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National farm legislation seeks to moderate the conditions of low farm incomes and commodity price instability. Homogeneity of producer response is generally assumed in national models of aggregate commodity supply. Differing conditions of soil, climate, production systems, costs of production, markets, etc., could cause disparate acreage responses to the commodity programs inter-structurally and/or inter-regionally. If national models of aggregate commodity supply are used as the basis for government policy decisions and if the impact of the farm bill on a given region is not the same as the aggregate impact on the United States, then national models are not appropriate for regional analysis.

The major aim of this research is to compare and evaluate the wheat acreage responses between production systems within Oregon and Washington and between this region and the estimated national average wheat acreage response. Oregon and Washington are disaggregated into five regions each on the basis of general similarity in soil, climate, substitute crops and production structures. First, the occurrence of different wheat production systems in these regions from 1966 to 1977 is measured and described. Secondly, regional acreage response models that allow differential inter-structural and inter-regional impacts of the major provisions for wheat price support and wheat acreage set-aside and diversion are developed. Parameters of three functions utilizing pooled time-series and cross-sectional data are estimated for each state--the first predicts the total acreage of wheat planted and the second and third predict the acreages of dryland and irrigated wheat planted, respectively. Government programs have little impact in Oregon, and only slightly more in Washington. The elasticity of acreage response with respect to market price differed from the national average in all cases but one. Finally, the implications of using the national acreage model influenced by the preponderance of red wheat grown in the Wheat Belt to predict the Northwest regional white wheat acreage response is addressed.

WHEAT ACREAGE RESPONSE IN OREGON AND WASHINGTON

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CHAPTER I

INTRODUCTION

Background

Conditions of low farm incomes and commodity price instability have long been motivating forces behind the development of national farm legislation. Major policy directives aimed at mitigating these problems have included programs with the goals of price stability, supply curtailment and price support. Policy makers consider the national implications when judging the effectiveness of a program. National models of aggregate commodity supply generally assume that all producers of a given commodity react similarly to the provisions in the government commodity programs. If national models of aggregate commodity supply are used as the basis for government policy decisions and if the impact of the farm bill on a given region is not the same as the aggregate impact on the United States, then national models are not appropriate for regional analysis.

The acreage responses of various wheat production systems to the many policy instruments may or may not correspond to the aggregated reaction of wheat producers as a whole. There are many suppositions as to why the inter-regional responses may be dissimilar. The local conditions of soil and climate could lead to regional discrepancies. As many varieties of wheat are grown in different regions of the country, wheat is not a totally homogeneous commodity.

Different regions of the country may produce the same commodity for different markets. One area may produce a given crop mostly for domestic consumption while another region may produce the same crop predominantly for export. Less expensive transportation costs attributed to geographic location may contribute to a distinct market for the production of a certain region. Differing demand and economic conditions in the diverse markets could potentially contribute to varied responses among producers in differing regions.

Inter- or intra-regionally, farms producing the same commodity, but organized along differing structural lines (i.e., utilizing different production methods), may or may not behave in the same manner when faced with the same commodity programs, nor may they have the same aspirations. As an example, a farm with high yields but low costs of production may be less inclined to participate in the programs. Differing rates of participation nationally would mean that the magnitude of payments to various regions would differ and, hence, that the program could potentially impact different regions in different manners. Costs of production differing from the national average specified as the basis for computing target prices in the 1977 farm bill could potentially contribute to differential impacts between regions or among structures within a region. It is questionable whether such a situation would correspond with the intent of farm bill legislation.

If a national model predicated on an erroneous assumption of homogeneity of producer response is utilized for regional analysis, then some of the ensuing regional impacts of the national policy decisions may be undetected and/or undesirable to the policy makers. For these reasons, it is important to take a closer look at regional acreage response to determine whether the intended impact on commodity price and supply is equivalent to the actual impact of the commodity programs when incorporating its inter-regional and inter-structural influences.

Study Objectives

1. To describe the extent of the occurrence of different wheat production systems (i.e., irrigated versus dryland production methods) within the Northwest states of Oregon and Washington.
2. To develop wheat acreage response models for Oregon and Washington that will allow for differential impacts of the national farm programs.
3. To compare and evaluate the wheat acreage responses between production systems within Oregon and Washington and between this region and the estimated national average wheat acreage response.

The Pacific Northwest states of Oregon and Washington provide an excellent opportunity to study the regional impacts of the national wheat policy mandated by the federal government.[1/] Wheat is of prime importance for farm incomes in these areas as it accounts for about one-half of all acreage planted.

1/ Idaho was not included because of the additional time and expense required for data collection.

A description of the occurrence of different structures of planted wheat acreage is made covering the years from 1966 to 1977. Wheat acreage is disaggregated by irrigated and dryland production methods. Data are presented on the magnitude of wheat production and the acreage planted within these divisions.

The major aim of this research is to determine the impacts of historical and current farm legislation on planted wheat acreage in Oregon and Washington. To do this, regional wheat acreage response models will be developed in a manner that allows for differential inter-structural and inter-regional impacts of the national farm programs. The government programs considered in the models developed for this research consist of the major provisions for wheat price support and wheat acreage set-aside and diversion.[2/] References to the impacts of the programs herein applies to the effects of these components of the legislation.

The discrepancies/similarities in wheat acreage response between production systems in this region and between this region and the national average will be determined and discussed. The implications of using the national model influenced by the preponderance of red wheat grown in the Wheat Belt to predict the Northwest regional white wheat acreage response is addressed. An attempt is made to identify the advantages/disadvantages this situation would imply for producers. Recommendations regarding alternatives at both the public and private decision-making levels which would eliminate or minimize the differential impacts (providing that differential impacts are found to exist) are extended.

[2/] A good review of national farm legislation is found in Cochrane and Ryan, American Farm Policy, 1948-1973. Summaries of the major programs will not be repeated here.

Chapter II summarizes the wheat production regions in Oregon and Washington. Brief discussions of the theory applicable to estimation of supply models of acreage response and of the measurement of the included variables is included in Chapter III. The model specification and functional form are also discussed. Chapter IV contains the empirical analysis. The summary and conclusions are in Chapter V.

CHAPTER II

WHEAT PRODUCTION AND THE WHEAT PRODUCING REGIONS IN OREGON AND WASHINGTON

The predominant class of wheat grown in Oregon and Washington is a soft white variety used primarily for unleavened bread, cakes, pastries, and noodles. Approximately 85 to 90 percent of the total quantity produced is exported every year. Part of the remaining wheat is milled domestically for flour and some is used as a feed for livestock in years of low market prices. The Pacific Northwest enjoys a comparative advantage in production plus shipping to the Pacific Rim countries because of geographical location as evidenced in reduced transportation time and reduced freight charges. Japan, South Korea, Iran and Pakistan were the largest importers of Pacific Northwest soft wheat during the 1977-1978 marketing year.

Oregon Wheat Production and Wheat Producing Regions

For the purposes of this study, the thirty-six counties in Oregon have been aggregated into five regions. The counties were grouped together in accordance with general similarities in wheat production (i.e., soil, climate, substitute crops and production methods). Admittedly, this entails some rough generalizations and glossing over of some of the intra-county variations to classify these areas as homogeneous producing regions. However, they do represent groups with broad similarities in production.

The acreage planted, the acreage harvested for grain and the production of wheat in bushels have been further disaggregated to account for different systems of wheat production. The acreage and production were first categorized as winter versus spring wheat. These two classes were then further subdivided on the basis of irrigated or dryland production systems. Dryland includes both rotation summer-fallow and after-legumes and continuous cropping. These classifications of wheat acreage and production are of varying importance in the five regions given the diverse local conditions found throughout the state.

At the state level, an average of 93 percent of all wheat acreage from 1966 to 1977 was planted to winter varieties while seven percent was planted to spring wheat. Dryland production methods are the most prevalent in the state accounting for 91 percent of all acreage planted to wheat from 1966 to 1977. Dryland wheat planted as a rotation crop constituted over three-fourths of all wheat planted in the state. Spring wheat accounted for five percent of dryland planted wheat acreage and two percent of irrigated planted wheat acreage.

The market price of wheat for the state from 1966 to 1977 reached its highest point of $4.65 per bushel in 1973 (Table 2-1). The lowest price ($1.28 per bushel) occurred in 1968. Statewide wheat acreage planted showed a response to the high market prices of 1973, 1974, and 1975, reaching a high in 1976 of 1,364,000 acres planted. The fewest acres were planted in 1970. The state average for all included years indicates that about 92 percent of all planted wheat acreage is harvested for grain. In general, this figure is higher for irrigated acreage. Wheat acreage receiving payments for participating in the government commodity programs for wheat reached a high in 1967, and there were no payments for current wheat production under the wheat price support programs in 1974, 1975 or 1976.

Table 2-1. Oregon Market Price of Wheat and Wheat Acreage Planted. a/

Year	Season Average Market Price of Wheat	Acres of Wheat Planted
	($/bu)	(1,000 acres)
1966	1.58	801
1967	1.42	1,063
1968	1.28	1,008
1969	1.31	815
1970	1.46	733
1971	1.43	805
1972	2.05	915
1973	4.65	1,114
1974	4.44	1,317
1975	3.78	1,301
1976	2.79	1,364
1977	2.65	1,278

a/ Sources for the data in all tables in Chapter II and III are listed in the appendix.

Wheat production in Oregon reached 60.3 million bushels of grain in 1976. The average from 1966 to 1977 was about forty million bushels annually. In general, most of the production comes from dryland methods. Sixty-four percent of the average total production was raised by dryland summer-fallow and after-legumes methods of which two percent were spring varieties. Dryland continuous cropping methods contributed 21 percent of total production with one percent of this amount from spring wheat. Irrigated acreage accounted for fifteen percent of total state production. Spring varieties made up 2.9 percent of irrigated production.

Brief discussions of the five Oregon wheat producing regions are presented below. Following this, participation in the government wheat programs by Oregon wheat producers will be addressed.

Willamette Valley

The Willamette Valley region is located in northwestern Oregon (Figure 2-1 and Table 2-2). Although no wheat production occurred in Clatsop, Tillamook, Lincoln or Hood River counties, they are included with the ten wheat producing counties to complete the data set. The Willamette Valley is second only to the Columbia Basin in terms of acreage of wheat planted and wheat production. Production increased 424 percent in this region from 1970 to 1977.

Total acreage of wheat planted followed the general state pattern reaching a low in 1970 and a high in 1977 (Table 2-3). The acreage planted to winter wheat has more than doubled from 1966 to 1977 while spring wheat has remained a minor portion of planted acreage. Both irrigated and dryland acreage have more than doubled over these years.

Figure 2-1. Map of the Five Oregon Wheat Producing Regions.

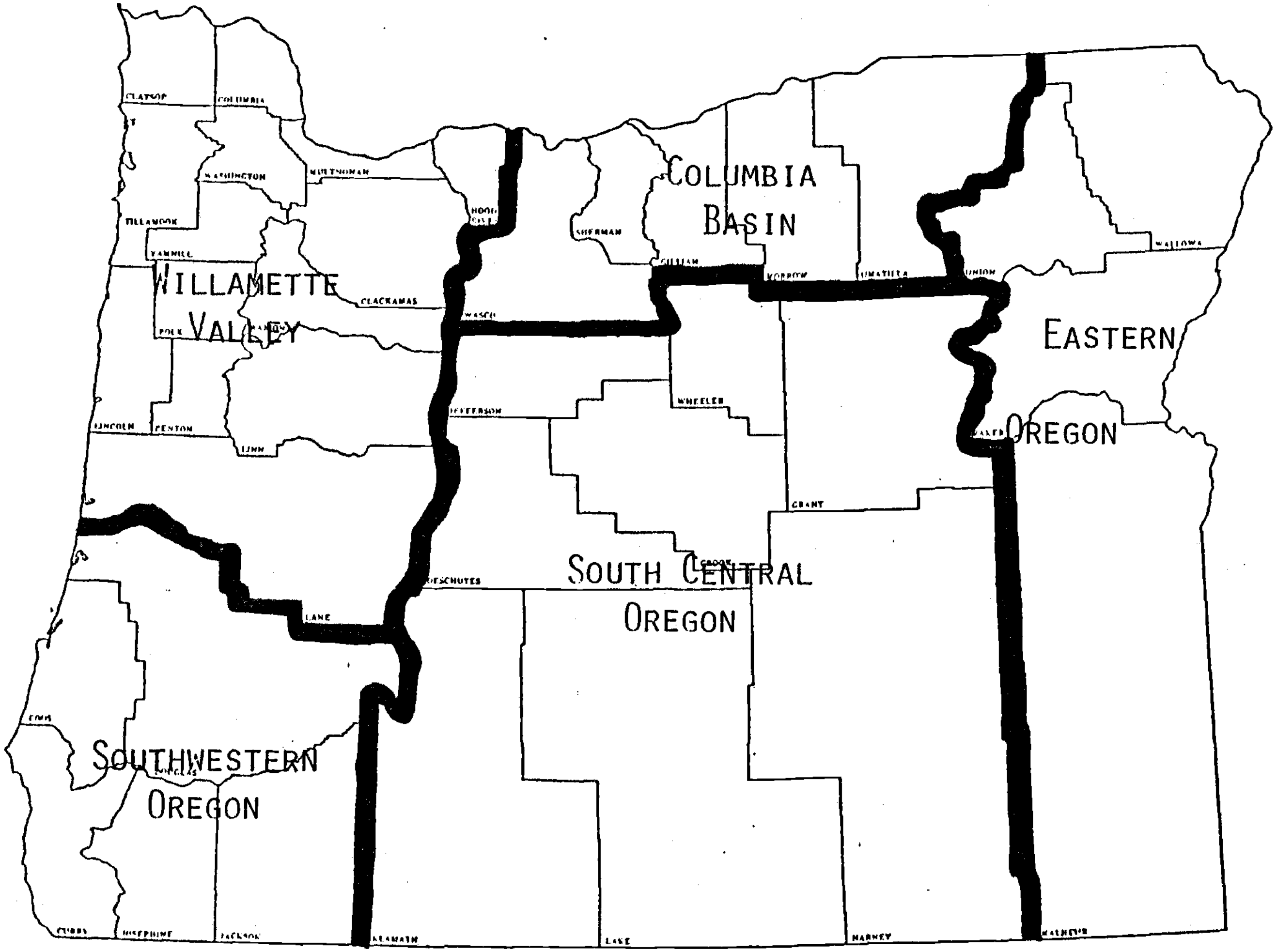

Table 2-2. Counties Comprising the Five Oregon Regions

REGION	COUNTIES
Willamette Valley (WV)	Columbia, Washington, Multnomah, Yamhill, Clackamas, Polk, Marion, Benton, Linn, Lane, Clatsop, Tillamook, Lincoln, Hood River
Columbia Basin (CB)	Umatilla, Morrow, Gilliam, Sherman, Wasco
Eastern Oregon (EO)	Wallowa, Union, Baker, Malheur
South Central Oregon (SC)	Jefferson, Wheeler, Grant, Crook, Deschutes, Klamath, Lake, Harney
Southwestern Oregon (SW)	Coos, Curry, Douglas, Josephine, Jackson

Table 2-3. Oregon Willamette Valley Wheat Acreage and Yields.

Year	Acreage of Wheat Planted (1,000 acres) Dryland	Acreage of Wheat Planted (1,000 acres) Irrigated	Yield (bu/acre) Dryland	Yield (bu/acre) Irrigated	Acreage of Wheat Planted (1,000acres) Winter	Acreage of Wheat Planted (1,000acres) Spring
1966	110	4	48	64	106	8
1967	150	4	43	62	148	6
1968	120	2	46	55	118	4
1969	82	3	52	55	78	8
1970	75	3	48	64	72	5
1971	94	2	55	65	81	15
1972	110	4	59	62	105	9
1973	167	6	71	80	162	11
1974	225	9	60	65	212	22
1975	225	8	62	71	211	21
1976	260	9	66	76	247	22
1977	257	10	67	74	254	13

Most of the wheat acreage is dryland winter wheat planted in rotation after legumes. There is still, however, a small percentage of wheat that is irrigated in the Willamette Valley. There has been a trend toward greater yields with the highest yields on both irrigated and dryland acreage occurring in 1973. As expected, irrigated yields are higher than dryland yields but in a good, rainy crop season, Willamette Valley dryland yields are close to the irrigated levels. The percentages of wheat production attributable to dryland and irrigated production systems within the region have been virtually constant since 1966.

The Willamette Valley accounts for about twenty-five percent of the total state production on average (Table 2-4). This region has increased in importance for wheat production from 1966 to 1977 while the regional percentage of planted wheat acreage has increased only slightly. In 1977, nearly forty percent of the state wheat crop was produced in this region. Regional production in that year exceeded 17.8 million bushels of wheat. The increase in regional yields is largely responsible for the increase in the proportion of state wheat production occurring in this region.

Columbia Basin

The Columbia Basin region is located in north central Oregon along the Columbia River (Figure 2-1). This is the major wheat producing region in the state of Oregon. It accounts for almost two-thirds of the state's total production.

Regional acreage of wheat planted reached an all-time high in 1976 (Table 2-5). Dryland agriculture is by far the most important wheat production system in the area. Nearly all of the dryland winter wheat acre-

Table 2-4. The Percentage of Oregon Wheat Production Attributed to the Five Subregions, 1966-1977

Year	Willamette Valley	Columbia Basin	Eastern Oregon	South Central Oregon	South-western Oregon
1966	21.4	60.9	10.9	6.7	0.2
1967	20.3	60.5	12.5	6.4	0.2
1968	19.2	59.6	13.9	6.7	0.5
1969	15.0	64.8	13.8	5.9	0.5
1970	14.1	68.5	12.9	4.1	0.3
1971	15.5	65.7	13.0	5.5	0.3
1972	18.4	66.1	11.5	3.9	0.2
1973	34.0	50.9	10.4	4.6	0.2
1974	26.8	56.1	11.6	5.4	0.1
1975	25.1	59.0	10.7	4.9	0.3
1976	29.7	56.8	8.6	4.4	0.5
1977	39.4	46.6	9.7	3.4	1.0

(Yearly totals may not sum to exactly 100 percent due to rounding error.)

Table 2-5. Oregon Columbia Basin Wheat Acreage and Yields

Year	Acreage of Wheat Planted (1,000 acres)		Yields (bu/acre)		Acreage of Wheat Planted (1,000 acres)	
	Dryland	Irrigated	Dryland	Irrigated	Winter	Spring
1966	551	6	28	42	537	20
1967	734	9	26	46	721	22
1968	719	11	24	60	720	11
1969	575	22	31	62	583	15
1970	514	19	34	57	523	10
1971	544	19	40	57	544	19
1972	650	21	36	60	658	13
1973	766	23	23	53	748	41
1974	827	53	31	73	786	94
1975	795	77	36	71	829	43
1976	801	83	35	77	838	47
1977	767	80	21	61	822	25

age is classified as summer-fallow and after-legumes acreage. With the exception of slight declines from 1969 to 1971, irrigated winter wheat acreage has climbed continuously from 1966 to 1971. The regional irrigated wheat acreage in 1977 was more than thirteen times the amount of irrigated acreage in 1966. Spring wheat is not very important in this region. Dryland yields have ranged from 21 bushels per acre in 1977 to 40 bushels per acre in 1971. There was a generally increasing trend of wheat yields on irrigated acreage through 1976. The percentage of regional wheat production from irrigated systems has been increasing from 1966 to 1977. This is caused by both increasing irrigated acreage and by the increasing yields on irrigated acreage.

