--
	(-1.32)	(-0.88)		
Diagnostics				
AR1	0.63***	0.55***	0.67***	0.70***
	(3.74)	(2.85)	(4.45)	(4.72)
Durbin-Watson	1.99	1.81	2.15	1.84
Adjusted R^2	0.40	0.34	0.50	0.51
Root Mean Square Error	12.23	16.31	4.29	2.11
Theil's U-Statistic	0.39	0.50	0.17	0.08
Percent Correct Direction	100%	100%	100%	100%

*Statistically significant at the 90% confidence level.
**Statistically significant at the 95% confidence level.
***Statistically significant at the 99% confidence level.