Grant Code: New
Title: Improving Basis Forecasts for Idaho Wheat
Personnel: Xiaoli Etienne (lead investigator), Andres Trujillo-Barrera (co-investigator)
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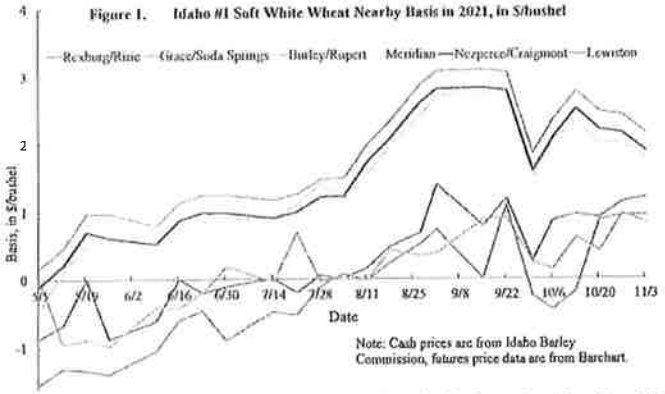
Justification/Rationale:

Volatile wheat prices pose significant risks to the profitability of the Idaho wheat industry. Successful risk management strategies for agribusiness firms and producers based on futures and options markets hinge critically on the ability to accurately forecast the basis, i.e., the difference between local cash prices and the prices of futures contracts traded on futures exchanges. As seen in **Figure 1**, the basis in Idaho has exhibited significant volatility over time and across locations. Such a high level of variability calls for a thorough examination of the driving forces behind basis variation and the identification of ways to improve basis forecasts. **The proposed project aims to examine historical basis patterns for different classes of wheat in Idaho, and develop statistical models to better understand and forecast the basis, so that participants in the Idaho wheat supply chain can make more informed production, marketing, and risk-management decisions.**



Although various analyses have been conducted to understand grain basis behavior in the US, very little information is available for the wheat market in Idaho. Previous work on grain production in Central and Great Plains shows that a reasonable basis forecast can be constructed using historical basis data (Hatchett et al. 2010). However, wheat basis in Idaho may behave differently from these regions because of the unique characteristics of wheat production in the state. For instance, Idaho produces different classes of wheat, whose prices may respond asymmetrically to each other. Further, protein content plays a key role in the pricing of wheat. While hard red winter (HRW) and hard red spring (HRS) wheat typically incur protein premiums, soft white (SW) wheat may suffer discounts if the protein level is high. Additionally, Idaho's wheat market is susceptible to global market shocks, as nearly half of its wheat is exported overseas.

Given the importance of wheat production in Idaho, the proposed project aims to fill a knowledge gap explaining basis behavior in Idaho over time and space, and seeks to improve basis forecasts for Idaho wheat by accounting for the unique characteristics of the state's wheat production. The project will generate the much-needed information on wheat basis, and by extension, the information on local cash prices, which plays a key role in producers' planting, marketing, and risk-management decisions, as well as on the marketing strategies for export firms and the lending decisions for agricultural lenders.

Hypothesis and Objectives:

We hypothesize that in addition to the historical basis, factors such as current market condition, export policies, protein content, and market volatility significantly affect the basis behavior for Idaho wheat. Statistical methods will be developed to understand the different drivers of basis across time, space, and classes, and to generate basis forecasting models to benefit the Idaho wheat industry. Specifically, the project aims to address the following objectives:

1. Explore basis patterns for different classes of wheat at various locations in Idaho.
2. Disentangle factors driving basis movement for Idaho wheat.
3. Develop statistical procedures to improve basis forecasts for Idaho.
4. Develop outreach materials on basis and basis forecasting to benefit wheat producers, agribusiness firms, and other market participants in Idaho.

Procedures/Plan of Work:

Obj. 1. Explore basis patterns for different types of wheat at various locations in Idaho

Task 1. Compile wheat cash price data and compute the basis: We will compile a cash price dataset using information from the Idaho Barley Commission and the Idaho Farm Bureau, the only two organizations that offer publicly accessible wheat cash prices in Idaho. Preliminary examination of the two datasets shows they differ in data frequency and geographic locations. Futures price data for different classes of wheat will be obtained from Barchart. Basis will be computed as the difference between cash and futures prices for a given geographic location. We will consider both nearby and harvest basis, where the former is calculated using the nearby futures contract and the latter using the harvest futures contract.

