An abstract geometric design consisting of several black lines and dots. A long line runs from the top left towards the top right. Another line runs from the top left towards the bottom right. A third line runs from the middle left towards the bottom right. A fourth line runs from the middle left towards the bottom right, crossing the third line. A fifth line runs from the bottom left towards the bottom right. There are dots at the ends of these lines and at their intersections.

Diversification---

does it reduce

Price Variation?

Yu Hsuen Mo and Emery Castle

Station Bulletin 569

May 1959

Agricultural Experiment Station

Oregon State College

•

Corvallis

Diversification---

Does it Reduce Price Variation?

	Page
Summary	3
Diversification versus Specialization	3
Commodities Studied	4
Diversification as a Means of Reducing Price Variability	4
Enterprise Combinations	7
Limitations of the Study	9
Conclusions	9

*AUTHORS: Graduate Research Assistant and Associate Agricultural Economist, respectively, Oregon Agricultural Experiment Station.

Summary

This study was undertaken to test the effect of diversification on price variability. Commodities commonly produced in Oregon were examined by type of farming areas.

A relatively small percentage of the enterprise combinations examined resulted in a reduction of total price variability. In some cases, however, adding a second enterprise significantly reduced variability from the production of either enterprise alone. Ninety-one enterprise combinations were examined for the entire State; eighteen resulted in a reduction of price variability. The reduction varied from 21.65% in some cases to an insignificant amount in others.

The conclusion was reached that for most types of farming areas diversification is ineffective in reducing price variability. However, there may be advantages to producing certain commodities whose prices have a relatively low association with other prices, or which have highly variable prices, in combination with other commodities. Examples of such commodities are onions and potatoes.

This study was not intended to be a complete evaluation of diversification. It is confined to a single aspect of the problem—the effectiveness of diversification as a hedge against price risk.

Diversification versus Specialization

One of the oldest arguments in farm management centers around the relative advantages of diversification and specialization. The trend in recent years has been toward greater specialization. Some agriculturists argue that considerable risk is associated with specialization. This study investigates the effect of diversification in stabilizing price fluctuations facing farmers in various parts of Oregon.

The problem has many aspects. The proper combination of enterprises permits the factors of production to be more fully utilized. A livestock enterprise may permit profitable winter em-

ployment which is not available to the specialized crop farmer. The establishment of a rotation with the production of several crops may enhance soil fertility and aid in the control of weeds and insects. Some enterprises actually contribute, one to another, when operated in combination. For example in combining sheep and seed crops, sheep utilize the aftermath of the seed crops, and sheep manure adds fertility to the soil.

Powerful economic forces underlie the trend toward specialization. Specialization frequently permits a commodity to be produced in volume, mak-

ing possible lower unit costs. The farmer may concentrate on a small number of commodities and become an expert in their production.

Advocates of diversification contend that if the price of one commodity is low in a particular year, the price of another commodity is likely to be high. They argue that the same thing is

likely to be true of yields. That is, a good year for strawberries may not be a good year for sweet cherries, and one crop will tend to stabilize the other. This study attempts to test this idea with prices. Inadequate yield data were available to test how much diversification stabilizes yields.

Commodities Studied

The State of Oregon was divided into six types of farming areas for the purposes of this study (figure 1). The principal commodities for each type of farming area were determined. These commodities were listed in table 1.

The Willamette Valley area was studied first and numerous commo-

ties were considered. Some commodities and enterprise combinations that are important in the Valley are also important in other types of farming areas. They are not always repeated in the analysis since the results obtained for the Valley would apply throughout the State. Average prices for the State were used.

Diversification as a Means of Reducing Price Variability

Diversification as a means of reducing price variability hinges on two main factors. Each factor will be described in turn.¹

The first factor is the relative price variability among the commodities. If one enterprise, (A), has a high price variability and another, (B), has a low

variability, the combination, $A + B$, will tend to have a variability intermediate between the two. The relative variability of the commodity prices analyzed for the 1936-56 period is listed in table 1. Variability is measured by the variance which has been developed by statisticians for such purposes. The

¹ The formula for testing diversification as a means of reducing variability is given below. It will be noted that the outcome will be influenced by the relative variability of the two enterprises and by the degree of association that exists between the enterprises.

$$V_z = \frac{V_A + V_B + 2r s_A s_B}{4}$$

4

V_z = Variance of the combination assuming resources are divided equally among enterprises

V_A = Variance of original enterprise

V_B = Variance of added enterprise

r = Correlation coefficient between enterprise A and enterprise B

s_A = Standard deviation of enterprise A

s_B = Standard deviation of enterprise B

The standard deviation is the square root of the variance. For a complete explanation of the theoretical aspects of diversification see: *The Effect of Diversification on Income Variability of Oregon Farmers* by Yu Hsuen Mo. A Masters thesis submitted to Oregon State College in June, 1958. This thesis is available on interlibrary loan.