Wheat production in the Columbia Basin exceeded 34 million bushels in both 1975 and 1976. This represented nearly sixty percent of the total wheat production in the state of Oregon (Table 2-4). While the percentage of state wheat acreage planted in this region has not changed much from 1966 to 1977, the percentage of Oregon wheat production attributable to this region has declined from a high in 1970 (nearly seventy percent) to 46.6 percent in 1977. This corresponds with the increasing percentage of state wheat production occurring in the Willamette Valley. Production in the Columbia Basin increased 220 percent from 1966 to 1976, but production in the Willamette Valley increased 328 percent. Much of the shift in the percentage of production from the Columbia Basin to the Willamette Valley is caused by the relatively greater increase in acreage and dryland yields in the Willamette Valley.

Eastern Oregon

The region defined as Eastern Oregon consists of four counties along the edge of eastern Oregon (Figure 2-1). From 1966 to 1977, this region has contained roughly ten percent of Oregon wheat acreage and production. Union County wheat production alone accounts for about one-half of the regional total acreage planted.

Wheat acreage planted in this region peaked in 1976 with production of just over five million bushels (Table 2-6). The least acreage planted occurred in 1966, the first year of the data set. Over three-fourths of the regional wheat acreage is planted to winter varieties annually. The acreage planted to spring varieties doubled between 1966 and 1971. Approximately two-thirds of the annual planted wheat acreage is classified as dryland production. There are no discernable trends in dryland yields. Irrigated yields display an increasing trend reaching their highest level in 1975.

Total wheat production in this region peaked at 6.2 million bushels in 1975. Production since 1973 is split with almost 50 percent from irrigated acreage. In 1966, dryland systems accounted for 60 percent of the regional production. The decrease in percentage of production from dryland systems is partially the result of relatively greater increases in irrigated yields.

South Central Oregon

The South Central Region consists of eight counties in south central Oregon (Figure 2-1). In general, this region has accounted for about five percent of Oregon wheat acreage and production.

Acreage of wheat planted in this region ranged from a high in 1974 (production of 2.8 million bushels) to a low in 1970 (1.1 million bushels).

Table 2-6. Eastern Oregon Wheat Acreage and Yields.

Year	Acreage of Wheat Planted (1,000 acres)		Yields (bu/acre)		Acreage of Wheat Planted (1,000 acres)	
	Dryland	Irrigated	Dryland	Irrigated	Winter	Spring
1966	52	24	32	48	66	9
1967	67	31	36	53	83	15
1968	68	25	39	56	86	7
1969	54	25	45	64	71	8
1970	57	21	39	58	70	8
1971	59	30	46	59	71	18
1972	60	23	47	63	68	14
1973	65	23	34	69	76	12
1974	76	46	44	60	99	23
1975	79	36	45	73	95	21
1976	87	39	29	67	102	25
1977	68	30	34	69	77	21

About two-thirds of the wheat acreage is planted to winter varieties annually (Table 2-7). Even though dryland wheat is more extensively planted, the number of bushels produced of irrigated wheat is greater. In 1977, dryland wheat constituted 63 percent of the regional acreage planted, whereas 71 percent of the regional production came from irrigated acreage. This is because of the much higher yields on irrigated acreage.

Unlike the Columbia Basin and the Eastern Oregon regions, the distribution of production between dryland and irrigated acreage in the South Central Region has remained relatively constant from 1966 to 1977. In 1966, irrigated acreage accounted for seventy percent of the regional production with thirty percent attributed to dryland methods. These percentages were the same in 1977. 1968 and 1969 present a deviation from this pattern. In these two years, production was divided just about equally between dryland and irrigated acreages.

Southwestern Oregon

The Southwestern region is the least important area in the state as far as acreage of wheat planted and wheat production are concerned. Less than one percent of the state total planted acreage and production occurs in this area. From 1966 to 1977, there was no wheat planted in either of the coastal counties of Coos or Curry.

Planted wheat acreage reached an all-time high in 1977 (Table 2-8). Production was under one-half million bushels. Winter wheat accounted for nearly all of the total acreage planted. The largest category of wheat planted in 1977 was dryland winter wheat. Most dryland winter

Table 2-7. South Central Oregon Wheat Acreage and Yields.

Year	Acreage of Wheat Planted (1,000 acres)		Yields (bu/acre)		Acreage of Wheat Planted (1,000 acres)	
	Dryland	Irrigated	Dryland	Irrigated	Winter	Spring
1966	32	22	16	55	36	17
1967	39	27	19	50	46	19
1968	38	21	25	50	48	10
1969	35	15	24	61	38	12
1970	25	16	14	46	33	9
1971	31	23	22	53	28	26
1972	29	17	17	55	28	18
1973	43	20	12	57	47	16
1974	43	37	19	54	45	35
1975	43	34	16	63	52	25
1976	48	31	15	64	53	26
1977	38	22	12	50	41	19

Table 2-8. Southwestern Oregon Wheat Acreage and Yields.

Year	Acreage of Wheat Planted (1,000 acres)		Yields (bu/acre)		Acreage of Wheat Planted (1,000 acres)	
	Dryland	Irrigated	Dryland	Irrigated	Winter	Spring
1966	1	*	34	53	1	*
1967	2	*	29	48	2	*
1968	4	*	34	57	4	*
1969	3	1	35	62	4	*
1970	2	*	30	56	3	*
1971	2	*	42	50	2	*
1972	2	*	27	65	2	*
1973	2	*	25	66	2	*
1974	2	*	34	70	2	*
1975	5	1	34	46	5	1
1976	5	1	54	71	5	1
1977	7	*	68	70	6	*

*less than 500 acres planted.

wheat acreage is classified as continuously cropped. Dryland wheat acreage has more than tripled since 1974 and the yield has doubled. Only a nominal amount of planted wheat acreage is irrigated annually.

Wheat in this region is increasingly produced by dryland methods. In 1966, 85 percent of the production was dryland. By 1977, 98 percent was by dryland methods.

Government Wheat Program Participation in Oregon

Participation in the government commodity programs by Oregon wheat producers has been variable both between regions and over time. Two measures were employed to compute the participation rate. First, measuring the extent of participation as the ratio of acreage on which the government made payments under the wheat programs to the acreage included in the allotment for a given region and year, Oregon's participation rate appears to be quite high for most regions. Using this measure, the wheat producers in the Columbia Basin register participation rates of 97 to 100 percent from 1966 to 1973, Eastern Oregon varies from 83 to 93 percent, South Central Oregon from 76 to 95 percent and the Willamette Valley increases continually from 54 to 92 percent. Only Southwestern Oregon registers participation rates below 50 percent for these years, but this region constitutes less than one percent of Oregon wheat production. In general, the five regions in Oregon display a trend of increasing participation from 1966 to 1973 utilizing this definition of participation. However, some of the increasing trend may reflect the decrease in regional allotments over these years (Appendix Table A-5).

Allotments were decreased significantly from 1970 to 1971 with the changing farm legislation, but remained relatively stable during each policy regime.

As an alternative measure of the participation rate, acreage participation was also computed as the ratio of the number of acres on which payments were made under the government wheat programs to the total acreage of wheat planted in each region. Table 2-9 contains the participation rate as a percentage of regional planted acreage. The Columbia Basin is illustrative of the changes this implies in the participation rate from 1966 to 1973. As a percentage of total acreage, the extent of participation decreased consistently throughout these years from a high of 91 percent in 1966 to just 25 percent in 1973. Some of this decrease in participation can be contributed to the increasing trend in wheat prices from 1969 to 1974. There is quite a discrepancy, however, between measuring 100 percent participation as a percentage of allotment and just 25 percent as a percentage of regional planted acreage in the Columbia Basin in 1973, as one example. This measure of participation indicates a decreasing trend rather than the increasing trend found under the first definition of participation. This would seem to imply that the government allotments at the regional level are quite rigid. Those farmers who had allotments participated in the government programs. This meant that the participating acreage just about equaled the allotment assigned to an area. However, it appears that more and more producers entered wheat production in the region over the years greatly expanding total wheat acreage planted. As a result of a time lag in obtaining an allotment, these producers were not eligible to participate in the government programs. The process of obtaining a government allotment can take several years.

Table 2-9. Government Wheat Program Participation Acreage in Oregon as a Percentage of Regional Acreage Planted, 1966-1977

Year	Willamette Valley	Columbia Basin	Eastern Oregon	South-Central Oregon	South-western Oregon
1966	44	91	99	89	30
1967	46	91	100	100	20
1968	53	80	94	97	8
1969	73	85	100	100	12
1970	70	84	88	100	12
1971	26	35	35	37	6
1972	22	30	38	45	8
1973	14	25	34	31	10
1974	0	0	0	0	0
1975	0	0	0	0	0
1976	0	0	0	0	0
1977	29	71	100	100	9

The significant decline in the participation rate as a percentage of total acreage planted may be attributed to several factors. These influences include increasing market prices of wheat, a decrease in the acreage eligible to participate in the wheat programs as a result of the legislated decrease in the allotment level from 1969 to 1971 and the incidence of more acreage and more farmers entering into wheat production in the region over the years. It would seem that measuring this rate as a percentage of total acreage planted in the region is more indicative of the current situation and of the real rate of participation among producers.

The trends in participation vary among the regions. Under the definition of participation as a percentage of total acres of wheat planted, the Willamette Valley, Eastern Oregon, and South Central Oregon register volatile but increasing rates of participation through 1969 with large decreases from 1970 to 1973. The participation rate as a percentage of total acreage planted is sometimes larger than the participation rate as a percentage of allotment. This occurs in Eastern Oregon and in South Central Oregon reflecting allotments based on historical wheat acreage that are greater than the total wheat acreage currently planted in these regions.

There were no government payments made for current wheat production in 1974, 1975 or 1976. This was the result of factors leading to greatly increased demand for wheat in these years and consequently much higher than normal market prices. With the resumption of lower prices in 1977, some producers signed up to participate in the government programs. The price movements of the previous years had caused some changes in the distribution of wheat acreage in the wheat producing regions. These dislocations showed up as generally higher rates of participation as a percentage of total wheat acreage planted in 1977 than the levels that had occurred prior to 1974. In 1977, the Willamette Valley doubled its 1974 participation rate while the Columbia Basin, Eastern Oregon and South Central Oregon tripled their 1974 rates of participation. Southwestern Oregon maintained about the same level of participation.

Washington Wheat Production and Wheat Producing Regions

The data for the 39 counties in Washington have been aggregated into five regions in the same manner as the Oregon data. These groups are designated based on general similarities in wheat production such as soil, climate, substitute crops and production methods.

From 1966 to 1977, an average of 88 percent of all wheat acreage in Washington has been planted to winter varieties annually. Dryland wheat production methods account for 92 percent of all wheat acreage planted in Washington; 8 percent is irrigated. The vast majority of the dryland wheat acreage is cropped by winter summer-fallow and after-legumes production methods. Spring varieties contributed 10 percent to the dryland total and two percent to the irrigated total.

The state market price of wheat reached $4.90 per bushel in 1973 (Table 2-10). The lowest price from 1966 to 1977 occurred in 1969 ($1.29). In the following year, 2,260,200 acres were planted to wheat in the state. This was the least acreage planted to wheat during the period from 1966 through 1977. Responding to the high market prices of 1973, 1974 and 1975, the acreage planted of wheat in the state reached a record level in 1976.

Table 2-10. Washington Market Price of Wheat and Wheat Acreage Planted.

Year	Season Average Market Price of Wheat $/bu	Acres of Wheat Planted (1,000 acres)
1966	1.56	2,406
1967	1.43	2,924
1968	1.30	2,775
1969	1.29	2,564
1970	1.48	2,260
1971	1.34	2,379
1972	2.20	2,697
1973	4.90	2,819
1974	4.20	3,167
1975	3.85	3,155
1976	2.85	3,275
1977		3,107

The average annual acreage planted was 2.8 million acres.

Production of wheat totaled over 144 million bushels in 1976. The annual average production from 1966 to 1977 was about 110 million bushels. Most of this wheat, 85 percent, was produced by dryland methods. While irrigated wheat accounted for the remaining 15 percent of production, just 8 percent of all planted wheat acreage was irrigated.

Brief discussions of the five Washington production regions are presented below.

Southeastern Washington

The Southeastern Washington region consisting of the six counties in the corner of the state is the major wheat producing region in the state (Figure 2-2 and Table 2-11). It accounts for between 40 and 45 percent of planted wheat acreage and for between 43 and 56 percent of wheat production in Washington for each year from 1966 to 1977 (Table 2-12).

The acreage of wheat planted in this region followed the general state pattern reaching a low in 1971 and a high in 1976 (Table 2-13). Prior to 1973, only one to two percent of the wheat acreage was planted with spring varieties. Much more spring wheat was planted from 1973 to 1976, but this acreage dropped to historical levels in 1977. Dryland wheat acreage accounts for nearly all of the planted acreage every year. The amount of irrigated wheat acreage displays an increasing trend particularly since 1972, but it still accounts for just a minor percentage of all wheat planted. Virtually none of the irrigated land is planted to spring varieties.

The southeastern region accounted for over 50 percent of Washington

Figure 2-2. Map of the Five Washington Wheat Producing Regions.

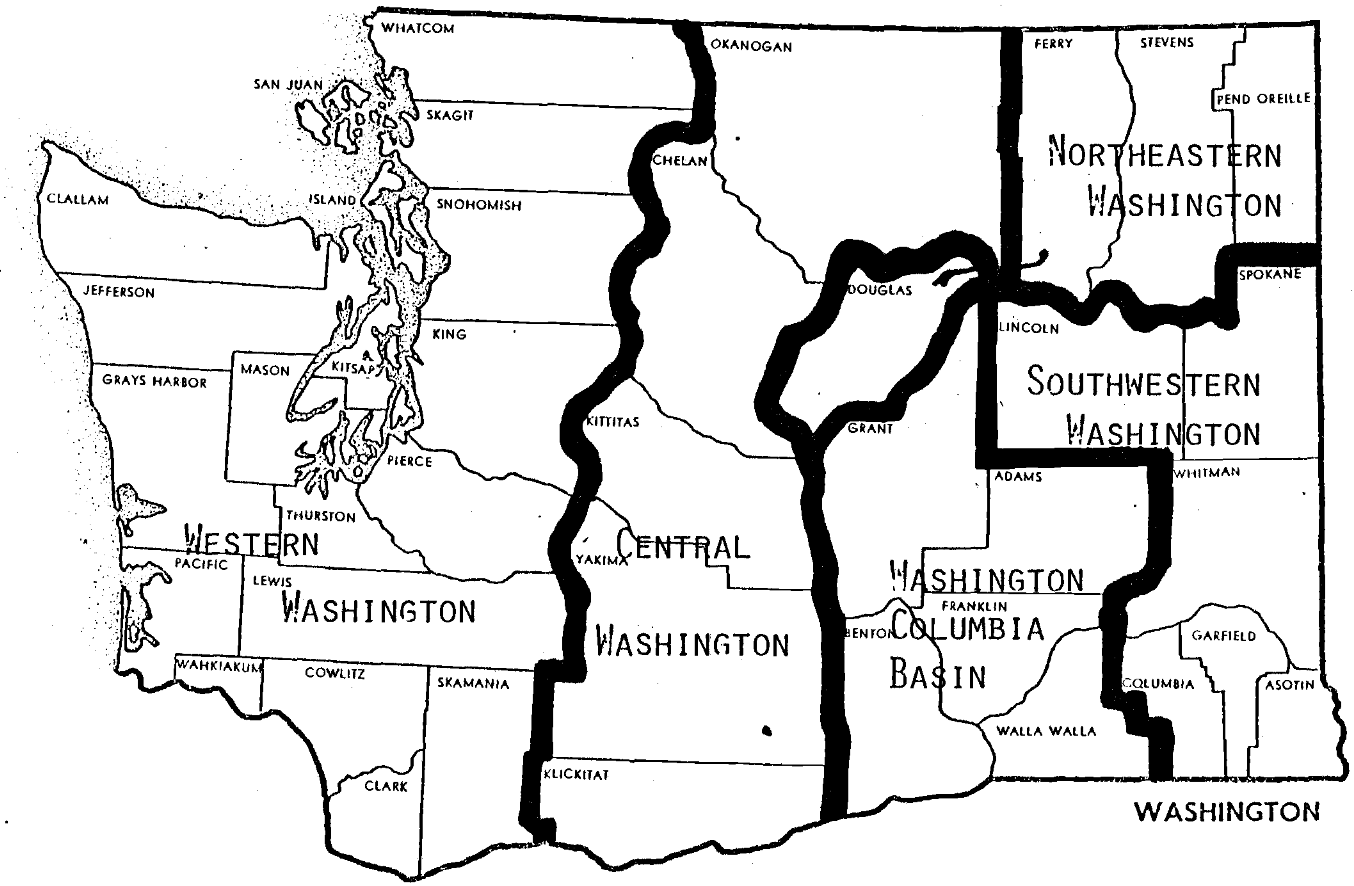

Table 2-11. Counties Comprising the Five Washington Regions

REGION	COUNTIES
Southeastern Washington (SEW)	Spokane, Lincoln, Whitman, Garfield, Columbia, Asotin
Washington Columbia Basin (WCB)	Benton, Walla Walla, Franklin, Adams, Grant
Central Washington (CNW)	Klicitat, Yakima, Kittitas, Cheland, Okanogan
Northeastern Washington (NEW)	Ferry, Stevens, Pend Oreille, Douglas
Western Washington (WWW)	Clallam, Clark, Cowlitz, Grays Harbor, Island, Jefferson, King, Kitsap, Lewis, Mason, Pacific, Pierce, San Juan, Skagit, Skamania, Snohomish, Thurston, Wahkiakum, Whatcom

Table 2-12. The Percentage of Washington Wheat Production Attributed to the Five Subregions, 1966-1977

Year	South-eastern Washington	Washington Columbia Basin	Central Washington	North-eastern Washington	Western Washington
1966	51.1	37.2	4.6	6.9	0.2
1967	49.2	37.0	5.2	8.5	0.1
1968	49.4	38.8	4.7	6.9	0.2
1969	56.1	32.7	3.8	7.3	0.2
1970	53.9	36.4	3.6	5.9	0.2
1971	49.5	39.2	4.3	6.8	0.2
1972	43.5	34.5	4.2	7.7	0.2
1973	44.8	41.7	5.6	7.1	0.8
1974	47.3	40.3	6.2	5.4	0.8
1975	43.2	42.8	7.3	6.0	0.7
1976	43.7	42.7	7.1	5.8	0.8
1977	43.9	43.9	4.8	6.2	1.2

(Yearly totals may not sum to exactly 100 percent due to rounding error.)

Table 2-13. Southeastern Washington Wheat Acreage and Yields.