Task 2. Examine basis patterns over time and space: We will generate various plots to visually examine the basis behavior, including 1) basis at a given location for each class of wheat over time, 2) spatial distribution of basis for a given class of wheat, 3) basis at a given location for different classes of wheat. These plots will be used to determine trend, seasonality, spatial patterns, and correlations across classes for the Idaho wheat market.

Objective 2: Disentangle factors driving basis movement in Idaho over space and time

Task 3. Conduct literature reviews and producer interviews to identify factors that affect basis movement: Previous studies note that historical basis determines much of the basis behavior. However, given the unique characteristics of the Idaho wheat market, variables such as the protein scale, price volatility, export policies, transportation logistics, weather conditions, and storage capacities, need to be considered. Additional variables will be selected based on a more detailed literature review and discussions with wheat producers in the region. Data for these variables will be collected from various sources including the USDA.

Task 4. Develop statistical models to disentangle factors driving basis behavior: We will use statistical tools, including time series models, cross-sectional analysis, and spatial methods to describe how wheat basis varies across space and time. The general model is specified as:

$$Basis_{ict} = \alpha + \beta X_{ict} + u_{itc},$$

where $Basis_{ict}$ is the basis at location i for wheat class c on date t, X_{ict} is a vector of explanatory variables including various factors identified in Task 3, u_{itc} is the error term, and α and β are model parameters. Ordinary least squares or maximum likelihood estimation will be used to estimate the model parameters. Goodness-of-fit tools such as the adjusted R-squared and information criterion will be used to determine the model that provides the best fit. The marginal effect for each variable will be computed to quantify the relative importance of each variable in driving the spatial and temporal variation of wheat basis in Idaho.

Objective 3: Develop statistical procedures to improve basis forecast for Idaho wheat

Task 5. Generate out-of-sample basis forecasts: While Task 4 focuses on the in-sample fit of statistical models, out-of-sample evaluation is needed to determine their forecasting performances. We will compute the model parameters (for those models identified in Task 4) based on 2008-2019 data, which will be used to forecast the basis for 2020-2022. Forecast errors, defined as the difference between the actual and forecasted basis, will be compared across models to determine whether these forecasts differ significantly from each other, and which model provides the most accurate forecast.

Objective 4: Develop outreach materials on basis and basis forecasting to benefit producers, agribusiness firms, and other market participants in Idaho

Task 6: Develop outreach materials on wheat basis: Outreach videos and factsheets will be developed based on the project findings. The topics covered will include but are not limited to: 1) common grain marketing tools, 2) importance of basis in risk management strategies, 3) wheat basis behavior in Idaho, 4) how to forecast wheat basis using historical data. These materials will be distributed through the University of Idaho Extension and Idaho AgBiz.

Duration: The project is expected to last one year. Tasks 1-3 will be conducted in the first quarter of the project period, while tasks 4-5 will be implemented in quarters 2 and 3. The last quarter of the project period will be devoted to developing materials for task 6 and drafting a research paper.

Cooperation/Collaboration: The project team will work with 1) the University of Idaho Extension and Idaho AgBiz to disseminate the information generated from the project, and 2) the Idaho Barley Commission and the Idaho Farm Bureau to obtain cash price data in Idaho. For task 3, we will interview local wheat producers at the 2022 Tri-State Grain Growers Convention.

Anticipated Benefits, Expected Outcomes and Impacts, and Transfer of Information:

We will develop statistical models to better understand short-term dynamics of basis behavior and forecast future basis for different classes of wheat in Idaho. Idaho wheat producers can benefit from an improved understanding of basis and local cash prices, which could aid in their production, marketing, and risk management decisions and position their farms for future growth and success. We anticipate the project results to also benefit elevator managers, grain traders, exporters, and agricultural lenders in the region who seek forecasts of future wheat basis and cash prices in Idaho.

We expect to generate research, teaching, and outreach materials. In addition to presenting the research findings at peer-reviewed conferences, we will also produce one peer-reviewed journal article. Teaching material will be developed based on the basis data and project findings. Students in the PI and CI's classes, as well as those students involved in the Agricultural Commodity Risk Management certificate at the University of Idaho, will experiment with risk management strategies using the basis data and compute marketing outcomes under various scenarios.