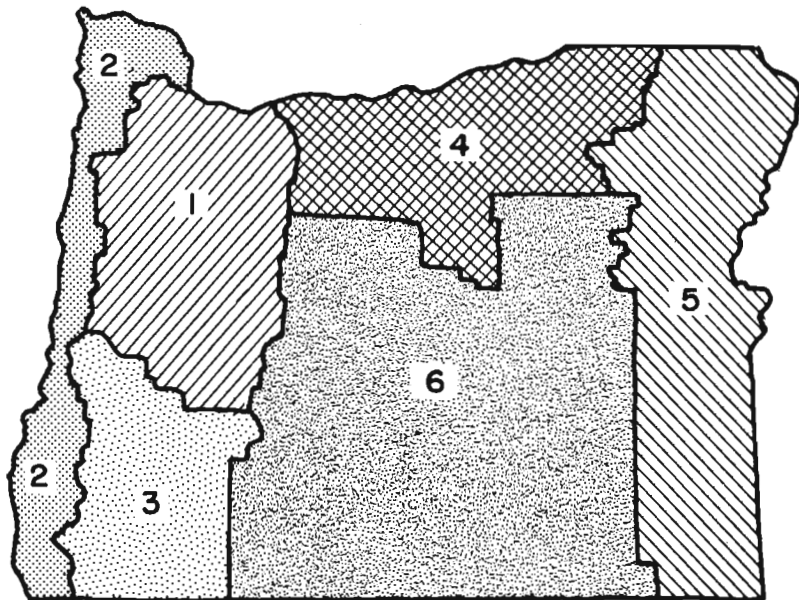
commodities are ranked by type of farming areas according to variation. Those having the lowest variation receive the highest rank.

The other important factor is the extent to which commodity prices vary together over time. If two commodities are influenced by the same demand and supply conditions, their prices will tend to vary together or be highly associated. Obviously, total price varia-

tion would be stabilized very little by producing these two commodities together. On the other hand, if the price of one commodity tended to be high while another was low and if the opposite condition also held, (when B was high and A was low) these commodities would tend to reduce variability when produced in combination.

The correlation coefficient was determined for the commodities studied

Figure 1. Agricultural Areas of Oregon



1. **Willamette Area:** Benton County, Clackamas County, Lane County, Linn County, Marion County, Multnomah County, Polk County, Washington County, Yamhill County.
2. **Lower Columbia and Coast Area:** Clatsop County, Columbia County, Coos County, Curry County, Lincoln County, Tillamook County.
3. **Southern Oregon Area:** Douglas County, Jackson County, Josephine County.
4. **Columbia Basin Area:** Gilliam County, Hood River County, Morrow County, Sherman County, Umatilla County, Wasco County, Wheeler County.
5. **Snake River Area:** Baker County, Malheur County, Union County, Wallowa County.
6. **South Central Oregon Area:** Crook County, Deschutes County, Grant County, Harney County, Jefferson County, Klamath County, Lake County.

by type of farming areas. The results are given in Appendix tables 1-7. The significant result is the high degree of association among the commodity prices. One reason for this is that general price level changes have not been removed from the data. When prices in

general move upward or downward, agricultural prices tend to respond in a similar fashion. This high degree of association reduces the effectiveness of diversification in combating price variability or price risk.

TABLE 1. PRICE VARIANCE FOR PRINCIPAL FARM PRODUCTS IN SIX AGRICULTURAL AREAS, OREGON, 1936-1956.