Year	Acreage of Wheat Planted (1,000 acres)		Yield (bu/acre)		Acreage of Wheat Planted (1,000 acres)	
	Dryland	Irrigated	Dryland	Irrigated	Winter	Spring
1966	1007	13	44	76	1006	14
1967	1212	20	45	69	1201	30
1968	1153	22	43	65	1165	10
1969	1053	32	45	63	1056	28
1970	962	16	51	71	972	6
1971	952	13	58	79	942	23
1972	1193	13	55	71	1201	5
1973	1177	23	33	63	858	343
1974	1334	27	42	63	1116	246
1975	1320	27	47	61	1196	152
1976	1328	46	45	68	1250	144
1977	1203	55	33	76	1233	25

state production in 1966 (Table 2-12). In 1977, 44 percent of state wheat production was attributable to this region. Production in 1966 and 1977 was about the same magnitude (about 45 million bushels). Total regional production peaked at a record level of nearly 66 million bushels in 1972 although production in both 1975 and 1976 exceeded 60 million bushels of wheat. 1973 had the lowest production of just under 40 million bushels of wheat. The lower production can be attributed, in part, to the reduced yields experienced that year. There were no definite trends in either irrigated or dryland yields.

Washington Columbia Basin

The Columbia Basin region in Washington is defined as five counties north of the Columbia River in eastern Washington (Figure 2-2). This region is second only to Southeastern Washington in terms of quantity of wheat produced for most of the years included in the data set. In 1977, production in this region equaled that of Southeastern Washington. Both regions had 43.9 percent of that years' production.

This region had from 41 to 45 percent of Washington planted wheat acreage. The regional planted acreage of wheat reached a high in 1976 and a low in 1970 (Table 2-14). Most of the wheat acreage is planted to winter varieties. While the number of planted wheat acres classified as dryland has increased from 1966 to 1977, dryland acreage as a percentage of total acreage has decreased from 90 to 79 percent. Irrigated planted wheat acreage has increased both nominally and relatively. About three-fourths of the dryland acreage is cropped by summer-fallow and after-legumes production methods.

Table 2-14. Washington Columbia Basin Wheat Acreage and Yield

Year	Acreage of Wheat Planted (1,000 acres)		Yield (bu/acre)		Acreage of Wheat Planted (1,000 acres)	
	Dryland	Irrigated	Dryland	Irrigated	Winter	Spring
1966	926	105	27	80	999	32
1967	1070	160	29	68	1160	70
1968	1001	180	26	77	1157	25
1969	948	126	22	65	921	152
1970	841	98	32	70	886	54
1971	950	98	39	76	963	84
1972	979	123	35	70	1036	65
1973	1039	141	26	73	927	252
1974	1106	206	32	71	1197	115
1975	1068	231	43	75	1201	98
1976	1122	272	37	75	1279	115
1977	1108	276	23	70	1244	139

Production in the Washington Columbia Basin consituted from 36 to 44 percent of state production. This percentage has trended upwards over time reflecting increased irrigation with accompanying higher yields. The 43.9 percent of state production in 1977 represents 44.5 million bushels of wheat. Dryland production has decreased as a percentage of regional production from 1966 to 1977. This may have been caused partially by the decrease in irrigated yields between 1966 and 1977. Dryland yields have been variable but show no distinct trends.

Central Washington

The Central Washington region consists of five counties located along a north-south line through central Washington (Figure 2-2). This area contributes less than seven percent of the annual state totals of planted wheat acreage and wheat production.

Planted wheat acreage has varied from a low in 1966 to a high in 1975 (Table 2-15). Most of the regional wheat acreage is cropped by dryland methods. Dryland summer-fallow and after-legumes production methods are the most common in this region. The percentage of wheat planted on irrigated acreage is the highest in this region of any of the five regions in Washington. The 1977 planted acreage classified as irrigated constituted nearly thirty percent of the total. Irrigated planted acreage increased substantially since 1970 reaching its highest level in 1976.

Central Washington wheat production represents less than seven percent of the state total. Regional production exceeded ten million bushels in 1975 and 1976. The 1977 production was raised predominantly on irrigated acreage. The irrigated production exceeded the dryland production

Table 2-15. Central Washington Wheat Acreage and Yield

Year	Acreage of Wheat Planted (1,000 acres)		Yield (bu/acre)		Acreage of Wheat Planted (1,000 acres)	
	Dryland	Irrigated	Dryland	Irrigated	Winter	Spring
1966	95	22	27	72	98	19
1967	132	36	26	70	140	28
1968	138	26	21	77	140	24
1969	111	20	19	63	121	10
1970	101	20	20	67	112	10
1971	104	22	31	75	111	15
1972	112	22	32	73	121	13
1973	125	27	24	76	140	13
1974	127	65	25	70	161	31
1975	160	74	32	77	193	42
1976	145	84	28	73	181	48
1977	116	50	16	62	140	24

even with fewer acres because of the substantially greater yields on irrigated acreage.

Northeastern Washington

Four counties in the corner of the state are defined as the Northeastern Washington region (Figure 2-2). Together they represent less than 10 percent of the state wheat production.

From 1966 to 1977, the percentage of state planted wheat acreage attributable to this region varied from 8 to 10 percent. Very little of the regional acreage is planted to spring varieties of wheat (Table 2-16). Even less of the planted wheat acreage is irrigated. Nearly all of the 1977 acreage planted to wheat is classified as dryland summer-fallow and after-legumes production acreage. Wheat acreage has increased only slightly in this region from 1966 to 1977 compared to the rest of the state.

Production in this region has varied from 5.5 to 9.6 million bushels. Dryland and irrigated yields were about the same in 1977 as they were in 1966.

Western Washington

The 19 counties defined as Western Washington are rather inconsequential as far as wheat production is concerned. From 1966 to 1977, the regional planted wheat acreage has never exceeded one percent of the state total.

The regional planted wheat acreage was less than 5000 acres from 1966 to 1972 (Table 2-17). Since 1973, this acreage has increased continually.

Table 2-16. Northeastern Washington Wheat Acreage and Yield

Year	Acreage of Wheat Planted (1,000 acres)		Yield (bu/acre)		Acreage of Wheat Planted (1,000 acres)	
	Dryland	Irrigated	Dryland	Irrigated	Winter	Spring
1966	232	2	26	58	181	52
1967	286	4	33	60	244	46
1968	249	1	28	63	230	21
1969	269	1	24	59	251	19
1970	217	2	25	68	181	38
1971	236	2	32	71	194	43
1972	251	2	37	60	211	41
1973	276	2	23	54	271	7
1974	281	3	23	49	196	87
1975	257	2	34	57	223	36
1976	254	3	32	56	248	10
1977	276	3	22	59	274	5

Table 2-17. Western Washington Wheat Acreage and Yield

Year	Acreage of Wheat Planted (1,000 acres)		Yield (bu/acre)		Acreage of Wheat Planted (1,000 acres)	
	Dryland	Irrigated	Dryland	Irrigated	Winter	Spring
1966	4	0	40	0	4	1
1967	4	0	39	0	3	1
1968	5	0	40	0	4	1
1969	4	0	38	0	3	1
1970	3	0	46	0	3	1
1971	4	0	50	0	3	1
1972	4	0	52	0	3	0
1973	10	0	73	0	9	1
1974	17	0	57	0	17	1
1975	16	0	64	0	14	2
1976	21	0	56	0	13	8
1977	24	0	52	0	16	7

No wheat acreage is irrigated in this region. All dryland acreage is continuously cropped. The percentage planted to spring varieties has increased from 1974 to 1977. Dryland yields have generally increased since 1969.

Government Wheat Program Participation in Washington

Participation in the government wheat programs appears to be very high for most regions in Washington when participation is defined as the percentage of regional allotment on which payments under the wheat programs were made. Using this measure, participation varies for the years 1966 to 1973 from 94 to 99 percent in Southeastern Washington, from 93 to 99 percent in the Columbia Basin and Northwestern Washington and from 78 to 95 percent in Central Washington. As in Oregon, the least important wheat region shows the greatest increase in participation over these years (37 to 77 percent in Western Washington) although all five regions display an increasing trend in participation.

As discussed earlier, the participation rate computed as a percentage of regional acreage planted appears to be a more realistic indicator of the current situation for participation rates by all producers. Utilizing this alternative measure, the regional participation rates decline significantly between 1966 and 1973 with most of the decrease occurring from 1970 to 1971 (Table 2-18). This corresponds with a decrease in the legislated allotment level which allowed fewer acres to be eligible for participation. More acreage entering production as the market price trended upwards from 1970 to 1974 contributed to the decline in participation rates. There was a slight increase from 1966 to 1967, but generally all regions displayed continuously decreasing participation rates

Table 2-18. Government Wheat Program Participation Acreage in Washington as a Percentage of Regional Acreage Planted, 1966-1977

Year	Southeastern Washington	Washington Columbia Basin	Central Washington	Northeastern Washington	Western Washington
1966	73	63	74	69	52
1967	83	72	69	74	74
1968	76	65	65	71	56
1969	71	63	74	60	63
1970	70	63	72	66	59
1971	32	25	31	27	24
1972	26	25	30	26	24
1973	25	22	25	23	9
1974	0	0	0	0	0
1975	0	0	0	0	0
1976	0	0	0	0	0
1977	67	63	69	77	12

thereafter. In 1966, Southeastern Washington, the Columbia Basin, Central Washington and Northeastern Washington all registered rates near 75 percent whereas in 1973, these same regions had participation rates only one-third as large. Western Washington had a 52 percent rate in 1966, 74 percent in 1967 and had fallen to just 9 percent in 1973. As in Oregon, measuring participation as a percentage of regional acreage planted rather than as a percentage of allotment reveals a strong decreasing trend in participation over the years from 1967 to 1973 compared to the very high participation rates and the increasing trend implied by the use of government allotments as the base acreage for computing participation. The percentage of regional planted acreage is the more realistic measure as it incorporates the participation decisions made by all producers not just those with designated allotments who were eligible to participate.

No payments were made under the government wheat programs for current production in 1974, 1975, or 1976. This was probably caused by market prices for wheat much greater than the announced support levels. Participation in 1977 for all of Washington excluding the Western region is around 70 percent of all regional acreage planted. This is nearly three times as high as the 1973 levels. These substantial changes could reflect a change in the government programs and the magnitude of the market price decline for wheat producers in these areas. Wheat acreage had been expanded based on the high market prices of 1974 to 1976. Western Washington maintained a low rate of twelve percent in 1977 that was similar to its 1973 level of 9 percent.

CHAPTER III

APPLICABLE THEORY, VARIABLE MEASUREMENT AND ESTIMATION TECHNIQUE

Applicable Theory and Variable Measurement

Economic theory suggests that commodity supply is a function of commodity price, prices of substitute crops, government programs, prices of the variable inputs, weather, the levels of technology and fixed inputs and the magnitude of risk. Government programs are included because they are a major market influence interacting with the forces determining both commodity price and the farmer's subjective expectations of price.

Commodity Price

Farmers must base production decisions on subjective expectations of future commodity price. The planting decision must be made several months before the producer knows with certainty what price he will receive for his crop. There are many hypotheses as to how these expectations are formulated. Houck et al. used the naive price expectations model which assumes the price a producer expects to receive for his crop in year t is the price he recieved in year t-1. Hence, market price is lagged one year to correspond with the timing of the wheat producer's planting decision. Gardner hypothesized that the price of a futures contract for next year's crop reflects the market's estimate of next year's cash price. However, in the case of cotton acreage response, it was found that the futures price and the lagged cash price seem to be good substitutes. Just hypothesized that expectations are based on geometrically lagged state variables including prices. This study will utilize the lagged market price of wheat as a measure of the price expectations of producers at planting time. Regional wheat prices for the Oregon regions are calculated by summing the weighted county market prices of wheat for all counties comprising each region. Each county price was weighted by the proportion of regional planted wheat acreage occurring in that county. Since only state prices were available in Washington, all regional prices equal the state price. The sign of the estimated coefficient for expected price is anticipated to be positive. Increases in the lagged market price of wheat are assumed to elicit corresponding increases in planted wheat acreage.

Prices of Substitutes

Economic theory suggests the price of substitute crops should be included in the model. At the national level, Lidman and Bawden found that there are no economically viable substitutes for wheat given favorable weather (i.e., if weather allows at fall planting time, wheat is planted; if not, the producer will wait until spring and plant a different crop). Hoffman included the price of cotton as a substitute for wheat in his national model, but concluded this was only significant in the Southern plains area, particularly Texas. However, the conclusion of no substitutes for wheat derived from the development of national supply models does not imply no alternatives exist at the regional level. In the Northwest, Winter and Whittaker found that barley was not a significant economic substitute for wheat production when aggregating the data by states (including Oregon, Washington, and Idaho). Disaggregating acreage response both by region and by production system, there may be some crop(s) determined to be an important substitute for wheat production in Oregon and/or Washington. Barley will be hypothesized as a possible substitute in the dryland areas of Oregon and alfalfa and potatoes will be considered in the higher rainfall and irrigated areas. Grass seeds, horticultural truck crops, red clover and barley are likely alternatives in the western valley region of Oregon.[3/] In Washington, barley and peas are hypothesized to be substitutes to wheat production in the dryland areas, and sugar beets and alfalfa are potential economic alternatives on irrigated acreage. Sugar beets may no longer be a viable alternative in Washinton because of the closing of a processing plant (1978).

Regional prices for the hypothesized substitutes in Oregon were computed by a simple average of the county season average prices received by farmers in the counties comprising each region. Only those counties that had planted acreage in the substitute commodity were included (i.e., if there was no production of the substitute commodity in a county, that county price was assumed to be zero). State season average prices will be utilized in Washington as these were the only prices available.

Since the decision whether to produce wheat or some alternative must be made at planting time, the prices of the hypothesized substitute crops were lagged one year to correspond with the producer's decision.

[3/] Peas and other vegetable crops are also possible alternatives in western Oregon. From conversations with county agents, these crops were not included as economic substitutes to wheat production. Vegetable crops are usually contract grown.

These lagged prices are assumed to be proxy variables for producers' price expectations for these alternatives to wheat. The estimated coefficients on the substitute crop variables are expected to be negative. This means that an increase in the price of an alternative commodity will cause a decrease in the acreage planted to wheat, all else held equal, as land is transferred from wheat production into production of the substitute crop.

Government Programs

Two major provisions for wheat, price support to guarantee farm income and diversion of wheat acreage to curtail supply, will be considered in this study. An effective support price will be constructed following the reasoning of Houck et al.[4/] This measure, based on the announced support payment schedule, is assumed to reflect the price that a farmer would expect to receive for this crop when participating in the government programs. Hence, the support price affects the producer's price expectations. It acts as a guaranteed minimum price.

Participation necessarily entails compliance with all provisions (i.e., including diversions or set-asides as well as other acreage restrictions such as cross-compliance) as written into the farm bill applicable for that year for the commodity in question. The effective support price variable is a composite of the announced support price weighted by any acreage restrictions that were in effect in that year plus the direct payment rate (if applicable) weighted by the qualifying acreage.

[4/] For a more detailed explanation of the formulation of the effective support rate, see Houck et al., Analyzing the Impact of Government Programs on Crop Acreage, pp 31-35.

Houck computed his effective support rate as follows:[5/]

$$PFW = \left(\frac{A_a' - RD + CP}{A_o}\right)(PSW) + \left(\frac{A_d}{A_o}\right)(PDW)$$

where PFW = Effective support for wheat, dollars per bushel

A_a' = Acreage allotment (total) adjusted for diversion and small farm adjustment; acres

A_d = Acreage allotment (domestic); acres

A_o = Base acres

RD = Required annual diversion from adjusted allotment; acres

CP = Feed grain base available for cross-planting substitution; acres

PSW = Announced loan rate for wheat, dollars per bushel

PDW = Direct payment rate, dollars per bushel.

For the purposes of this study, the county loan rates will be aggregated into regional loan rates. The regional loan rate will be computed by summing for each region the county loan rates weighted by the acreage of wheat planted in that county and dividing this total by the sum of the acreage planted for the region. The national announced loan rate for wheat in the effective support rate variable formulation by Houck et al. will be replaced by this regional loan rate. The result is a regional effective support rate. The sign on the estimated coefficient is expected to be positive. This means that an increase in the effective support rate, ceteris paribus, will elicit an increase in the acreage planted to wheat.

Houck et al.'s formulation of the effective support rate is recognized to have some drawbacks. Danin points out that this variable should depend not only on the relative level of the support price and acreage restrictions, but also on the absolute level of the support price. In addition, there are many aspects of the government programs that are difficult to quantify. For example, many of the compliance provisions impose acreage restrictions on several crops simultaneously in order to be in accordance with the wheat program. Houck made an attempt to account for some of the major cross-compliance structures. Whether this was done adequately is beyond the scope of this paper. Just and Lidman and Bawden suggest alternative formulations for the government policy variables. Since, however, the formulation of the effective support rate developed by Houck et al. is the most common in the literature, this formulation will be used in this study to quantify the government provisions for wheat price support.

A separate variable will be included in the model to account for the voluntary diversion provisions over and above the diversion required for compliance with the commodity program. Compliance in this instance refers to meeting the provisions necessary to qualify for support or deficiency payments. The additional diversion provision stipulates a cash payment for acreage voluntarily diverted from wheat production in addition to the diversion required of a producer participating in the government programs. In other words, the participation of the producer in the government wheat programs served as a prerequisite for qualifying for collection of payment from voluntary wheat acreage diversion. In general, this payment was not at the same rate as that for required diversion. It was usually much lower.

As before, since the formulation of the effective diversion payment by Houck et al. is the most common in the literature, this quantification of the government diversion provisions will be used in this study.[6/] Houck computed the effective voluntary diversion payment for wheat as follows:

$$DPW = \left(\frac{A_a (PAD)}{A_o} \right) (DPR)\ (PNY)$$

where DPW = Effective voluntary diversion payment for wheat, dollars per bushel

A_a = Acreage allotment; acres

A_o = Base acres

PAD = Permitted additional diversion, proportion of allotment

DPR = Payment rate for diversion, dollars per bushel

PNY = Proportion of normal yield on which DPR is paid.

Wheat acreage diversion functions as an alternative to wheat production. Land that can be used for wheat production can also be used for wheat diversion in the same manner that a producer can decide to plant acreage to wheat or to potatoes. As the diversion payment rate was not available at the regional level, Houck _et al_.'s quantification using the national announced payment rate was assumed to also represent the regional payment rate. The sign on this estimated coefficient is expected to be negative just as the sign on the price of any substitute

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[6/] Just suggests an alternative variable formulation for government programs which incorporates a vector of subsidies and taxes announced before planting decisions are made, another vector for subsidies and taxes not known until after the planting decisions were made, a binary allotment indicator multiplied by the respective rate of participation (defined as the acreage on participating farms divided by the total allotment), a vector of the allotment levels multiplied by the respective rate of participation, a vector of price support levels times the respective rate of participation and a variable measuring the acreage diverted under the government program for crop j (pp 442-449).

commodity is expected to be negative. This means that an increase in the effective payment rate for wheat diversion will induce fewer acres to be planted to wheat, all else held equal.

Prices of Variable Inputs

The variable input bundle used in wheat production is not unique in the sense of either items or quantity. The variable inputs used are standard inputs applied in a rather standard manner and quantity in the production of most crops, particuarly those that might compete with wheat. Therefore, changes in the absolute level of the prices of these inputs does not significantly change the relative cost of wheat production as compared to the cost of producing other crops, such as barley, i.e., any increase in the cost of the variable input bundle also applies to the production of alternative crops. Consequently, input prices are not included in most wheat supply models. Following this precedent, variable input prices will not be included in this study of wheat acreage. It will be assumed that the prices of the variable inputs are the same throughout the region and that any changes in the costs of the variable inputs affects the production of wheat and the production of alternatives to wheat in a similar manner as long as it is still profitable to produce.