Several venues will be used to disseminate the information through outreach and extension activities. First, we will produce one University of Idaho Extension publication, focusing on the historical basis behavior for different classes of wheat in Idaho. Second, as discussed in task 6 we will generate several factsheets and educational videos on price risk management strategies, with a particular focus on the wheat market. These materials will be posted on the University of Idaho Extension's AgBiz website and YouTube channel and distributed to interested parties. Third, we will work with the University of Idaho Extension to present the findings of the study at Cereal Schools and other extension workshops. In addition, the information generated will be provided to extension personnel for other training modules.

Literature Review:

Several studies have examined the basis behavior for winter wheat in the Central and Southern Plains region. Averages of historical basis are often found to generate reasonable forecasts (Kastens et al. 1998, Hatchett et al. 2010). Other studies show that including current marketing year information along with relatively short historical averages reduces basis forecast errors (Taylor et al. 2006). Wilson and Miljkovic (2013) note that HRS wheat basis in the Northern Great Plains is affected by its protein level, production of HRW, and the Canadian wheat market. Bekkerman et al. (2016) find that unlike basis behavior for other crops and regions, recent futures prices, protein content, and harvest information play an essential role in determining the HRS and HRW wheat basis in the northern US.

Existing studies are limited on several fronts. First, none of these studies considered the basis patterns in Idaho. Second, most of the studies use data prior to 2012, which predates many of the important developments in the global grain market. The basis behavior is likely to have been affected by recent events such as the trade war, Covid-19, and weather anomalies. Third, most studies only consider HRS and HRW, without discussing other classes of wheat that presents unique market characteristics. These issues will be addressed in the proposed project.

References:

Bekkerman, A., Brester, G.W. and Taylor, M., 2016. Forecasting a moving target: The roles of quality and timing for determining northern US wheat basis. *Journal of Agricultural and Resource Economics*, pp.25-41.

Hatchett, R.B., Brorsen, B.W. and Anderson, K.B., 2010. Optimal length of moving average to forecast futures basis. *Journal of Agricultural and Resource Economics*, pp.18-33.

Kastens, T.L., Jones, R. and Schroeder, T.C., 1998. Futures-based price forecasts for agricultural producers and businesses. *Journal of Agricultural and Resource Economics*, pp.294-307.

Wilson, W.W. and Miljkovic, D., 2013. Dynamic interrelationships in hard wheat basis markets. Canadian Journal of Agricultural Economics, 61(3), pp.397-416.

FY2023

COMMODITY COMMISSION BUDGET
Principal Investigator: *Xiaoli Etienne*

Allocated by _____ *(Commission/Organization)*	**during FY2021**	$ -
Allocated by _____ *(Commission/Organization)*	**during FY2022**	$ -

REQUESTED SUPPORT: **Budget Categories**	*Awarded for FY2022*	*Requested for FY2023*
(10) Salary *(staff, post-docs, et NOTE: Faculty salary/fringe not allowed*	$ -	$ 24,000
(12) Temporary Help	$ -	$ -
(11) Fringe Benefits	$ -	$ 720
(20) Travel	$ -	$ 3,546
(30) Other Expenses	$ -	$ -
(40) Capital Outlay >$5k	$ -	$ -
(45) Capital Outlay <$5k	$ -	$ -
(70) Graduate Student Tuition/Fees	$ -	$ 10,110
TOTALS	$ -	$ 38,376

TOTAL BUDGET REQUESTED FOR FY2023:	$ 38,376

BREAKDOWN FOR MULTIPLE INDEXES:

Budget Categories	*Xiaoli Etienne*	*Andres Trujillo-Barrera*	*(Insert Co-PI Name)*	*(Insert Co-PI Name)*
(10) Salary *(staff, post-docs, et*	$ 24,000	$ -	$ -	$ -
(12) Temporary Help	$ -	$ -	$ -	$ -
(11) Fringe Benefits	$ 720	$ -	$ -	$ -
(20) Travel	$ 2,411	$ 1,135	$ -	$ -
(30) Other Expenses	$ -	$ -	$ -	$ -
(40) Capital Outlay >$5k	$ -	$ -	$ -	$ -
(45) Capital Outlay <$5k	$ -	$ -	$ -	$ -
(70) Graduate Student Tuition/Fees	$ 10,110	$ -	$ -	$ -
TOTALS	$ 37,241	$ 1,135	$ -	$ -
			Total Sub-budgets	$ 38,376