Agricultural area	Farm products	Variance	Relative variances ¹
Willamette Valley	Hairy vetch seed	0.0888	100.00
	Oats	0.1135	127.76
	Barley	0.1212	136.39
	Eggs	0.1224	137.74
	Milk	0.1390	156.40
	Hogs	0.1543	173.59
	Wheat	0.1550	174.46
	Beef cattle	0.1975	222.20
	Strawberries	0.2125	239.11
Coast and Lower Columbia	Milk	0.1390	100.00
	Beef cattle	0.1975	142.07
	Lambs	0.1979	142.39
Southern Oregon	Alsike clover seed	0.1115	100.00
	Eggs	0.1224	109.78
	Milk	0.1390	124.66
	Lambs	0.1979	177.50
Columbia Basin	Barley	0.1212	100.00
	Pears	0.1406	116.04
	Wheat	0.1550	127.91
	Cherries	0.1625	134.11
	Prunes	0.1971	162.62
	Beef cattle	0.1975	162.91
	Apples	0.2061	170.04
	Hay	0.0995	100.00
Snake River	Hogs	0.1543	155.98
	Potatoes	0.1725	173.34
	Beef cattle	0.1975	198.38
	Onions	0.2117	212.67
	Hay	0.0995	100.00
South Central Oregon	Barley	0.1212	121.77
	Potatoes	0.1725	173.34
	Beef cattle	0.1975	198.38

¹ The enterprise in each type of farming area having the lowest variance is 100. Others are calculated as a percentage of the lowest.

Enterprise Combinations

The price variability of various enterprise combinations was computed. The enterprise combinations tested for the Willamette Valley are shown in table 2. Of the twenty-four enterprise combinations tested, only one, barley and eggs, resulted in less variation than the original enterprise having the smallest variance.¹ The reason for this is that the prices of the original enterprises are highly associated. Therefore, when two enterprises are combined, the combination usually has a variance intermediate between the original enterprises. The conclusion is that diversification is inadequate protection against price variability in the Willamette Valley.

The percentage change from the original enterprise having the greatest variance is also shown. This illustrates that the variance of the combination is usually intermediate between the original enterprises.

The results for the coast and lower Columbia area are similar (table 3). The combination of beef cattle and lambs would have resulted in a reduction in price variability for the 1936-56 period from the original enterprise having the smallest variance. However, the reduction would not have been great.

In the southern Oregon area eleven enterprise combinations were tested. Of these, three would have resulted in a reduction in variability from the most stable single enterprise. Alsike

clover seed was less highly correlated with eggs, lambs, and milk than was true of many commodity prices. Consequently three combinations which included alsike clover seed resulted in a reduction in price variability (table 4).

Four of fifteen enterprise combinations resulted in a reduction of price variability for the Columbia Basin area and these combinations all involved fruit (table 5). (The reduction was calculated from the original enterprise having the smallest variance.) A fruit farmer may have good reasons for planting a variety of fruits. Much of the same equipment can be utilized for different kinds of fruits and a better distribution of labor can be achieved if a number of fruits are grown.

In the Snake River area, 26 enterprise combinations were examined and 9 of the 26 resulted in a reduction. Onions have a rather high price variability and are not highly correlated with most enterprises except potatoes. To a lesser extent this is true of potatoes. Consequently, it appears that while potatoes and onions have rather unstable prices they may not add greatly to over-all price risk if combined with the proper enterprises (table 6).

Enterprise combinations for the south central Oregon area were also examined (table 7). Of the 11 enterprise combinations studied only one, beef cattle and potatoes, resulted in a reduction.

¹ In tables 2-7 the percentage change in the variance of the combination from the original enterprises having both the largest and the smallest variance is shown. Whether diversification reduces variability depends upon the variability of the enterprise selected as a starting point. If A has considerably more variability than B, adding B to A may reduce variability from A alone, although A + B may have greater variability than B alone. The discussion of the tables centers on the comparison of A + B with the original enterprise having the smallest variance. (However, the data are available if one wishes to compare the variability of A + B with the variability of the original enterprise having the greatest variance.)

TABLE 2. VARIABILITY OF PRICE OF VARIOUS ENTERPRISE COMBINATIONS IN WILLAMETTE AREA, OREGON, 1936-1956.

