



BRIEFING

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Expanded Crop Rotations and Price Risk Effect

Kevin McNew

Agricultural Marketing Policy Center
Linfield Hall
P.O. Box 172920
Montana State University
Bozeman, MT 59717-2920
Tel: (406) 994-3511
Fax: (406) 994-4838
email: ampc@montana.edu
website: www.ampc.montana.edu

Contact:

Kevin McNew
(406) 994-7816
kmcnew@montana.edu

**Objective
Analysis
for Informed
Decision Making**

A common perception is that increasing the number of crops in cropping rotation reduces risk. For example, suppose a farm's crop rotation consists of 50 percent spring wheat production and 50 percent winter wheat production. Would this farm necessarily have less risk if an alternative crop was added so that the rotation was 45 percent spring wheat, 45 percent winter wheat, and 10 percent in the alternative crop?

Contrary to popular beliefs, it is not necessarily true that adding additional crops to a rotation will necessarily reduce risk. A new crop may or may not reduce risk depending on the crop's revenue variability and the extent to which annual changes in revenue are similar to the existing crops in the rotation.

For example, suppose a farm manager considers growing dry peas on 10 percent of acreage while reducing spring wheat and winter wheat acreage from 50 percent each to 45 percent each. Would this new crop mix lead to lower farm risk than the 50-50 mix of winter and spring wheat? The answer depends in part on the price risk of dry peas relative to spring and winter wheat.

Although there are several ways to measure risk, this Briefing considers the riskiness of national average annual prices from 1992-2000 as reported by USDA National Agricultural Statistics Service. Table 1 reports a measure of price risk for a variety of crops. The price risk measure captures the riskiness of a crop's price relative to its average value. This measure is called the coefficient of variation and gives an indication of how variable a crop's price is relative to its average. ¹ The higher the risk measure, the more volatile is the crop price is relative to its average value.

For the crops reported in Table 1, dry peas have the highest price risk while safflower

Table 1: Crop Price Risk Based on U.S. Average Prices, 1992-2001

| Crop | Price Risk |
|--------------|------------|
| Canola | 18.5% |
| Dry Beans | 15.4% |
| Dry Peas | 27.8% |
| Flaxseed | 20.8% |
| Lentils | 19.9% |
| Mustard | 19.3% |
| Safflower | 13.4% |
| Sunflower | 20.3% |
| Wheat-Spring | 16.7% |
| Wheat-Winter | 23.3% |
| Barley | 15.2% |
| Alfalfa | 10.2% |

has the lowest price risk. However, riskiness of the alternative crops is similar to that of wheat. Therefore, taking land out of wheat production and replacing it with one of the alternative crops may not necessarily reduce price risk since the prices of all crops have about the same level of risk.

Along with the size of price risk, the ability of an alternative crop to reduce price risk depends upon the correlation of the alternative crop's price with prices of crops already in rotation. Correlation refers to the extent to which two prices move together over time and is measured on a scale of -1 to +1. A correlation of +1 implies that two prices move up and down in unison over time, whereas a correlation of -1 implies that two prices move in unison but in opposite directions.

Table 2 presents the correlation of various price pairs. For example, the

¹The coefficient of variation (CV) is calculated by taking the standard deviation of prices and dividing it by average price for the 1992 to 2000 period. Mathematically, $CV = \sqrt{S_1^2} \div \bar{y}_1$

(See Briefing 5, revised November 2002, for the calculation of S_1^2)

Table 2. Crop Price Correlations

| | Canola | Dry Beans | Dry Peas | Flaxseed | Lentils | Mustard | Safflower | Sunflower | Spring Wheat | Winter Wheat | Barley |
|--------------|--------|-----------|----------|----------|---------|---------|-----------|-----------|--------------|--------------|--------|
| Alfalfa | 0.454 | 0.633 | 0.442 | 0.452 | 0.187 | 0.546 | 0.483 | 0.284 | 0.438 | 0.854 | 0.826 |
| Canola | | 0.85 | 0.82 | 0.88 | 0.62 | 0.65 | 0.92 | 0.91 | 0.73 | 0.75 | 0.45 |
| Dry Beans | | | 0.74 | 0.52 | 0.64 | 0.24 | 0.77 | 0.88 | 0.63 | 0.62 | 0.19 |
| Dry Peas | | | | 0.64 | 0.69 | 0.33 | 0.71 | 0.60 | 0.69 | 0.81 | 0.44 |
| Flaxseed | | | | | 0.38 | 0.91 | 0.85 | 0.70 | 0.67 | 0.69 | 0.55 |
| Lentils | | | | | | 0.14 | 0.59 | 0.54 | 0.70 | 0.77 | 0.44 |
| Mustard | | | | | | | 0.73 | 0.46 | 0.41 | 0.43 | 0.55 |
| Safflower | | | | | | | | 0.78 | 0.63 | 0.64 | 0.45 |
| Sunflower | | | | | | | | | 0.67 | 0.60 | 0.28 |
| Spring Wheat | | | | | | | | | | 0.96 | 0.85 |
| Winter Wheat | | | | | | | | | | | 0.83 |

Table 3: Variability of Weighted Farm Prices in Alternative Rotations

| Rotation | Price Risk |
|---|--------------------|
| 50% Spring Wheat, 50% Winter Wheat | 19.7% ^a |
| 45% Spring Wheat, 45% Winter Wheat 5% Flaxseed, 5% Dry Peas | 19.6% |
| 40% Spring Wheat, 40% Winter Wheat 5% Flaxseed, 5% Dry Peas, 5% Sunflower, 5% Mustard | 17.8% |
| 40% Spring Wheat, 40% Winter Wheat, 5% Flaxseed, 5% Dry Peas, 5% Sunflower, 5% Mustard, 5% Canola, 5% Dry Beans | 16.6% |
| Equal amount of acreage in 10 crops | 15.3% |

^a These calculations are available upon request from the author

correlation between spring wheat (Spring Wheat row) and winter wheat (Winter Wheat column) prices is 0.96. This means that spring wheat and winter wheat prices tend to move together very closely since their correlation is very close to +1.

In general, alternative crop prices are fairly highly correlated with winter and spring wheat prices. The primary exception is that the price of mustard is weakly correlated with wheat prices. When two crops have a high correlation, substituting one crop for another in a crop mix will do little to reduce overall price risk.

As an example of how changing crops effects overall price risk, Table 3 shows overall price risk for different crop mixes. The first rotation is a 50-50 mix between spring wheat and winter wheat. For this rotation, overall price risk is 19.7 percent. Alternatively, if the farm took 10 percent of production out of wheat and produced equal amounts of flaxseed and dry peas, then overall price risk would decline only slightly to 19.6 percent. Thus, this expansion of the crop rotation does little to reduce overall price risk. Even in an extreme case of complete crop diversification where a farm produces equal amounts of the 10 crops considered here, the overall price risk would be 15.3 percent. This level of price risk is only slightly lower than the

risk of growing only spring wheat which was 16.7 percent (Table 1). In addition, many alternative crops lack price risk management options.

Although there may be a number of economic reasons for expanding rotations with alternative crops, it is important to understand how new crops will influence overall price risk. Because many crop prices tend to move together over time and tend to be volatile, the substitution of an alternative crop may not reduce risk significantly and in some cases, may actually increase overall price risk.

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