Weather

Weather is often included in supply models. In a national acreage model, Houck et al. included an index of range conditions in the Southern Plains Region as a proxy variable for weather conditions at the time wheat is planted. The analysis by Houck et al. found that the Southern

Plains was the only region where the effect of weather on planted wheat acreage was significant. Since this study deals with the Northwest states of Oregon and Washington disaggregated into homogeneous production regions by soil and climate, no variables to explicitly measure the effects of weather are included. It is assumed that any subregional differences in weather conditions among these areas is minimal.

Technology

Many researchers have used linear or logarithmic time trends as proxy variables to account for the increases in production attributable to technological advances. Tomek and Robinson point out that the use of simple time trends in empirical supply analysis is because of the definitional and measurement problems involved in measuring technological improvements. Time trends are utilized as a measure of technological advances without specifically identifying and measuring those factors responsible for the shifts in supply. It is often unclear what the time trends actually measure.

Winter and Whittaker tried using both linear and logarithmic time trends. Neither of these measures was found to be significant in a Northwest wheat supply model based on pooled cross-sectional and time-series data aggregated by states. Pooling the data reduces the number of years for which observations are necessary for reliable estimation of the coefficients. Shortening the time span under study appears to make it unnecessary to incorporate a time trend into the model to account for technological changes. It is also assumed that the impact of technological innovations has been much greater on yields than on acreage. Since this study will estimate an acreage response model based on pooled time-series observations from twelve recent years, no measure of technological change will be included.

Risk

Risk is hypothesized to affect the planting decisions made by producers. A variable to explicitly measure the effects of risk was incorporated into the model following the previous quantification utilized by Lin. Risk was computed as a moving average based on the previous three years of the standard deviation of gross income per acre for each region. This is a measure of the variability of gross income per acre. Other authors have used various geometric and polynomial lags to weight the relative importance of past values on current price expectations. Just assumed that decision makers formed their expectations following a geometric lag of the square of the difference between the explanatory variables and their expected values. Traill hypothesized a polynomial lag of the absolute difference between the actual prices and their expected values. Robison and Carman suggest a risk formulation in an aggregate supply function of the log of the variance of expected wealth. Lin's risk formulation was chosen because of the availability of data necessary to compute the variable.

Gross income per acre is defined as the regional weighted price of wheat multiplied by the regional yield of wheat. Gross income will be computed three times utilizing the average regional yields, the regional yield on irrigated acreage and the regional yield on dryland acreage. These three gross incomes per acre will then be used to compute the risk variable for all planted acreage and separately for irrigated and dryland acreage. The latter will be used to test the hypothesis that producers react differently to risk depending on the production system as well as between regions.

The risk variable as formulated by Lin is computed as follows:

$$RISK_t = \sqrt{\sum_{i=1}^{3} \frac{(GI_{(t-i)} - \overline{GI})^2}{2}}$$

where GI = gross income per acre, $\overline{GI}$ = the mean gross income for the previous three years, and t = year. This formula respresents a moving average of the standard deviation of gross income per acre based on the previous three years. The risk variable is computed to correspond with the producers knowledge at planting time of price and yield variability over the previous three years. The sign of the estimated coefficient is expected to be negative, i.e., producers are assumed to be risk averse. An increase in the volatility of gross income per acre derived from wheat production is expected to reduce the acreage planted to wheat, ceteris paribus. This implies that economic uncertainty induces producers to decrease wheat acreage and, hence, to diversify assuming that the idled wheat land is utilized in the production of another commodity (including diversion). A positive sign on this estimated coefficient would indicate a risk taker.

Estimation Technique

The parameters of the acreage response models developed in this study were estimated using pooled cross-sectional and time-series data. The time-series observations begin in 1966 and cover the next twelve years to 1977. The year 1966 was designated as the starting point because of the availability of data. The cross-sectional units have been described in Chapter II.

The major advantage of pooling the data is that it allows for several potentially different populations (i.e., structures) to be combined within one sample while allowing these groups to display different behavioral patterns. Specifically, it allows the estimated coefficients on the independent variables to differ between the defined cross-sectional units. The importance and magnitude of the effects estimated will differ. This relaxes the assumption of constant elasticities throughout the entire region studied. As discussed earlier, the second advantage of pooled data is that it reduces the number of time-series observations necessary for reliable estimation of the coefficients and, therefore, minimizes the need to try to quantify technology.

Separate equations will be estimated for Oregon and Washington. Three models will be estimated for each state. The first is an acreage response model utilizing all planted acreage of wheat as the dependent variable. The second equation is based on irrigated planted acreage of wheat as the dependent variable and the third model estimates the dryland acreage planted of wheat. Hence, six models in total will be estimated, three for Oregon and three for Washington.

Summary of Model Specification

Summarizing the earlier discussion in this chapter on applicable theory and variable measurement, the six pooled acreage response models with the addition of binary intercept shifters are specified as follows:

(Oregon--AWP)
$$AWP_{r,t} = f(C_r, MP_{r,t-1}, HES_{r,t}, HED_{r,t}, BAR_{r,t-1}, ALF_{r,t-1}, POES_{r,t-1}, GRAS_{WV,t-1}, CLOV_{t-1}, RISK_{r,t}) \quad (1)$$

(2) (Oregon--IRR) $AWPIRR_{r,t} = g(......)$

(3) (Oregon--DRY) $AWPDRY_{r,t} = h(......)$

(4) (Washington--AWP) $AWP_{r,t} = j(C_r, MP_{r,t-1}, HES_{r,t}, HED_{r,t}, BAR_{r,t-1}, ALF_{r,t-1}, SUGBT_{r,t-1}, PEAS_{r,t-1}, RISK_{r,t})$

(5) (Washington--IRR) $AWPIRR_{r,t} = k(......)$

(6) (Washington--DRY) $AWPIRR_{r,t} = l(......)$

where $AWP_{r,t}$ = acres of wheat planted for region r in year t

$AWPIRR_{r,t}$ = irrigated acres of wheat planted in region r in year t

$AWPDRY_{r,t}$ = dryland acres of wheat planted in region r in year t (sum of summer-fallow and after-legumes and continuous cropping production methods)

C_r = binary intercept shift variable for region r (= 1 if observation is in region r; = 0 otherwise)

$MP_{r,t-1}$ = the price of wheat for region r in year t-1; dollars per bushel

$HES_{r,t}$ = the effective support rate of wheat for region r in year t; dollars per bushel

$HED_{r,t}$ = the effective voluntary diversion rate for region r in year t; dollars per bushel

$BAR_{r,t-1}$ = the average price of barley in region r in year t-1; dollars per bushel

$ALF_{r,t-1}$ = the average price of alfalfa in region r in year t-1; dollars per ton

$POES_{r,t-1}$ = the average price of potatoes in region r in year t-1; dollars per hundredweight

$GRAS_{WV,t-1}$ = the average price of orchard grass in the Willamette Valley in year t-1; dollars per bushel; 0 in other regions

$CLOV_{t-1}$ = the average price of red clover in the Willamette Valley in year t-1; dollars per ton; 0 in other regions

$RISK_{r,t}$ = moving average of the standard deviation of gross income per acre in region r in the previous three years

$SUGBT_{r,t-1}$ = the average price of sugar beets in region r in year t-1; dollars per ton

$PEAS_{r,t-1}$ = the average price of peas in region r in year t-1; dollars per hundredweight.

The binary intercept shift variables added to the model account for regional differences in mean planted acreage. The estimated intercepts are expected to be the most positive in the regions where the most wheat is planted.

Functional Form

All six models will be estimated using a double logarithmic functional form. This entails taking the natural logarithm of all variables (excluding the constant) prior to estimation of the function. Consequently, all the estimated coefficients are elasticities. The double logarithmic functional formulation assumes that the acreage elasticities are equal in each subregion specified. This is a reasonable assumption given the small size of the area covered and the relatively homogeneous nature of wheat production in each subregion. A pooled-data linear functional form, on the other hand, is not acceptable in that it implies that a given change in an independent variable will induce the same change in acreage in all regions. This assumption is not reasonable given the large differences in acreage planted among the regions defined. In summary, the double logarithmic formulation assumes more justifiably that a given percentage change in an independent variable will cause the same percentage change in acreage across the subregions. The double logarithmic functional form is clearly preferable for this study.

Serial Correlation

The models in double-logarithmic functional form were estimated by ordinary least squares (OLS). It was initially assumed that the residuals were non-autoregressive and homoskedastic. After the six acreage response models were determined, each of the OLS estimations was tested for serial correlation in each of the give regions. This is a test of the assumption that the error terms are not correlated over time.

The first order auto regressor, $\hat{\rho}$, was estimated by regressing the residual in year t on the residuals in year t-1 separately for each region following equation (1).

$$e_{r,t} = \hat{\rho} e_{r,t-1} + u_{r,t} \qquad (1)$$

where r represents the region. The magnitude of the estimated coefficient $\hat{\rho}$ is compared to the size of its respective standard error to ascertain the degree of serial correlation. Serial correlation is a problem if the estimated coefficient is significantly different than zero. If serial correlation is present, then the assumption that the error terms are not correlated over time is violated. Under this condition, the OLS estimates are still unbiased and consistent, but they are not efficient. The data must be corrected for serial correlation.

The data was transformed in the regions where serial correlation was determined to be present, following the iterative procedure outlined by Kmenta (pp 287-288) to obtain estimators that are asymptotically equivalent to best-linear-unbiased estimators. This procedure required all the dependent and independent variables (including the constant) to be transformed according to equation (2) to correct for the serial correlation.

$$Y^*_{r,t} = Y_{r,t} - \hat{\rho}Y_{r,t-1} \qquad (2)$$

$$X^*_{k,r,t} = X_{k,r,t} - \hat{\rho}X_{k,r,t-1}$$

where Y is the dependent variable, X_k represents the kth independent variable, r is the region and t is the year.

The first observation was lost by this procedure since the lagged values of the dependent and independent variables were not available. This data transformation was omitted in those regions where serial correlation was not present. The regression was then repeated using the transformed data (X^*, Y^*). The standard errors of the generalized least squares (GLS) estimates of the model corrected for serial correlation should be smaller than those in the uncorrected OLS version, and the F for regression should increase.

Heteroskedasticity

Following the tests and the necessary corrections for serial correlation, the residuals for each cross-sectional unit from the resultant model were subsequently tested for heteroskedasticity. To test the assumption of homoskedasticity or equal variances of the error terms among regions, a consistent estimate of the variance for each region was obtained using equation (3).

$$S_r^2 = \frac{1}{T-K} \sum_{t=1}^{T} e_{r,t}^2 \qquad (3)$$

where r represents the region, t is the year and T-K is equal to the degrees of freedom for one cross-sectional unit.

The hypothesis of homoskedasticity is tested by an F-test, following Kmenta (pp 267-268), set up as the ratio of the consistent estimates of the variances in two regions. This test is an indication of the degree to which heteroskedasticity is present. If the hypothesis is rejected, then the assumption of homoskedasticity is violated. Under the conditions that the model is cross-sectionally heteroskedastic, the OLS estimates are still unbiased and consistent but not efficient. The existence of heteroskedasticity between regions requires that the data be transformed in such a manner that the assumption of homoskedasticity applies. The appropriate data transformation in this case is to divide the dependent variable and all the independent variables (including the constant) by the standard deviation of the error terms for each of the five regions as in equation (4).

$$Y_{r,t}^{**} = \frac{Y_{r,t}}{s_{e,r}} \qquad (4)$$

$$X_{k,r,t}^{**} = \frac{X_{k,r,t}}{s_{e,r}}$$

where Y is the dependent variable and X_k represents the kth independent variable.[7/]

The regression is then repeated using OLS on the transformed variables (Y^{**}, X^{**}). This weighting by the standard errors is done to improve the efficiency of the estimates, i.e., the standard errors of the estimated coefficients should be smaller using the transformed data than they were in the uncorrected model. The estimators from the corrected GLS version of the model are asymptotically equivalent to best-linear-unbiased estimators. The F for regression should increase.

[7/] $Y_{r,t}$ and $X_{k,r,t}$ were transformed by equation (2) to correct for serial correlation prior to computing equation (4) in those regions where serial correlation was determined to be a problem.

CHAPTER IV

EMPIRICAL ANALYSIS

Oregon Wheat Acreage Response Model

The parameters of the model of Oregon planted wheat acreage estimated in double-logarithmic functional form are summarized in Table 4-1. The initial ordinary least squares (OLS) estimation is represented by model Oregon--AWP(1). All coefficients are at least twice the size of their standard errors. All signs are as expected from the discussion of pertinent economic theory in Chapter II. The coefficients and variables included in the model will be more fully discussed below.

Model Oregon--AWP(1) was tested for serial correlation. Auto correlation was not found to be a problem with these data for any region. None of the estimated first order auto correlation regressors were significant at the 20 percent level. Consequently, the assumption of nonautoregression cannot be rejected in any of the Oregon subregions. Table 4-2 lists the estimated first order auto correlation regressors, $\hat{\rho}$, and their associated standard errors.

Model Oregon--AWP(1) was subsequently tested for heteroskedasticity. The variance of the error terms for each region is presented in Table 4-2. The assumption of homoskedasticity or equal variances of the error terms between regions was violated. As an example of the violation, the F-test that the variance of the error terms for Eastern Oregon is equal to the variance of the error terms for Southwestern Oregon yields an F-statistic of 41.73. The hypothesis that these two variances are equal

Table 4-1. Estimated Oregon Wheat Acreage Response Model

	Constant				Market Price		Support	Risk	Orchard Grass	
MODEL	C	C_{EO}	C_{SW}	C_{SC}	LNMP	$LNMP_{WV}$	$LNHES_{WV,SW}$	LNRISK	$LNGRAS_{WV}$	R^2
Oregon-AWP(1)	13.32	-2.02	-5.90	-2.49	0.47	0.58	1.00	-0.08	-0.76	.98
	(0.08)	(o.08)	(0.18)	(0.08)	(0.10)	(.14)	(0.34)	(0.04)	(0.07)	
Oregon-AWP(2)	13.29	-2.01	-5.87	-2.48	0.43	0.58	0.92	-0.05	-0.75	.99
	(0.03)	(0.03)	(0.19)	(0.04)	(0.04)	(.10)	(0.33)	(0.02)	(0.06)	

(The standard errors are in parentheses)

Table 4-2. Model Oregon-AWP(1): Estimated First Order Auto Regressors and Variance of the Error Terms by Region

REGION	$\hat{\rho}$	Standard Error of $\hat{\rho}$	s_e^2
Willamette Valley	-0.079	0.316	0.051
Columbia Basin	0.170	0.298	0.021
Eastern Oregon	-0.073	0.297	0.009
South Central Oregon	0.047	0.326	0.043
Southwestern Oregon	0.339	0.274	0.377

can be rejected at the five percent level of probability (Kmenta, pp 267-268). The existence of heteroskedasticity between regions requires that the data be transformed in such a manner that the assumption of homoskedasticity holds. Model Oregon--AWP(2), presented in Table 4-1, is the OLS estimation of the parameters of the model using the transformed variables corrected for heteroskedasticity between regions as detailed in the previous chapter. This model is discussed in detail below. The estimated generalized least squares (GLS) coefficients changed little from the magnitude of the coefficients estimated by OLS in the original model. All standard errors decreased in magnitude in the weighted regression except that for the intercept shifter for Southwestern Oregon. All estimated coefficients are more than twice their standard errors and all signs are as anticipated.

The Oregon wheat acreage response model was estimated with the major wheat producing region of the Columbia Basin designated as the base region. Regional intercept and coefficient shifters defined as the addition to the base coefficient applicable for each region were incorporated into the model. The shifters are represented in Table 4-1 by the variable labels with a subscript of the abbreviation for the applicable region. For example, the estimated intercept (C = 13.29) applies to the base region which is the Columbia Basin in this case. The intercept shifter for Eastern Oregon, C_{EO}, is -2.01. Hence, the estimated intercept for Eastern Oregon is obtained by adding the base intercept plus the intercept shifter for Eastern Oregon, e.g., 13.29 + (-2.01) = 11.28. If no shifter is included for a region, as in the case of the intercept shifter for the Willamette Valley, then there is no change in the coefficient for this region from the base coefficient. In other words, the intercept for the Willamette Valley is equal to the intercept for the Columbia Basin. When there is no base designated (i.e., no variable label without a subscript), as in the case of the effective support rate, the estimated coefficient for the base was zero. The estimated coefficient for the effective support rate applies only to the two regions subscripted, the Willamette Valley and Southwestern Oregon. There was no response to a change in this variable in the other three regions. As this model is estimated in double-logarithmic form, the estimated coefficients represent the elasticities of acreage response with respect to the associated variables. The intercepts and the elasticity values for all independent variables for each of the five regions are listed in Table 4-3.

The elasticity of planted acreage with respect to the expected market price of wheat for most of the state, that is all regions except the Willamette Valley, is 0.43, which is approximately that estimated for national wheat acreage response by Nerlove before the advent of government acreage programs for wheat. Using data from 1910 to 1932, Nerlove made several estimates ranging from 0.38 to 0.45. This level is slightly higher than that estimated by Houck (0.39) in his aggregate supply model. Winter and Whittaker estimated this elasticity for Oregon as 0.376 in a pooled regional model. An elasticity of 0.43 is quite inelastic reflecting the lack of substitutes for wheat production in most parts of the state. The choice open to many farmers, particularly in the eastern regions of the state, is essentially limited to whether or not to produce wheat.

The elasticity of acreage response with respect to expected price is much greater in the Willamette Valley than in the rest of the state. The estimated elasticity in this region is 1.01 (0.43 + 0.58), almost

Table 4-3. Model Oregon-AWP(2): Estimated Intercepts and Elasticities for all Independent Variables by Region.

REGION	CONSTANT	Market Price LNMP	Support LNHES	Risk LNRISK	Orchard Grass LNGRAS
Willamette Valley	13.29	1.01	0.92	-0.05	-0.75
Columbia Basin	13.29	0.43	0.00	-0.05	0.00
Eastern Oregon	11.28	0.43	0.00	-0.05	0.00
South Central Oregon	10.81	0.43	0.00	-0.05	0.00
Southwestern Oregon	7.42	0.43	0.92	-0.05	0.00

unitary elastiicty, indicating that wheat producers in this region are more responsive to expected market price than are wheat producers in other parts of the state. The occurrence of a higher elasticity of response for producers in the Willamette Valley is reflective of the fact that more alternatives exist for these producers. The conditions for crop production in the fertile Willamette Valley are conducive to raising many different commodities. Miles reports that over 100 crops are produced in the Valley and many of these can substitute for wheat production technologically.

The variables measuring the government programs are not significant at the 20 percent level for the most part. Only an estimated coefficient for the support price variable for the westernmost regions, the Willamette Valley and the Southern coast, are included in the model. The effect of the support price on acreage is not significantly different between these two regions. The estimated elasticity of acreage response with respect to the support rate in these regions is 0.92, about the same as the elasticity with respect to market price in the Willamette Valley. This elasticity is much higher than previous regional estimates. Winter and Whittaker estimated this elasticity to be 0.508 in an aggregate regional model (Oregon, Idaho, and Washington) and 0.242 for the state in a pooled data model. This level is also much higher than Houck et al.'s national estimate of 0.58. This high elasticity is also reflective of the fact that numerous substitutes for wheat production exist in the Valley. Consequently, the producers are highly sensitive to variations in price--both market price and support price.