Enterprise combination	Variance	
	Smallest ¹	Largest ²
	<i>Percent</i>	<i>Percent</i>
Barley—hairy vetch seed	+ 8.02	—20.80
Barley—eggs	— 4.86	— 5.80
Barley—oats	+ 2.08	— 4.37
Oats—milk	+ 7.68	—12.04
Barley—milk	+ 2.68	—10.46
Oats—wheat	+12.16	—17.86
Barley—hogs	+ 7.32	—15.68
Barley—wheat	+ 8.07	—15.51
Wheat—milk	+ 4.38	— 6.42
Barley—beef cattle	+20.00	—26.34
Beef cattle—eggs	+20.79	—25.12
Barley—strawberries	+22.59	—30.07
Barley—oats—hairy vetch seed	+13.08	—17.09
Barley—milk—hairy vetch seed	+19.76	—23.43
Barley—milk—oats	+ 5.37	—13.93
Barley—oats—wheat	+ 8.34	—20.65
Oats—wheat—milk	+14.61	—16.06
Barley—wheat—milk	+ 8.80	—14.94
Barley—milk—strawberries	+14.41	—34.74
Beef cattle—eggs—milk	+16.61	—27.71
Beef cattle—eggs—hogs	+18.02	—26.84
Barley—milk—strawberries—hairy vetch seed	+35.85	—43.18
Barley—oats—wheat—milk	+10.45	—19.11
Beef cattle—eggs—hogs—milk	+15.77	—28.23

¹ Percentage change from the original enterprise having the smallest variance.

² Percentage change from the original enterprise having the largest variance.

TABLE 3. VARIABILITY OF PRICE OF VARIOUS ENTERPRISE COMBINATIONS IN COAST AND LOWER COLUMBIA AREA, OREGON, 1936-1956.

Enterprise combination	Variance	
	Smallest ¹	Largest ²
	<i>Percent</i>	<i>Percent</i>
Milk—beef cattle	+14.73	—19.24
Milk—lambs	+16.50	—18.18
Beef cattle—lambs	— 0.74	— 0.51
Milk—beef cattle—lambs	+22.87	—13.71

¹ Percentage change from the original enterprise having the smallest variance.

² Percentage change from the original enterprise having the largest variance.

In table 8 the percent reduction resulting from diversification is summarized by types of farming areas. The reduction varies from as much as 21.65% with highly uncertain crops, such as onions, to an insignificant amount. On the basis of these historical data it appears that only a few diversification systems would have been an effective precaution against price risk. In certain cases, however, diversi-

fication would have been highly effective. Adding a third or fourth enterprise seldom significantly reduced price variability over one or two enterprises. This indicates that the second enterprise is more effective than the third, the third is more effective than the fourth, and so forth, other things being equal. Normally, it would not be wise to diversify beyond the point of maximum profit to reduce price variability.

Limitations of the Study

The principal limitation of the study is that only price variability was considered. If yield data had been available it would have been possible to incorporate yields into the analysis. This would have added considerably to the evaluation of diversification as a means of reducing income variability.

Another possible limitation relates to the reliability of historical prices. When a single price is considered, it is doubtful that the results would be reliable.

However, when many agricultural prices are being considered confidence probably can be placed in the result.

The study is not a complete evaluation of diversification. Some farms may be most profitable when producing a number of commodities. Others may be most profitable with considerable specialization. This study was confined to the effect of diversification on price variability.

Conclusions

Diversification appears to be an inadequate measure in combating price risk. The principal reason is that most agricultural commodity prices tend to increase and decrease together. This may partially explain the rapid trend

toward specialization in American agriculture. Diversification is inadequate protection against price risk. Also, specialization has often resulted in greater efficiency and hence in greater profit.

TABLE 4. VARIABILITY OF PRICE OF VARIOUS ENTERPRISE COMBINATIONS IN SOUTHERN OREGON AREA, OREGON, 1936-1956.

Enterprise combination	Variance	
	Smallest ¹	Largest ²
	<i>Percent</i>	<i>Percent</i>
Eggs—alsike clover seed	—12.91	—20.68
Milk—alsike clover seed	— 5.99	—24.59
Milk—eggs	+ 5.04	— 7.50
Lambs—alsike clover seed	+15.91	—34.70
Eggs—lambs	+22.26	—24.38
Milk—lambs	+16.50	—18.18
Milk—eggs—alsike clover seed	— 5.42	—24.13
Eggs—lambs—alsike clover seed	+ 6.84	—39.81
Milk—lambs—alsike clover seed	+13.16	—36.25
Milk—eggs—lambs	+18.12	—26.94
Milk—eggs—lambs—alsike clover seed	+ 8.95	—38.62

¹ Percentage change from the original enterprise having the smallest variance.

² Percentage change from the original enterprise having the largest variance.

TABLE 5. VARIABILITY OF PRICE OF VARIOUS ENTERPRISE COMBINATIONS IN COLUMBIA BASIN AREA, OREGON, 1936-1956.

Enterprise combination	Variance	
	Smallest ¹	Largest ²
	<i>Percent</i>	<i>Percent</i>
Wheat—barley	+ 8.07	—15.51
Beef cattle—barley	+20.00	—26.34
Beef cattle—wheat	+ 5.76	—16.96
Beef cattle—wheat—barley	+18.06	—27.53
Pears—cherries	— 0.35	—13.78
Pears—prunes	+ 8.18	—22.81
Cherries—prunes	— 0.18	—17.67
Apples—pears	+16.44	—20.54
Apples—cherries	+ 3.90	—18.05
Apples—prunes	—13.58	—17.36
Pears—cherries—prunes	+ 4.12	—25.70
Apples—pears—cherries	+ 9.18	—25.50
Apples—pears—prunes	+10.69	—24.47
Apples—cherries—prunes	— 1.56	—22.36
Apples—pears—cherries—prunes	+ 7.42	—26.69

¹ Percentage change from the original enterprise having the smallest variance.

² Percentage change from the original enterprise having the largest variance.

TABLE 6. VARIABILITY OF PRICE OF VARIOUS ENTERPRISE COMBINATIONS IN SNAKE RIVER AREA, OREGON, 1936-1956.

Enterprise combination	Variance	
	Smallest ¹	Largest ²
	<i>Percent</i>	<i>Percent</i>
Hogs—hay	+15.81	—25.28
Onions—hay	+19.82	—43.66
Potatoes—hay	+20.12	—30.70
Hogs—onions	—14.56	—37.73
Beef cattle—hay	+35.90	—31.50
Hogs—potatoes	— 8.32	—18.03
Beef cattle—onions	—21.65	—26.92
Beef cattle—potatoes	— 7.73	—19.37
Beef cattle—hogs	+ 5.18	—17.83
Potatoes—onions	+ 0.58	—18.02
Hogs—onions—hay	+11.62	—47.52
Hogs—potatoes—hay	+20.41	—30.54
Beef cattle—onions—hay	+25.94	—40.78
Potatoes—onions—hay	+30.12	—38.81
Beef cattle—potatoes—hay	+32.46	—33.23
Beef cattle—hogs—hay	+33.94	—32.48
Beef cattle—hogs—onions	—11.29	—35.35
Hogs—potatoes—onions	—10.07	—34.46
Beef cattle—hogs—potatoes	— 4.40	—25.31
Beef cattle—potatoes—onions	—11.90	—28.19
Hogs—potatoes—onions—hay	+21.02	—43.09
Beef cattle—hogs—onions—hay	+22.34	—42.48
Beef cattle—potatoes—onions—hay	+30.84	—38.48
Beef cattle—hogs—potatoes—hay	+30.88	—34.02
Beef cattle—hogs—potatoes—onions	—10.06	—34.46
Beef cattle—hogs—potatoes—onions—hay	+26.30	—40.62

¹ Percentage change from the original enterprise having the smallest variance.

² Percentage change from the original enterprise having the largest variance.

TABLE 7. VARIABILITY OF PRICE OF VARIOUS ENTERPRISE COMBINATIONS IN SOUTH CENTRAL OREGON AREA, OREGON, 1936-1956.

Enterprise combination	Variance	
	Smallest ¹	Largest ²
	<i>Percent</i>	<i>Percent</i>
Hay—barley	+ 4.24	—14.40
Potatoes—hay	+20.12	—30.70
Beef cattle—hay	+35.90	—31.50
Potatoes—barley	+11.79	—21.47
Beef cattle—barley	+20.00	—26.34
Beef cattle—potatoes	— 7.73	—19.37
Potatoes—hay—barley	+16.31	—32.90
Beef cattle—hay—barley	+24.99	—36.99
Beef cattle—potatoes—hay	+32.46	—33.23
Beef cattle—potatoes—barley	+16.37	—28.57
Beef cattle—potatoes—hay—barley	+26.43	—36.27

¹ Percentage change from the original enterprise having the smallest variance.

² Percentage change from the original enterprise having the largest variance.