The coefficient on support price is zero in the Columbia Basin, Eastern, and South Central Oregon regions, indicating that the government wheat price support programs have no influence on the wheat planting decision in these areas. This elasticity is influenced by the same arguments as that for an inelastic response with respect to market price in these regions. These producers do not have any economic substitutes for wheat production. They have little choice but to produce wheat. The relative price of producing wheat appears to have always been greater during these years than the relative price of diverting the land. Consequently, they do not respond to changes in the government wheat price support programs.

The variable measuring the effect of the government wheat diversion programs did not enter the model at 20 percent for any region in the state. This is consistent with the results of this model reported above. In the eastern regions, the wheat producers are not responsive to changes in the acreage diversion provisions just as they are not responsive to changes in the wheat price support programs. This follows the same reasoning that no economic substitutes for wheat production exist in these regions. For the western regions, producers are not responsive to the additional diversion provisions since there appears to always have been a more economic alternative to diverting land from wheat production and recieving a direct payment for leaving the land idle or planted to an acceptable cover crop under the wheat additional diversion programs. The relative price received for additional diversion under the wheat programs was less during the estimation period than the relative price that would be received by the producer for diverting the land from wheat into the production of another commodity. Hence, wheat acreage diversion in addition to that required for participation in the price support program is not a viable substitute for wheat production in any region in the state. The additional acreage diversion provisions included in the government wheat programs were estimated as having no impact on the acreage of wheat planted in Oregon.

Consistent with the hypothesis that many alternatives to wheat production exist in the Willamette Valley while no economic alternatives exist elsewhere in the state, the market price of grass seeds in the Willamette Valley is the only significant substitute crop in the acreage response model. The farm level market price of orchard grass was lagged to act as a proxy variable to measure the effects of the expected price of grass seeds grown in the Willamette Valley. The choice of orchard grass for this variable is discussed in an earlier chapter. Barley, alfalfa, potatoes and red clover were also hypothesized to be substitutes for wheat production in the state. None of the estimated coefficients for these variables were significant at 20 percent for any region in the state. This substantiates the claim that no alternatives exist for wheat production in the eastern regions of the state while orchard grass as a proxy for grass seed production is a substitute in the western regions.

Risk was found to affect the planting decision. The coefficient on risk was estimated as -0.05 for the state. The negative sign indicates that producers are risk averse. The magnitude of this coefficient translates into a five percent reduction in the acreage planted of wheat in the state for a 100 percent increase in the standard deviation of the moving average of the gross income per acre computed for the previous three years. For example, the risk variable increased by 516 percent from 1973 to 1974 in the Willamette Valley implying that acreage would have decreased by over 25 percent in this region, ceteris paribus. This implies that stable prices have a positive influence on planted wheat acreage in the state.

Equation AWP(2) was used to predict planted wheat acreage in Oregon from 1966 to 1977. The average annual estimation error of state planted wheat acreage for this model is 6.6 percent with a standard deviation of 3.5. A graph of the predicted versus the actual state planted wheat acreage is presented in Figure 4-1. The large prediction error in 1977 may have been partially caused by the announcement of the government programs occurring several months after the crop had been planted. There was a larger decrease in harvested acreage from planted acreage in 1977 than the average in previous years (Appendix Tables A-1 and A-2).

Oregon Dryland Wheat Acreage Response Model

The estimated Oregon dryland wheat acreage response model parameters in double-logarithmic form are presented in Table 4-4. This model was estimated using data for 1969 through 1977. 1966, 1967 and 1968 were not included because of the lack of data with which to compute the risk variable for dryland acreage for these years. Model Oregon--DRY(1) is the initial OLS estimation of the model. All signs are as expected with the exception of the negative sign on the effective support rate shifter for the South Central Region. This aberration and the estimated coefficients will be discussed below with model Oregon--DRY(2).

Model Oregon--DRY(1) was tested for serial correlation. The estimated first order auto regressors and their standard errors are presented in Table 4-5. None of the estimated coefficients are significant at the twenty percent level.

The equation DRY(1) was then tested for heteroskedasticity. The

Figure 4-1. Predicted versus Actual Oregon Planted Wheat Acreage

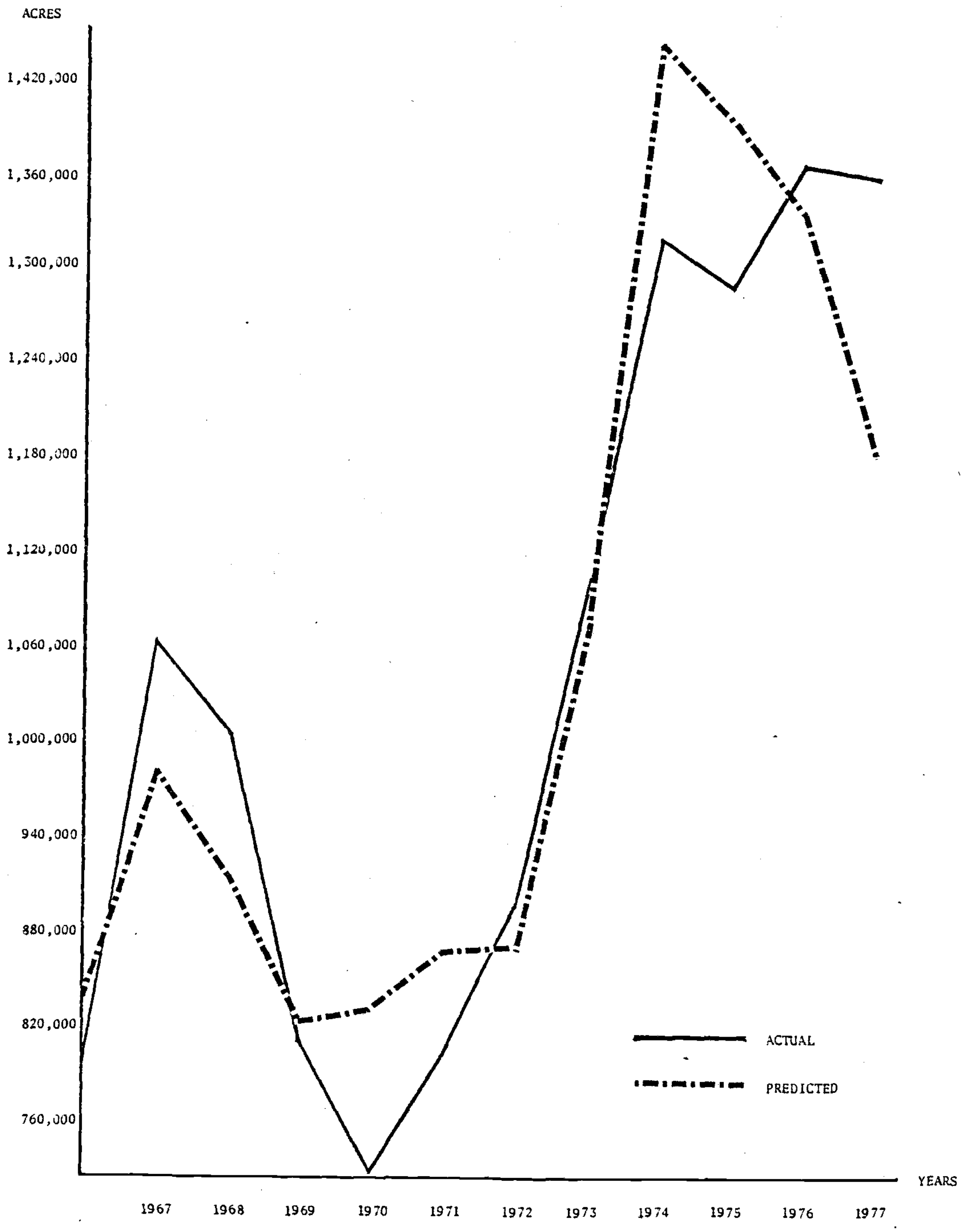


Table 4-4. Estimated Oregon Dryland Wheat Acreage Response Model

	Constant			Market Price		Support			Orchard Grass	Risk	
MODEL	C	$C_{EO,SC}$	C_{SW}	LNMP	$LNMP_{WV}$	LNHES	$LNHES_{CB}$	$LNHES_{SC}$	$LNGRAS_{WV}$	LNDRYRISK	R^2
Oregon-Dry(1)	13.39	-2.83	-5.90	0.56	0.66	0.92	-0.91	-1.15	-0.73	-0.16	.98
	(0.25)	(0.28)	(0.28)	(0.11)	(0.15)	(0.24)	(0.48)	(0.16)	(0.09)	(0.05)	
Oregon-Dry(2)	13.30	-2.74	-5.83	0.43	0.65	0.78	-0.76	-1.11	-0.72	-0.09	.99
	(o.15)	(0.12)	(0.15)	(0.09)	(0.13)	(0.23)	(0.32)	(0.13)	(0.06)	(0.05)	

(The standard errors are in parentheses).

Table 4-5. Model Oregon-DRY(1): Estimated First Order Auto Regressors and Variance of the Error Terms by Region

REGION	$\hat{\rho}$	Standard Error of $\hat{\rho}$	s_e^2
Willamette Valley	-0.030	0.381	0.203
Columbia Basin	0.080	0.400	0.086
Eastern Oregon	-0.299	0.326	0.199
South Central Oregon	-0.236	0.416	0.163
Southwestern Oregon	0.317	0.341	0.674

variances of the error terms are also included in Table 4-5. The hypothesis that the variance of the error terms is equal between the Columbia Basin and the Southwestern Oregon regions, as one example, can be rejected at the five percent level. Consequently, the variables were transformed for all regions following the procedures outlined in Chapter II and OLS was repeated on the transformed variables. The coefficients in model Oregon--DRY(2) are the GLS estimates for the Oregon dryland acreage after correction for heteroskedasticity. As anticipated, all of the standard errors are smaller in the GLS estimation. The estimated coefficients are also decreased in magnitude.

The estimated intercepts and elasticities for all independent variables are presented in Table 4-6 by region. These values were calculated from the base coefficients and the estimated shifters as illustrated for the previous model. The negative intercept shifters resulting in smaller constants for Eastern Oregon, South Central and Southwestern Oregon were anticipated since the Willamette Valley and the Columbia Basin have the overwhelming majority of dryland wheat acreage in the state. The intercepts and elasticities estimated with the dryland model bear a marked resemblence to those for the state total acreage model presented earlier. Only the support price elasticities vary substantially.

The estimated elasticity of response with respect to expected price is 0.43 for the state with the exception of the Willamette Valley. This is exactly the estimate derived from the total acreage model for these regions. This similarity is caused by the preponderance of dryland wheat acreage in the state total wheat acreage. The inelastic estimate reflects the limited alternatives to wheat production by dryland and particularly Eastern Oregon dryland wheat producers.

Table 4-6. Model Oregon-DRY(2): Estimated Intercepts and Elasticities for all Independent Variable by Region

		Market Price	Support	Risk	Orchard Grass
REGION	CONSTANT	LNMP	LNHES	LNDRYRISK	LNGRAS
Willamette Valley	13.30	1.08	0.78	-0.09	-0.72
Columbia Basin	13.30	0.43	0.02	-0.09	0.00
Eastern Oregon	10.56	0.43	0.78	-0.09	0.00
South Central Oregon	10.56	0.43	-0.33	-0.09	0.00
Southwestern Oregon	7.47	0.43	0.78	-0.09	0.00

The estimated elasticity of response with respect to the expected market price of wheat is 1.08 in the Willamette Valley. This is very similar to the estimate of 1.01 derived from the total wheat acreage model for this region. As discussed earlier, this estimate for the Willamette Valley is elastic, reflecting the numerous alternatives to wheat production available to Valley producers.

The estimated coefficients for the various regions of the government policy variable measuring the effective support rate are somewhat different than those for the total wheat acreage model. The irrigated acreage included in the total planted wheat acreage model may exert a mitigating influence on the responses by dryland producers. The magnitude of the elasticity with respect to the effective support rate for the two coastal regions and Eastern Oregon is 0.78. This level is more elastic than Houck et al.'s national estimate of 0.58. For the western coastal regions, this elasticity is indicative of the availability of substitutes and is comparable to the 0.92 estimate for these regions derived from the total acreage model. This estimate for Eastern Oregon may be the result of the paucity of economically viable alternatives to wheat production. The effective support rate would guarantee a certain price for wheat production on acreage participating in the government programs and may indirectly stimulate an increase in wheat production by acting as a price floor for the market price. The model may be misspecified and a crop that functions as a substitute for wheat production in this region may have been ignored. However, the Eastern Oregon region contains just over five percent of the state's annual dryland planted wheat acreage.

The elasticity of response with respect to the effective support rate is estimated to be virtually zero for the Columbia Basin. This is the same estimate derived from the total acreage model for this region. Producers in this region are not responsive to changes in the government mandated effective support rate. The effective support rate does not influence the planting decision of producers in this region.

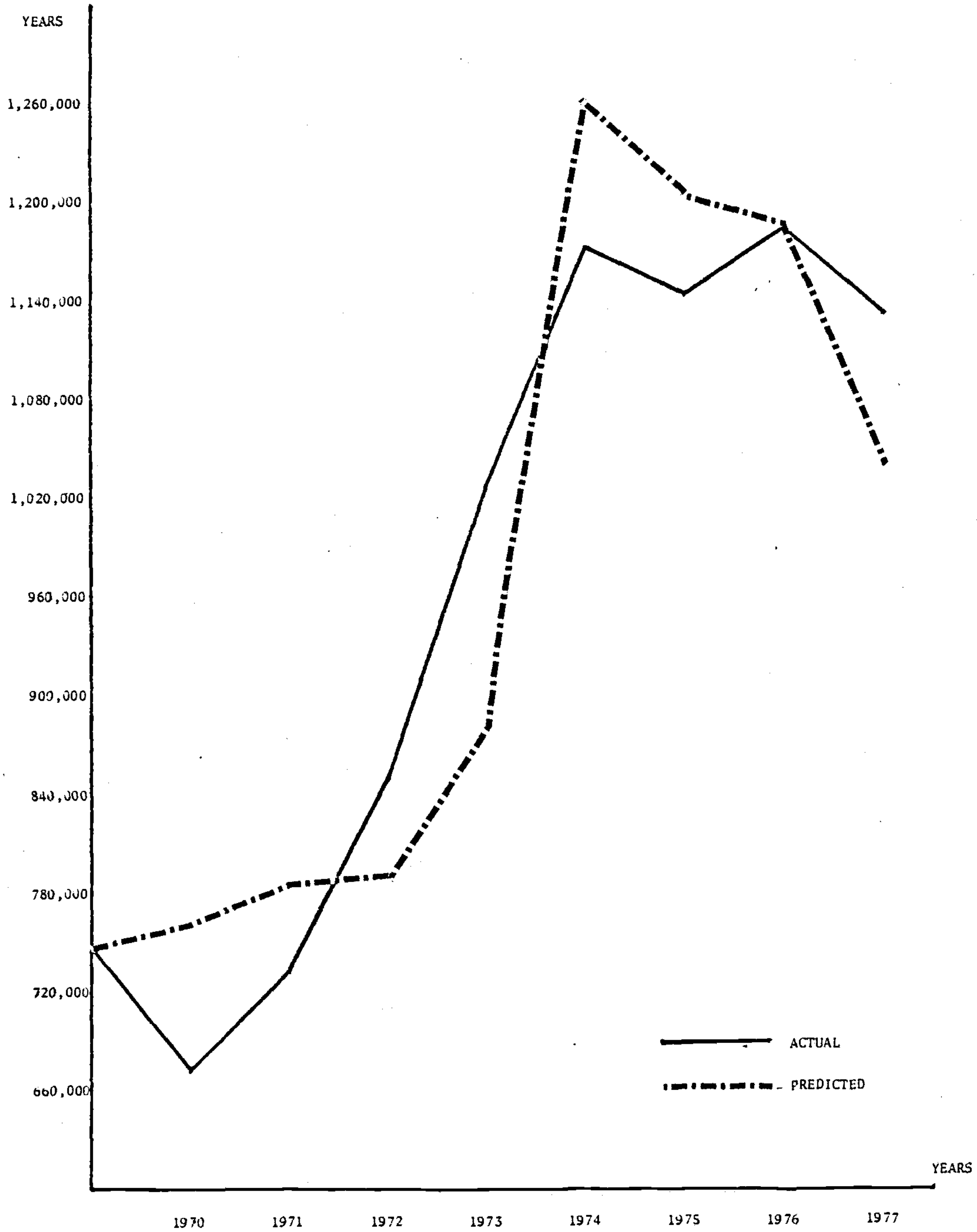
The estimated elasticity of the effective support rate in the South Central region presents a dilemma in that the estimated sign is not positive as expected. It may be that the decrease in acreage as a response to an increase in the effective support rate is reflective of and concurrent with changing relative prices of wheat production and an alternative to wheat production that is not included in the model. However, the estimated coefficient is not significantly different than zero at ten percent.

The estimated coefficient with respect to the price of orchard grass is estimated as -0.72. This is virtually the same estimate as from the overall model. Barley, alfalfa, potatoes and red clover were also hypothesized as substitutes to wheat production but none were statistically significant.

The estimated coefficient on risk is less than twice the size of its standard error in the version of the model corrected for heteroskedasticity. This could indicate model misspecification. The estimated magnitude of -0.09 is nearly twice the estimated risk aversity of -0.05 indicated in the total acreage model.

Equation DRY(2) was used to predict dryland wheat acreage in Oregon from 1969 to 1977. The average annual estimation error for model Oregon-DRY(2) is 7.48 percent with a standard deviation of 4.91. Using this criteria, the overall wheat acreage model is a slightly better estimator. Figure 4-2 presents a graph of the predicted versus the dryland planted wheat acreage for Oregon. Again, the large 1977 error may be because the

Figure 4-2. Predicted versus Actual Oregon Dryland Planted Wheat Acreage



government program was announced so late in 1977 that planted acreage was not affected.

Oregon Irrigated Wheat Acreage Response Model

Table 4-7 presents a summary of the Oregon irrigated wheat acreage response model parameters estimated in double-log form. Model Oregon--IRR (1) is the initial OLS estimation. All coefficients are more than three times the size of their respective standard errors. All signs are as expected with the exception of the effective support price variable in the Southwestern region. A brief discussion of the estimated coefficients is included below under the Oregon--IRR(3) model which is the GLS estimation correcting the data for auto correlation and heteroskedasticity.

Model Oregon--IRR(1) was tested for serial correlation in the five regions. Table 4-8 includes the estimated auto correlation regressors by region and their associated standard errors. The estimated first order auto regressor was found to be significant at greater than the 20 percent level in the Columbia Basin region. Serial correlation was not determined to be a problem in the other four regions. The data from the Columbia Basin were corrected following the procedure outlined in Chapter III. The first observation, 1966, was lost because of the lagging procedure to correct for serial correlation. OLS regression was then repeated on the transformed variables using data from 1967 to 1977. Model Oregon--IRR(2) is the irrigated acreage model corrected for serial correlation. The standard errors decreased from the previous model with the exception of the Columbia Basin regional shifters for the intercept and for the expected market price.