TABLE 8. PERCENTAGE REDUCTION IN PRICE VARIABILITY OF VARIOUS ENTERPRISE COMBINATIONS FROM ORIGINAL ENTERPRISES.¹

Agricultural area	Enterprise combination	Reduction
		<i>Percent</i>
Willamette	Barley—eggs	4.86
Coast and Lower Columbia	Lambs—beef cattle	0.51
Southern Oregon	Milk—alsike clover seed	5.99
	Milk—eggs—alsike clover seed	5.42
	Eggs—alsike clover seed	12.91
Columbia Basin	Apples—prunes—cherries	1.56
	Prunes—cherries	0.18
	Apples—prunes	13.58
	Cherries—pears	0.35
Snake River	Onions—hogs	14.56
	Onions—beef cattle—hogs	11.29
	Onions—potatoes—hogs	10.07
	Onions—beef cattle— potatoes—hogs	10.06
	Onions—beef cattle—potatoes	11.90
	Onions—beef cattle	21.65
	Beef cattle—potatoes—hogs	4.40
	Beef cattle—potatoes	7.73
	Potatoes—hogs	8.32
South Central Oregon	Beef cattle—potatoes	7.73

¹ Percentage reduction is calculated from the original enterprise having the smallest variance.

APPENDIX TABLE 1.
CORRELATION COEFFICIENT OF PRICES BETWEEN ENTERPRISES, WILLAMETTE AREA, OREGON, 1936-1956.

	Milk	Beef cattle	Eggs	Hogs	Oats	Wheat	Barley	Straw- berries	Hairy vetch seed
Milk	1.0000	0.9096	0.9694	0.9351	0.9413	0.9751	0.9154	0.8086	0.8874
Beef cattle		1.0000	0.8734	0.8517	0.8902	0.8669	0.8504	0.7155	0.8436
Eggs			1.0000	0.9359	0.9430	0.9428	0.8933	0.8020	0.9705
Hogs				1.0000	0.9218	0.9416	0.8952	0.7577	0.8380
Oats					1.0000	0.9075	0.9755	0.8528	0.8861
Wheat						1.0000	0.9034	0.7872	0.8623
Barley							1.0000	0.8121	0.8379
Strawberries								1.0000	0.8135
Hairy vetch seed ..									1.0000

APPENDIX

APPENDIX TABLE 2. CORRELATION COEFFICIENT OF PRICES BETWEEN ENTERPRISES, COAST AND LOWER COLUMBIA AREA, OREGON, 1936-1956.

	Milk	Beef cattle	Lambs
Milk	1.0000	0.9096	0.9370
Beef cattle		1.0000	0.9874
Lambs			1.0000

APPENDIX TABLE 3. CORRELATION COEFFICIENT OF PRICES BETWEEN ENTERPRISES, SOUTH OREGON, OREGON, 1936-1956.

	Milk	Eggs	Lambs	Alsike clover seed
Milk	1.0000	0.9694	0.9370	0.6778
Eggs		1.0000	0.8941	0.6612
Lambs			1.0000	0.6985
Alsike clover seed				1.0000

APPENDIX TABLE 4. CORRELATION COEFFICIENT OF PRICES BETWEEN ENTERPRISES, COLUMBIA BASIN AREA, OREGON, 1936-1956.

	Beef cattle	Wheat	Barley	Apples	Pears	Cherries	Prunes
Beef cattle	1.0000	0.8669	0.8505	—	—	—	—
Wheat		1.0000	0.8941	—	—	—	—
Barley			1.0000	—	—	—	—
Apples				1.0000	0.9054	0.8384	0.6899
Pears					1.0000	0.8513	0.8134
Cherries						1.0000	0.8084
Prunes							1.0000

APPENDIX TABLE 5. CORRELATION COEFFICIENT OF PRICES BETWEEN ENTERPRISES, SNAKE RIVER AREA, OREGON, 1936-1956.

	Beef cattle	Hogs	Potatoes	Onions	Hay
Beef cattle	1.0000	0.8517	0.7229	0.5127	0.8705
Hogs		1.0000	0.7322	0.4463	0.8364
Potatoes			1.0000	0.8108	0.7867
Onions				1.0000	0.5712
Hay					1.0000

APPENDIX TABLE 6. CORRELATION COEFFICIENT OF PRICES BETWEEN ENTERPRISES, SOUTH CENTRAL OREGON AREA, OREGON, 1936-1956.

	Beef cattle	Potatoes	Hay	Barley
Beef cattle	1.0000	0.7229	0.8705	0.8505
Potatoes		1.0000	0.7867	0.8582
Hay			1.0000	0.8844
Barley				1.0000