Table 4-7. Estimated Oregon Irrigated Wheat Acreage Response Model

MODEL	Constant				Market Price		Support	Potatoes	
	C	C_{CB}	C_{EO}	C_{SC}	LNMP	$LNMP_{CB}$	$LNHES_{SW}$	LNPOES	R^2
Oregon-IRR(1)	7.80	2.42	3.32	3.03	0.87	0.98	-2.38	-1.09	.96
	(0.12)	(0.33)	(0.31)	(0.30)	(0.12)	(0.25)	(0.63)	(0.22)	
Oregon-IRR(2)	7.82	2.87	3.19	2.88	0.82	0.52	-2.53	-0.97	.98
	(0.12)	(0.43)	(0.29)	(0.28)	(0.11)	(0.35)	(0.58)	(0.20)	
Oregon-IRR(3)	7.84	2.68	2.95	2.65	0.77	0.48	-3.02	-0.78	.99
	(0.11)	(0.39)	(0.28)	(0.27)	(0.09)	(0.29)	(0.64)	(0.20)	

(The standard errors are in parentheses).

Table 4-8. Model Oregon-IRR: Estimated First Order Auto Regressors and Variance of the Error Terms by Region

REGION	$\hat{\rho}$ *	Standard Error of $\hat{\rho}$	s_e^2 **
Willamette Valley	0.051	0.355	0.246
Columbia Basin	0.586	0.254	0.183
Eastern Oregon	0.399	0.290	0.057
South Central Oregon	0.105	0.303	0.048
Southwestern Oregon	-0.103	0.289	0.725

* $\hat{\rho}$ was estimated using the residual from Oregon--IRR(1)

** s_e^2 was estimated using the residuals from Oregon-IRR(2) which had been corrected for serial correlation

Model Oregon--IRR(2) was tested for heteroskedasticity. The variances of the error terms are presented by region in Table 4-8. As in the previous models, the assumption of homoskedasticity between regions was violated. The hypothesis that the variances of the error terms are equal between regions can be rejected as before at the five percent level of probability. The variables were corrected and the OLS regression was repeated. Model Oregon--IRR(3) presents the GLS parameter estimates of the Oregon irrigated wheat acreage model corrected for both serial correlation and heteroskedasticity. The standard errors decreased from model Oregon--IRR(2) except for potatoes which remained the same and except for the effective support rate in Southwestern Oregon which increased slightly. The coefficients decreased slightly in magnitude with the exception again of the effective support rate for wheat in Southwestern Oregon which increased.

The Oregon irrigated acreage response model was estimated with the Willamette Valley designated as the base region. The positive intercept shifters for the Columbia Basin, Eastern Oregon and the South Central region were expected reflecting a greater number of irrigated shifters for these three regions appear to be approximately the same in this model. However, the hypothesis that these coefficients were equal was rejected at the five percent level of probability in the uncorrected model. The estimated intercepts and elasticities for all the independent variables are presented in Table 4-9 by region.

The estimated elasticity with respect to expected price for the state excluding the Columbia Basin region is 0.77. This is a much more elastic estimate than that derived from the dryland or total acreage models (estimated elasticity of 0.43). The difference in elasticity

Table 4-9. Model Oregon-IRR(3): Estimated Intercepts and Elasticities for all Independent Variables by Region

		Market Price	Support Price	Potatoes
REGION	CONSTANT	LNMP	LNHES	LNPOES
Willamette Valley	7.84	0.77	0.00	0.00
Columbia Basin	10.52	1.25	0.00	-0.78
Eastern Oregon	10.79	0.77	0.00	-0.78
South Central Oregon	10.49	0.77	0.00	-0.78
Southwestern Oregon	7.84	0.77	-3.02	-0.78

estimates between irrigated and dryland wheat acreage illustrates the distinction between wheat production systems gained by disaggregating total wheat acreage. These estimates also differ markedly from the national estimates of Houck et al. and Nerlove substantiating the need for regional models. The estimate of this elasticity for the Columbia Basin wheat producers (1.25, Table 4-9) is even further from the national estimates. The magnitude of these elasticities reflects the existence of more substitutes to wheat production on irrigated acreage.

Potatoes were found to be an important alternative to wheat production on irrigated acreage.[8/] Potatoes were hypothesized as an alternative to wheat production in all regions of the state except the Willamette Valley where few potatoes are grown. They are extensively cultivated in two areas of the state--the Columbia Basin and Eastern Oregon. The estimated elasticity with respect to the expected price of potatoes in -0.78 for all regions in the state outside of the Willamette Valley. This is practically the same estimate but with the opposite sign as the elasticity with respect to expected market price for all regions in the state except the Columbia Basin. This is indicative of producers alternating acreages between wheat and potatoes as the market signals dictate. The existence of substitute crops to wheat production provides an added discrepancy from the national wheat models which included no substitutes to wheat production.

[8/] Wheat is generally used as a rotation for potatoes to control potato diseases. The time period used to estimate this model may have made potatoes a substitute rather than a complement. Irrigated wheat acreage increased continually in the major producing regions of the Columbia Basin and Eastern Oregon from 1966 to 1977.

The government policy variables were not found to have a significant impact on irrigated wheat acreage in Oregon. The effective diversion rate variable was not significant at the 20 percent level for any region in the state. Hence, changes in the effective diversion rate will have no impact on irrigated wheat acreage. The coefficient on effective support was estimated to be zero for all regions except Southwestern Oregon. Hence, irrigated wheat producers in most of the state have not been responsive to the government wheat programs. This was anticipated a priori for several reasons. Irrigated wheat acreage doubled over the data set from 1966 to 1977. Since it can take several years to obtain a government acreage allotment and to establish normal yields, much of the newly irrigated acreage was not eligible to participate in the government programs. Consequently, this acreage would not respond to changes in wheat policy. In addition, wheat is considered the low income crop on much of the irrigated acreage. This is especially true in the areas where potatoes are important such as the Columbia Basin which is also the region with most of the irrigated acreage. Potatoes are a viable economic substitute as discussed earlier. Wheat is important as a rotation crop for potatoes to control various plant diseases. These factors discourage wheat program participation in that the production of potatoes will yield a higher income than does the production of wheat under either support prices or market prices. In addition, at least in most years, potatoes are not an acceptable ground cover for diverted wheat acreage under the government programs. This further inhibits response to the government policy by making participation less desirable.

In contrast to the rest of the state, the estimated coefficient on the effective support rate in Southwestern Oregon is -3.02 with a standard error of .64. This large negative magnitude could be indicative of model misspecification but given the very few acres of wheat planted in this region, it is probable that the response of the handful of producers to reduce wheat acreage as the effective support price increases is a spurious connection and not indicative of causality. Irrigated wheat acreage has not exceeded 750 acres in this region from 1967 to 1977. This is less than one percent of irrigated wheat acreage in the state.

Risk was not found to be an important factor influencing the planting decisions on irrigated wheat acreage in the state. This reflects the increased yields and the increased investment which discourage the producer to remove irrigated land from production as well as the importance of potatoes as an economic alternative to wheat.

Equation IRR(3) was used to predict the number of irrigated acres planted to wheat in the state. For the years from 1967 to 1977, the average annual estimation error is 9.7 percent with a standard deviation of 5.2. The actual versus the predicted irrigated acreage planted to wheat in Oregon is graphed in Figure 4-3. The actual planted acreage in 1975, 1976 and 1977 is predicted poorly. A relevant factor may have been omitted from the model.

Washington Wheat Acreage Response Model

The estimated Washington wheat acreage response model parameters in double-logarithmic functional form are presented in Table 4-10. This model was estimated using data from 1969 to 1977. The information necessary to compute the risk variable for 1966, 1967 and 1968 was not available so these years were deleted from the estimation period. Model AWP(1) is the intial OLS estimation of the coefficients for the total Washington wheat acreage model. All signs are as expected with the exception of the effective diversion rate which is positive. All coefficients and the included variables will be discussed below.

Model Washington-AWP(1) was tested for serial correlation. Table

Figure 4-3. Predicted versus Actual Oregon Irrigated Planted Wheat Acreage

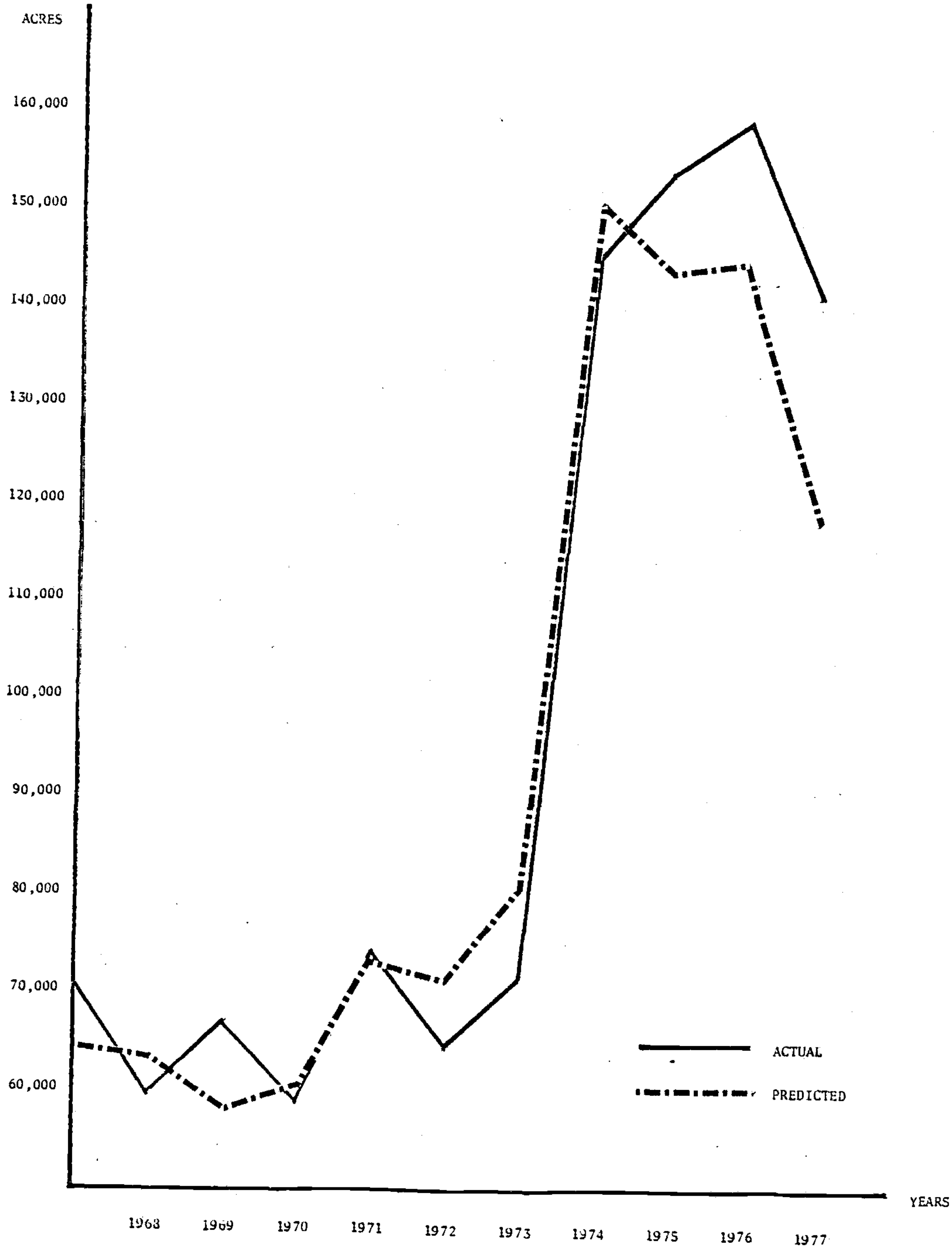


Table 4-10. Estimated Washington Wheat Acreage Response Model

	Constant			Market Price			Support Price		Diversion	Peas	Alfalfa	
MODEL	C	C_{NEW}	C_{WWW}	LNMP	$LNMP_{CNW}$	$LNMP_{WWW}$	LNHES	$LNHES_{WWW}$	LNHED	LNPEAS	$LNALF_{CNW}$	R^2
Washington-AWP(1)	13.73	-1.52	-6.38	0.49	0.69	1.08	0.79	0.92	1.13	-0.35	-0.64	.994
	(o.13)	(0.13)	(0.20)	(0.14)	(0.12)	(0.12)	(0.26)	(0.38)	(0.45)	(0.14)	(0.03)	
Washington-AWP(2)	13.72	-1.52	-6.34	0.39	0.67	1.07	0.64	0.87	0.68	-0.23	-0.63	.999
	(0.08)	(0.08)	(0.32)	(0.09)	(0.07)	(0.19)	(0.16)	(0.60)	(0.28)	(0.09)	(0.02)	

(The standard errors are in parentheses).

4-11 contains the estimated first order auto regressors and their standard errors by regions. Since all standard errors were at least as large as the estimated coefficients, serial correlation was not determined to be a problem with these data.

Equation AWP(1) was then tested and corrected for heteroskedasticity. The variances of the error terms by region are listed in Table 4-11. Model Washington-AWP(2) in Table 4-10 is the OLS estimation of the model on the transformed variables corrected for heteroskedasticity. All standard errors decreased with the exception of the three shift variables on market price, effective support and the constant for Western Washington. Western Washington contains very little wheat acreage--less than one percent of the state total, all of which is dryland acreage.

The Washington wheat acreage response model was estimated with the major wheat producing region of Southeastern Washington designated as the base region. The negative intercept shift variables for Northeastern Washington and Western Washington were expected reflecting the much smaller acreages of wheat planted in these areas. The estimated intercepts and elasticities for all independent variables are presented in Table 4-12 by region.

The estimated elasticity of acreage response with respect to expected market price is 0.39 for most of the wheat producing regions in the state--specifically, Southeastern Washington, the Columbia Basin and Northeastern Washington. This estimate is exactly the elasticity of acreage response estimated by Houck et al. in a national wheat supply model. It is within the range of Nerlove's estimates (0.38 to 0.45), and is comparable to the elasticity of 0.43 estimated for most of the state of Oregon.

The elasticity with respect to expected price is more elastic in

Table 4-11. Model Washington-AWP(1): Estimated First Order Auto Regressors and Variance of the Error Terms by Region

REGION	$\hat{\rho}$	Standard error of $\hat{\rho}$	s_e^2
Southeastern Washington	-0.176	0.395	0.056
Washington Columbia Basin	-0.168	0.346	0.036
Central Washington	-0.260	0.675	0.039
Northeastern Washington	0.363	0.352	0.082
Western Washington	-0.042	0.413	0.449

Table 4-12. Model Washington-AWP(2): Estimated Intercepts and Elasticities for all Independent Variables by Region

		Market	Support	Diversion	Peas	Alfalfa
REGION	CONSTANT	LNMP	LNHES	LNHED	LNPEAS	LNALF
Southeastern Washington	13.73	0.39	0.64	0.68	-0.23	0.00
Washington Columbia Basin	13.73	0.39	0.64	0.68	-0.23	0.00
Central Washington	13.73	0.67	0.64	0.68	-0.23	-0.63
Northeastern Washington	12.20	0.39	0.64	0.68	-0.23	0.00
Western Washington	7.38	1.07	0.87	0.68	-0.23	0.00

Central Washington (0.67). This increased elasticity reflects the increased number of substitutes to wheat production available in this region. Alfalfa was found to be a significant substitute at the 20 percent level in this region, but not in any of the other regions of the state. The elasticity with respect to market price is even more elastic in Western Washington (1.07) reflecting the existence of numerous alternatives to wheat production in the western area. Similarly in Oregon, the estimated price elasticity is 1.01 in the western region. With a wider range of alternatives, the producers in these regions are expected to be more responsive to market signals than those producers with fewer options.

The government wheat policy has a significant impact on wheat acreage and production in Washington. The estimated elasticity of acreage response with respect to the effective support price is 0.64 for all regions except Western Washington. Since more alternatives to wheat production exist in the west, the Western Washington support price elasticity was expected to be more elastic just as the estimated market price elasticity was more elastic for this region. The estimated support price elasticity is 0.87 in this region. The Western Washington estimate is similar to the elasticity of 0.92 for western Oregon. However, no other region in Oregon displayed a response to the government support programs. This is quite different from the situation in Washington where much more wheat is grown.

Wheat acreage planted in Washington was also found to be responsive to the government additional diversion programs. The estimated elasticity of acreage response with respect to the effective diversion rate is 0.68. The sign on this coefficient was expected to be negative. It was hypothesized that diversion functioned as an alternative to wheat production--the acreage could either be used for wheat production or wheat diversion just as it could be used for wheat production or alfalfa production. It appears, however, that in Washington, an increase in the effective diversion rate corresponds with an increase in wheat acreage. This could be spurious correlation. The wheat acreage diversion programs were determined to have no impact on Oregon planted wheat acreage.

Peas were found to be a significant substitute to wheat production at the 20 percent level. The estimated coefficient is -0.23 for all regions in the state. Washington leads the country in acreage and production of peas. As discussed earlier, alfalfa was found to be an important substitute in Central Washington. Barley and sugarbeets were also hypothesized to be substitutes to wheat production, but these variables were not significant at 20 percent.

Risk was not determined to affect the planting decision in Washington. The estimated coefficient was not significant at the 20 percent level.

Equation AWP(2) was used to predict planted wheat acreage in Washington from 1969 to 1977. The average annual estimation error was 4.6 percent with a standard deviation of 2.1. Figure 4-4 presents a graph of the predicted versus the actual planted wheat acreage in the state over these years.

Washington Dryland Wheat Acreage Response Model

The Washington dryland wheat acreage response model parameters estimated in double-logarithmic form are presented in Table 4-13. As with the Washington total planted wheat acreage model, the estimation period

Figure 4-4. Predicted versus Actual Washington Planted Wheat Acreage

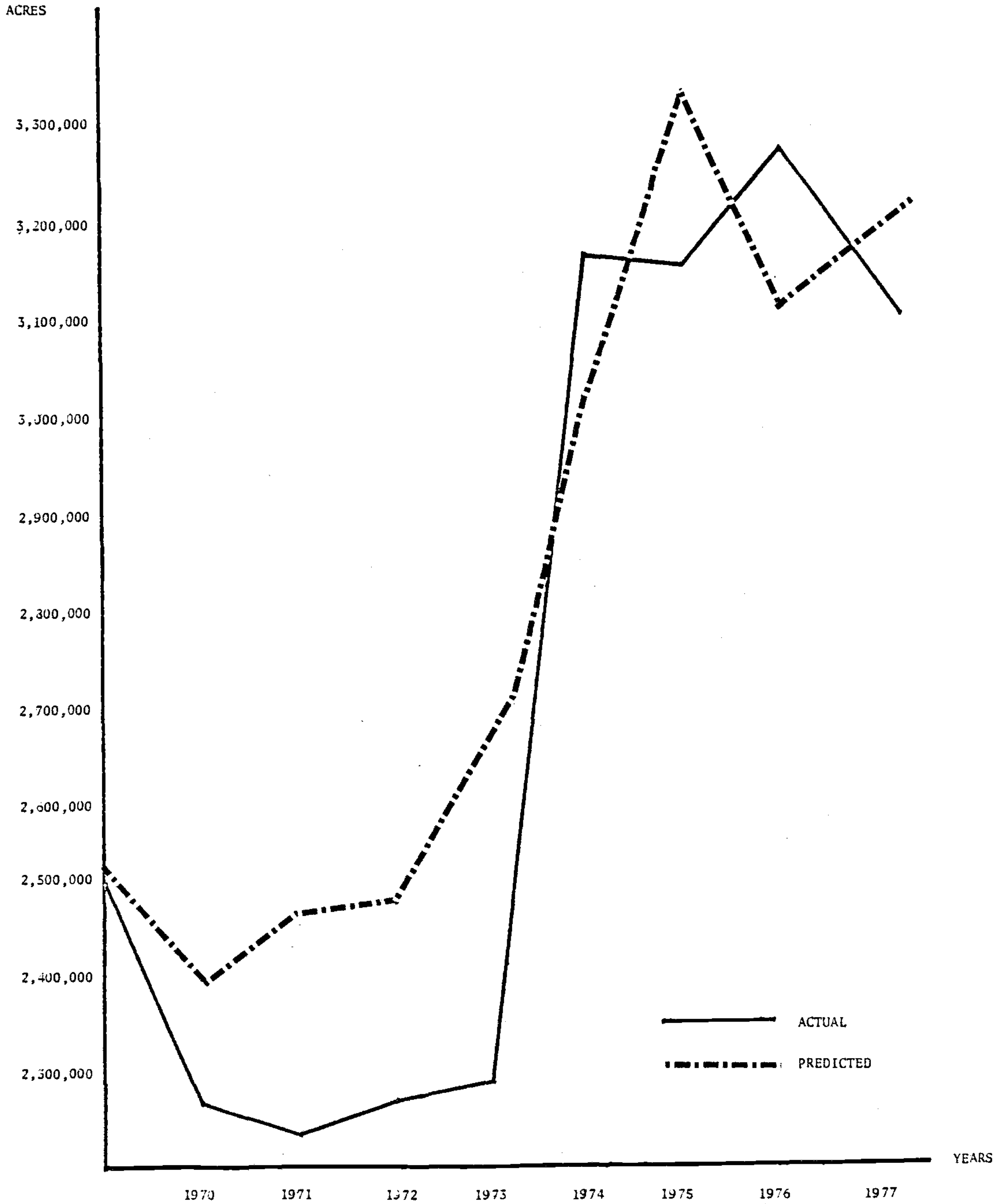


Table 4-13. Estimated Washington Dryland Wheat Acreage Response Model

	Constant				Market Price		Support	Alfalfa	
MODEL	C	C_{CNW}	C_{NEW}	C_{WWW}	LNMP	$LNMP_{WWW}$	$LNHES_{WWW}$	$LNALF_{WCB}$	R^2
Washington-DRY(1)	13.82	-2.26	-1.51	-6.45	0.17	1.06	1.14	-0.33	.994
	(0.06)	(0.06)	(0.06)	(0.19)	(0.05)	(0.12)	(0.36)	(0.02)	
Washington-DRY(2)	13.82	-2.26	-1.51	-6.45	0.18	1.05	1.14	-0.33	.999
	(0.03)	(0.04)	(0.04)	(0.36)	(0.02)	(0.22)	(0.69)	(0.01)	

(The standard errors are in parentheses).

for the dryland model covered the years from 1969 to 1977. The omission of the observations from 1966 to 1968 was on account of the unavailability of data with which to compute the risk variable for these years. DRY(1) is the initial OLS estimation of the model. All signs are as expected and all coefficients are more than three times the size of their respective standard errors. The estimated coefficients and the included variables will be discussed in more detail below.

DRY(1) was tested for serial correlation. The estimated first order auto regressors and their standard errors are presented in Table 4-14 by region. The assumption of nonautoregression was not determined to be violated in any region as the respective standard errors were all larger than the estimated auto regressor coefficients.

DRY(1) was subsequently tested for heteroskedasticity. Table 4-14 includes the variances of the error terms by region. The hypothesis of homoskedasticity between the Western Washington region and the Washington Columbia Basin can be rejected at the five percent level of probability, as one example of the violation of equal variances among the regions. DRY(2) in Table 4-13 is the OLS estimation of the parameters using the transformed variables corrected for heteroskedasticity. The standard errors for the shift variables on the constant, the expected market price and the effective support rate for Western Washington increased in the GLS estimation. This also occurred in the total acreage model. The standard errors on all other estimated coefficients decreased. The magnitudes of the estimated coefficients remained virtually the same.

The Southeastern Washington region was designated as the base for this parameter estimation as it has the most extensive planted wheat acreage. Consequently, as in the previous model, the negative shift

Table 4-14. Model Washington-DRY(1): Estimated First Order Auto Regressors and Variance of the Error Terms by Region

REGION	$\hat{\rho}$	Standard error of $\hat{\rho}$	s_e^2
Southeastern Washington	-0.006	0.378	0.040
Washington Columbia Basin	0.028	0.430	0.021
Central Washington	-0.071	0.397	0.067
Northeastern Washington	0.064	0.307	0.062
Western Washington	-0.040	0.413	0.605

variables for the intercept for Central Washington, Northeastern Washington and Western Washington were expected. Table 4-15 presents the DRY(2) estimated intercepts and elasticities for all independent variables by region.

The estimated elasticity of acreage response with respect to market price is 0.18 for all regions in the state except Western Washington where it is 1.05. The Western Washington elasticity is similar to that estimated in the total acreage model (1.07) reflecting the many alternatives to wheat in this region. The most elastic estimates in Oregon were also for the western regions. The elasticity for the rest of the state (0.18) is much more inelastic than that derived from the total acreage model. It is assumed that the inclusion of the irrigated wheat acreage in the total acreage model provided a mitigating influence. The inelastic estimate of acreage response for the Central and Eastern regions is consistent with the findings of the model that there are few economically viable substitutes for wheat on dryland wheat acreage in these areas.

At 20 percent, only the expected market price of alfalfa was found to be significant as a substitute for wheat and then only in the Columbia Basin. There were no other crops determined to be economically viable substitutes for dryland wheat production in this state. Barley, sugarbeets and peas were also hypothesized to be economic substitutes.

There was no response to the government wheat programs estimated for Washington dryland acreage with the exception of the effective support rate for Western Washington. The estimated coefficient on the effective diversion rate is zero for all regions in the state, and the estimated coefficient on the effective support rate is zero for all regions except Western Washington. These estimates are in sharp contrast with the

Table 4-15. Model Washington-DRY(2): Estimated Intercepts and Elasticities for all Independent Variables by Region

REGION	CONSTANT	Market Price LNMP	Support LNHES	Alfalfa LNALF
Southeastern Washington	13.82	0.18	0.00	0.00
Washington Columbia Basin	13.82	0.18	0.00	-0.33
Central Washington	11.56	0.18	0.00	0.00
Northeastern Washington	12.31	0.18	0.00	0.00
Western Washington	7.37	1.05	1.14	0.00

estimated elasticities for effective support and effective diversion in the total wheat acreage response model. It is assumed, again, that the irrigated acreage response influenced the total acreage model. The extent of the influence is surprising given the preponderance of dryland acreage in the total planted wheat acreage in the state. The estimated acreage elasticity with respect to the effective support rate is 1.14 in Western Washington. This estimate is similar to the elasticity of 1.05 with respect to market price estimated for this region. The elasticity is expected to be more elastic in regions where more substitutes exist. Because of the range of substitutes to wheat production available in this region, producers are very responsive to changes in the market price and the support price as these variables influence income expectations.

Risk, as measured by the three years standard deviation of variability in gross income per acre, was not found to affect the planting decision. The estimated coefficient on this variable is not significant at the 20 percent level of probability.

Model DRY(2) was utilized to estimate the predicted dryland planted wheat acreage in Washington over the estimation period from 1969 to 1977. The annual estimation error is 4.1 percent with a standard deviation of 2.9. Figure 4-5 is a graph of the predicted versus the actual dryland wheat acreage in Washington over these years.

Washington Irrigated Wheat Acreage Response Model

The Washington irrigated wheat acreage response function estimated in double-logarithmic form is summarized in Table 4-16. As for the other

Figure 4-5. Predicted versus Actual Washington Dryland Planted Wheat Acreage

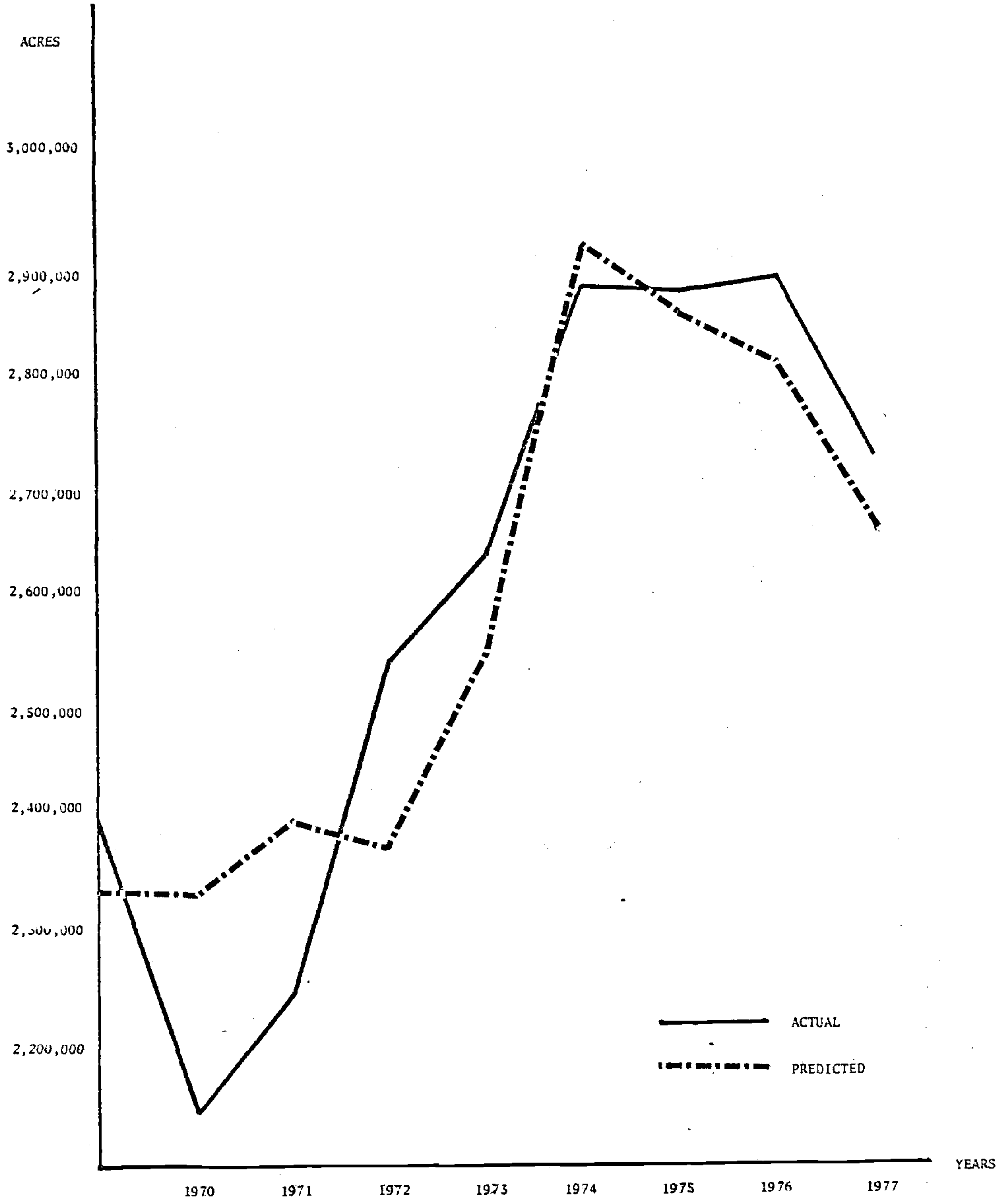


Table 4-16. Estimated Washington Irrigated Wheat Acreage Response Model

MODEL	Constant			Market Price		Support	Diversion	Sugarbeets	
	C	C_{WCB}	C_{NEW}	LNMP	$LNMP_{CNW}$	LNHES	LNHED	LNSBEETS	R^2
Washington-IRR(1)	10.45	-1.87	-2.54	0.85	0.45	0.72	1.07	-0.49	.98
	(0.43)	(0.43)	(0.43)	(0.13)	(0.10)	(0.28)	(0.65)	(0.15)	
Washington-IRR(2)	10.57	-1.88	-2.54	0.81	0.45	0.44	0.31	-0.45	.99
	(0.33)	(0.33)	(0.33)	(0.10)	(0.09)	(0.22)	(0.50)	(0.11)	

(The standard errors are in parentheses).

Washington models, the estimation period for this model was limited to 1969 to 1977 by the lack of data with which to compute the risk variable for the previous three years. The Western Washington region was not included in the data set since there was no irrigated planted wheat acreage in this region during any of the years considered. IRR(1) is the initial OLS estimation of the model. All signs are as anticipated with the exception of the coefficient on the effective diversion rate which is positive. All coefficients are more than twice the size of their standard errors, again with the exception of the coefficient on the effective diversion rate which is slightly less than twice the size of its standard error. The estimated coefficients and the included variables are discussed below.

Equation IRR(1) was tested for serial correlation. The estimated first order auto regressors and their standard errors are presented in Table 4-17 by region. Serial correlation is not a problem with this data since all the standard errors were nearly as large or larger than their estimated coefficients.

IRR(1) was next tested and corrected for heteroskedasticity. The regional variances of the error terms are included in Table 4-17. Equation IRR(2) is the OLS estimation on the transformed variables corrected for heteroskedasticity. The magnitude of the estimated coefficients on the effective support rate and the effective diversion rate decreased substantially with the result that the estimated coefficient on effective support is just twice the size of its standard error and the estimated coefficient on the effective diversion rate is less than its standard error. The sign on the effective diversion rate is positive contrary to expectations but it is not significantly different from zero. All other

Table 4-17. Model Washington-IRR(1): Estimated First Order Auto Regressors and Variance of the Error Terms by Region

REGION	$\hat{\rho}$	Standard error of $\hat{\rho}$	s_e^2
Southeastern Washington	0.091	0.387	0.752
Washington Columbia Basin	0.450	0.371	0.166
Central Washington	-0.331	0.343	0.133
Northeastern Washington	-0.167	0.350	0.258

estimated coefficients have the anticipated signs and are more than three times the size of their respective standard errors. The estimated intercepts and elasticities for all independent variables are listed in Table 4-18 by region.

The estimated elasticity with respect to expected market price is 0.81 for Southeastern Washington, the Columbia Basin and Northeastern Washington. This is much more elastic than the estimated elasticity of 0.18 for dryland acreage response in these regions. The more elastic estimate for irrigated wheat acreage is reflective of the greater number of substitutes to wheat production that are both technologically feasible and economically viable on irrigated acreage. The coefficient on expected market price in Central Washington (0.45) is less elastic than that estimated for the other three regions in the state.

The effective support rate is an important influence on the planting decision on irrigated acreage while there was no response to this variable estimated in the dryland model for the same four regions. The estimated elasticity of irrigated acreage with respect to the effective support rate is 0.44 for the four regions containing irrigated wheat acreage. The estimated coefficient was exactly twice the size of its standard error in the OLS regression on the variables transformed to correct for heteroskedasticity.

The estimated coefficient on the effective diversion rate is 0.31. The sign on this coefficient was expected to be negative. However, this coefficient is less than its standard error in the version of the model corrected for heteroskedasticity. It was significant at the 20 percent level in the uncorrected version. This indicates possible multicollinearity and model misspecification.

Table 4-18. Model Washington-IRR(2): Estimated Intercepts and Elasticities for all Independent Variables by Region

REGION	CONSTANT	Market Price LNMP	Support LNHES	Diversion LNHED	Sugarbeets LNSBEETS
Southeastern Washington	10.57	0.81	0.44	0.31	-0.45
Western Columbia Basin	12.45	0.81	0.44	0.31	-0.45
Central Washington	10.57	0.45	0.44	0.31	-0.45
Northeastern Washington	8.04	0.81	0.44	0.31	-0.45
Western Washington*	0.00	0.00	0.00	0.00	0.00

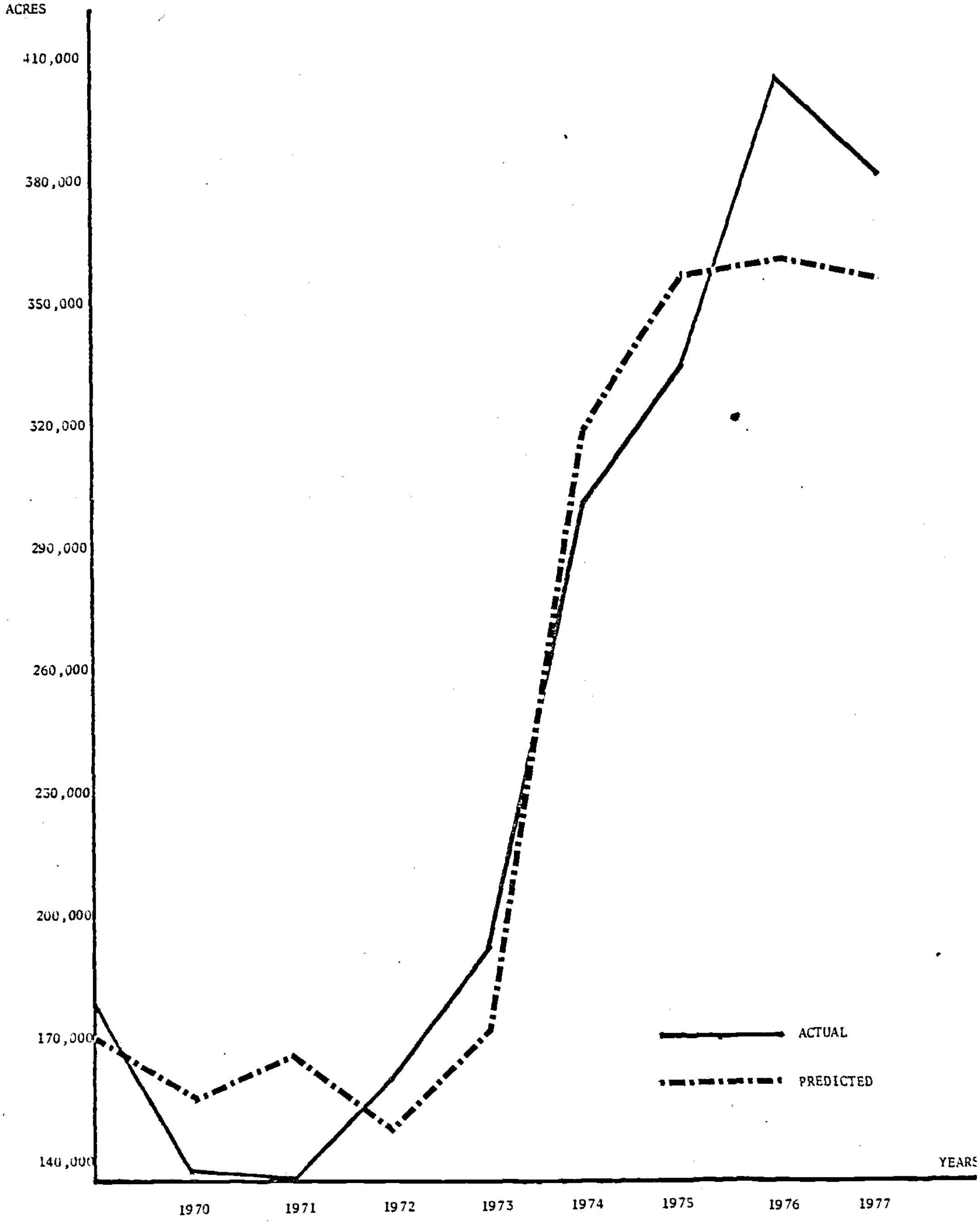
* (There was no irrigated wheat acreage in Western Washington for any of the years in the data set).

Sugarbeets were determined to be a viable economic substitute at the 20 percent level of probability. The estimated elasticity is -0.45 for the four regions considered in this model. Alfalfa, barley and peas were also hypothesized to be alternatives to wheat production, but were not statistically significant. Sugarbeets may no longer be a viable substitute because of the closing of a Washington processing plant.

Risk was not found to affect the irrigated wheat acreage planting decision. The estimated coefficient on this variable was not significant at 20 percent.

IRR(2) was used to estimate irrigated wheat acreage in the state over the estimation period. The annual estimation error was 11.5 percent with a standard deviation of 5.9. Figure 4-6 presents a graph of the predicted versus the actual irrigated wheat acreage in Washington from 1969 to 1977.

Figure 4-6. Predicted versus Actual Washington Irrigated Planted Wheat Acreage



CHAPTER V

SUMMARY AND CONCLUSIONS

Background

Three wheat acreage response models for Oregon and three for Washington have been developed. The first predicts total acreage planted of wheat in the state and the second and third functions predict planted wheat acreage separately for irrigated and dryland acreage.

Summary

Market Price

The impacts of changes in the expected market price of wheat, the effective wheat support rate and the effective wheat diversion rate on dryland wheat acreage are similar in eastern Oregon and eastern Washington and distinct from western Oregon and western Washington. The estimated elasticities with respect to the expected market price are elastic in the western regions of these two states and quite inelastic in the eastern regions. The wheat price elasticities for western Oregon and Washington dryland wheat acreage are much more elastic than the national estimate of 0.39. The higher elasticities reflect the importance of substitutes in these areas. The estimate of price elasticity for eastern Washington is much lower, and the eastern Oregon dryland estimate is the only price elasticity that approximates the national average response as estimated by Houck *et al*.

In general, the estimated elasticity of irrigated wheat acreage in Oregon and Washington with respect to the expected market price is about the same. The central areas of both states, the Columbia Basin in Oregon and the Central Washington region, are exceptions. The Oregon and Washington irrigated acreage elasticities with respect to the market price are much higher than the national average response. The increased elasticity reflects the importance of substitutes on irrigated acreage in the Northwest.

Government programs

The dryland acreage response to the effective support rate is divided geographically between the eastern and western regions of the two states. The effective support rate as measured by Houck et al. has no impact on the eastern regions with but one exception of the effective support rate in the Eastern Oregon region. In the western regions, the effective support price elasticity is more elastic than the national estimate of 0.58. The estimated response to the effective additional diversion rate is zero for all dryland wheat acreage in both Oregon and Washington.

The only responses with respect to the government programs on irrigated acreage were in Washington. It was found that the estimated Washington support price elasticity is slightly less than the national average while the Washington diversion price elasticity is positive, contrary to expectations, but not significantly different than zero. The government programs of wheat price support and wheat acreage diversion have no impact in Oregon.

Substitute Crops

Orchard grass in the Willamette Valley and alfalfa in the Washington

Columbia Basin were determined to be important substitutes to wheat production on dryland acreage. Potatoes are an economic substitute on irrigated acreage in Oregon outside of the Willamette Valley. Sugarbeets were found to be an economic substitute on irrigated acreage in eastern Washington. However, because of the closing of a processing plant in Washington, sugarbeets may no longer be a viable substitute in this region.

Risk

Risk, measured as a three year moving average of the standard deviation of gross income per acre, was determined to be an important factor affecting dryland wheat acreage in Oregon but not in Washington. This is contradictory to the findings of Winter and Whittaker who could not reject the hypothesis that the response to risk was significant and homogeneous across the three states of Oregon, Washington and Idaho. There was less variation in the risk variable for the major wheat producing regions of Washington than for these regions in Oregon. This was caused by more stable yields and production in Washington. The negative sign on the estimated coefficient implies a reduction of wheat acreage in response to an increase in the magnitude of the risk variable. The land that is transferred from wheat production in response to the risk factor must be transferred to another use. It is doubtful that the land is left idle. However, there were no important substitutes (including diversion) that were statistically significant on dryland wheat acreage in Eastern Oregon. There are several reasons that might explain this situation. Preliminary research by Wilson and Whittaker suggests that both the estimated coefficient and the significance of the risk variable are highly sensitive to the measurement used. Perhaps the risk measurement formulated by Lin was not the most appropriate. There is some question as to what the risk variable actually measures. There may also be an interaction between the risk variable and the government programs. The announced support price functions as a guaranteed price floor. By removing the lower end of the price distribution of potential market prices received by producers, the income risk would be reduced. The risk variable could be measuring this effect of the government programs.

Implications

Care should be exercised in interpreting the results of this research. The estimated acreage responses are only valid for the 12 years included in the estimation period, 1966 to 1977. The government wheat diversion/set-aside programs were not important in Oregon and were only slightly more important in Washington during these years because the payment levels were not high enough to elicit a significant acreage response in these areas. Producers found themselves better off in the open market. However, given escalating wheat price supports/target prices and potentially low market prices, the government wheat policy could have a greater impact in this region in the near future.

It is possible that the Northwest models are distinct from the national wheat supply model in that the Northwest white wheat market is distinct from the red wheat market. Different markets could partially explain why Northwest wheat producers do not react to the effective support rate and other market factors consistently with the national average. Given the preponderance of U.S. wheat production in the Wheat Belt, the support rate itself reflects how the red wheat producers in the Wheat Belt are expected to react on average. The relative prices between the season average price received by producers in Oregon, i.e., white wheat production, and the national season average price, i.e., reflecting mostly red wheat production, has not been constant from 1966 to 1977. Red and white wheat have different uses and different markets and are not perfect substitutes in food production.

In this study, regional acreage response varies substantially between irrigated and dryland acreage responses. The only exception is no response to diversion programs on either irrigated or dryland Oregon acreage. It is not possible to say which type of acreage most influenced the total state acreage models. In Oregon, the dryland acreage response model was very similar to the total acreage model, while in Washington the western dryland regions and the eastern irrigated regions showed more similarity with the state total acreage model than either the overall irrigated or dryland models. It is both possible and enlightening to make the distinction between the irrigated acreage response and the dryland acreage response. The average annual estimation error statistics reported for the six acreage response models in this study suggest these models are adequate for this purpose.

Nearly all of the regional estimated elasticities differ substantially from the national estimates of Houck et al. The disparate regional acreage responses imply that the national supply model is not an appropriate basis with which to calculate the responses of Northwest wheat producers to government wheat policy. If the government determines the national support and diversion prices in an effort to elicit some specific and known magnitude of wheat production or range of wheat production, at least regionally, these goals may not be met. For example, dryland wheat producers in western Oregon and Washington would increase wheat acreage more than expected from the national models in response to an increase in the effective wheat price support rate while eastern producers would not be expected to increase acres planted in response to such a change. Changes in the effective support rate were only found to affect the dryland planted acreage in the western regions. The weighted average elasticity of acreage response is 0.125 based on 1977 production for these two states computed from the disaggregated dryland and irrigated acreage models. This is indeed less than the national average of 0.39. Consequently, the increase in planted acreage in the western areas that would be greater than expected from the national supply model would not counteract the lack of increase in Eastern Oregon acreage to equal the increase in acreage desired by the policy makers.

In summary, this research supports the hypothesis that wheat should be disaggregated into dryland versus irrigated production and separate supply models estimated for each structural type. This study is also illustrative of the regional impacts of the government wheat programs and the regional influences on commodity supply that are masked by a national wheat supply model.

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APPENDIX A

OREGON AND WASHINGTON DATA

TABLE A-1. Oregon Planted Wheat Acreage by Region, 1966-1977 (Acres).*

Region	Year	AWPIRRW	AWPSFALW	AWPCCW	AWPIRRS	AWPSFALS	AWPCCS	AWPIRR	AWPDRY	SUMAWP
	1966	3500	29700	72600	300	1100	6600	3800	110000	113800
	1967	3500	36300	107900	100	400	5450	3600	150050	153650
	1968	1650	29600	86750	300	350	2850	1950	119550	121500
	1969	2650	24700	50150	450	700	6450	3100	82000	85100
	1970	2500	25750	44150	0	700	4400	2500	75000	77500
Willamette Valley	1971	2000	28250	51050	100	2500	12600	2100	94400	96500
	1972	2950	37200	64650	800	2200	6400	3750	110450	114200
	1973	4450	31450	125700	1050	1750	8000	5500	166900	172400
	1974	8650	19600	184050	650	1950	19700	9300	225300	234600
	1975	6450	20550	184150	1500	1800	18050	7950	224550	232500
	1976	8100	16700	222500	1200	850	20250	9300	260300	269600
	1977	9200	14200	230250	400	250	12650	9600	257350	266950
	1966	5200	529600	2500	1200	18500	0	6400	550600	557000
	1967	8700	703100	9600	500	19300	2400	9200	734400	743600
	1968	10500	703300	5700	900	8100	1800	11400	718900	730300
	1969	21300	559700	1500	600	14100	0	21900	575300	597200
	1970	19000	502000	2000	400	9700	0	19400	513700	533100
Columbia Basin	1971	18400	525100	500	900	18000	0	19300	543600	562900
	1972	18600	637500	1700	2300	10800	0	20900	650000	670900
	1973	20200	702300	25100	2500	37600	550	22700	765550	788250
	1974	44500	724800	16600	8200	85000	300	52700	826700	879400
	1975	66700	743400	18400	9900	32700	0	76600	794500	871100
	1976	75300	726000	36500	8150	38250	200	83450	800950	884400
	1977	77650	740500	4000	2600	22200	0	80250	766700	846950
	1966	17200	47400	1700	6300	1800	800	23500	51700	75200
	1967	22200	58100	2900	9100	4200	1800	31300	67000	98300
	1968	21000	60300	5100	4450	1850	1100	25450	68350	93800
	1969	20700	47900	2200	4750	3000	550	25450	53650	79100
	1970	16100	50100	3800	5100	2500	600	21200	57000	78200
Eastern Oregon	1971	17400	51400	2400	12700	4200	900	30100	58900	89000
	1972	12900	51700	3500	9800	4400	0	22700	59600	82300
	1973	15400	56800	4100	7550	3900	200	22950	65000	87950
	1974	29500	61700	7500	16700	5700	600	46200	75500	121700
	1975	21900	67600	5100	14500	5500	500	36400	78700	115100
	1976	24800	72300	4600	14250	10250	0	39050	87150	126200
	1977	20400	54450	2000	9450	11200	300	29850	67950	97800
	1966	15200	20400	800	6700	8500	1900	21900	31600	53500
	1967	18400	26300	1200	8150	9900	1300	26550	38700	65250
	1968	16050	29750	2300	4650	5450	0	20700	37500	58200
	1969	9400	28200	0	5500	6200	500	14900	34900	49800
	1970	10700	22200	0	5700	2900	0	16400	25100	41500
South-central Oregon	1971	8150	17200	2800	14850	10750	200	23000	30950	53950
	1972	7200	20800	0	10050	7550	400	17250	28750	46000
	1973	13100	32500	1400	7110	7600	1740	20210	43240	63450
	1974	19600	22100	2800	17100	17100	900	36700	42900	79600
	1975	23700	28750	0	10700	14250	0	34400	43000	77400
	1976	20500	31500	800	10350	15400	0	30850	47700	78550
	1977	16250	24400	400	5300	13200	0	21550	38000	59550
	1966	150	0	1050	0	0	300	150	1350	1500
	1967	400	0	1400	0	0	400	400	1800	2200
	1968	300	1000	2700	0	0	200	300	3900	4200
	1969	700	700	2200	0	0	200	700	3100	3800
	1970	350	400	1950	0	0	0	350	2350	2700
South-western Oregon	1971	300	350	1700	0	0	300	300	2350	2650
	1972	200	0	1400	100	0	200	300	1600	1900
	1973	200	0	1300	130	0	320	330	1620	1950
	1974	100	0	2000	0	0	100	100	2100	2200
	1975	450	850	3300	300	0	300	750	4450	5200
	1976	600	100	3900	150	0	700	750	4700	5450
	1977	100	1100	5050	50	0	400	150	6550	6700

Source: Statistical Reporting Service, USDA, Oregon State Office, Portland, Oregon.

* (Variable Definitions in Table A-11).

TABLE A-2. Oregon Wheat Acreage Harvested for Grain by Region, 1966-1977 (Acres).

Region	Year	AHGIRRW	AHGSFLAW	AHGCCW	AHGIRRS	AHGSFALS	AHGCCS	AHGIRR	AHGDRY	SUMAHG
	1966	3400	28800	69950	300	1100	6150	3700	106000	109700
	1967	3500	35500	105200	100	350	3950	3600	145000	148600
	1968	1650	28700	80750	300	350	2250	1950	112050	114000
	1969	2650	23700	48150	450	700	5950	3100	78500	81600
	1970	2500	25350	41650	0	600	3700	2500	71300	73800
Willamette	1971	2000	27250	48950	100	2250	11450	2100	89900	92000
Valley	1972	2750	36700	63050	750	1900	5750	3500	107400	110900
	1973	4450	30600	121550	1000	1550	7050	5450	160750	166200
	1974	8350	19000	182150	600	1700	19100	8950	221950	230900
	1975	6300	19900	179650	1400	1750	17200	7700	218500	226200
	1976	7850	15900	217050	1150	850	19200	9000	253000	262000
	1977	8650	13300	224100	350	150	10850	9000	248400	257400
	1966	4500	506500	2000	1000	15500	0	5500	524000	529500
	1967	8000	689500	8500	500	17500	2100	8500	717600	726100
	1968	10500	670400	4600	900	7200	1400	11400	683600	695000
	1969	20300	530000	1000	600	12900	0	20900	543900	564800
	1970	18500	462200	1500	400	8800	0	18900	472500	491400
Columbia	1971	17600	505900	500	900	16100	0	18500	522500	541000
Basin	1972	18000	614300	1700	2300	9900	0	20300	625900	646200
	1973	20000	652200	23100	2500	34050	500	22500	709850	732350
	1974	44300	695200	16400	8200	79900	300	52500	791800	844300
	1975	63500	730100	17600	9800	31100	0	73300	778800	852100
	1976	73800	722500	36500	8100	35400	200	81900	794600	876500
	1977	69900	709400	4000	2600	21300	0	72500	734700	807200
	1966	16600	46200	1500	5500	1200	500	22100	49400	71500
	1967	21700	57000	2800	8700	3800	1300	30400	64900	95300
	1968	20500	58600	4500	4450	1450	900	24950	65450	90400
	1969	20500	47200	2000	4750	2600	350	25250	52150	77400
	1970	15700	46800	3000	5100	2000	400	20800	52200	73000
Eastern	1971	16900	49800	2300	12200	3900	900	29100	56900	86000
Oregon	1972	12900	50500	3400	9500	3900	0	22400	57800	80200
	1973	15300	53400	3500	7450	3100	100	22750	60100	82850
	1974	28700	61100	7300	16400	5300	300	45100	74000	119100
	1975	20800	65800	4900	14500	5000	500	35300	76200	111500
	1976	24200	71000	4500	14100	9700	0	38300	85200	123500
	1977	20200	47500	2000	9100	9400	200	29300	59100	88400
	1966	14400	16300	800	6100	6000	1500	20500	24600	45100
	1967	17400	23100	1200	7000	8200	1200	24400	33700	58100
	1968	13850	26050	2200	4350	4350	0	18200	32600	50800
	1969	9200	24100	0	5450	5750	300	14650	30150	44800
	1970	8600	15800	0	5600	2400	0	14200	18200	32400
South-central	1971	7650	15250	0	14250	9750	0	21900	25000	46900
Oregon	1972	6400	17200	0	9750	6750	300	16150	24250	40400
	1973	12120	21880	1300	6775	5935	1640	18895	30755	49650
	1974	16750	17250	1700	16400	16100	600	33150	35650	68800
	1975	22300	15850	0	10350	12900	0	32650	28750	61400
	1976	18900	23250	200	9500	13950	0	28400	37400	65800
	1977	10850	13950	200	4900	10700	0	15750	24850	40600
	1966	150	0	900	0	0	250	150	1150	1300
	1967	400	0	1200	0	0	300	400	1500	1900
	1968	300	1000	2400	0	0	100	300	3500	3800
	1969	700	600	1900	0	0	200	700	2700	3400
	1970	350	300	1750	0	0	0	350	2050	2400
South-	1971	300	200	1400	0	0	200	300	1800	2100
western	1972	200	0	900	100	0	100	300	1000	1300
Oregon	1973	170	0	530	130	0	220	300	750	1050
	1974	100	0	1700	0	0	100	100	1800	1900
	1975	350	650	2300	200	0	300	550	3250	3800
	1976	600	50	3700	150	0	700	750	4450	5200
	1977	100	900	4950	50	0	400	150	6250	6400

Source: Statistical Reporting Service, USDA, Oregon State Office, Portland, Oregon.

TABLE A-3. Oregon Wheat Production by Region, 1966-1977 (100 bushels).

Region	Year	PRDIRRW	PRDSFALW	PRDCCW	PRDIRRS	PRDSFALS	PRDCCS	PRDIRR	PRDDRY	TOTPROD
	1966	2310	16490	33640	125	434	1711	2435	52275	54710
	1967	2180	17640	45330	40	90	815	2220	63875	66095
	1968	955	16121	38924	113	110	400	1068	55555	56623
	1969	1500	15092	25089	211	320	2006	1711	42507	44218
	1970	1588	14398	20280	0	214	1193	1588	36085	37673
Willamette	1971	1323	17826	29227	50	938	3928	1373	51919	53292
Valley	1972	1960	24813	37922	354	813	1798	2314	65346	67660
	1973	3761	26483	87460	614	1069	4077	4375	119089	123464
	1974	5721	12713	114081	315	941	7682	6036	135417	141453
	1975	4879	15317	116843	741	796	6866	5620	139822	145442
	1976	6425	10540	153176	660	369	8137	7085	172222	179307
	1977	6927	10643	157030	160	65	3628	7087	171366	178453
	1966	2300	148890	500	380	3475	0	2680	152865	155545
	1967	4100	187050	2220	163	3073	219	4263	192562	196825
	1968	6365	166550	1115	448	846	236	6813	168747	175560
	1969	13300	174490	200	348	2928	0	13648	177618	191266
	1970	10910	169500	570	175	1895	0	11085	171965	183050
Columbia	1971	10605	211870	165	340	3615	0	10945	215650	226595
Basin	1972	11440	228499	581	1010	1989	0	12450	231069	243519
	1973	11000	155548	7826	1000	9282	200	12000	172856	184856
	1974	33870	232958	5580	4320	18990	60	38190	257588	295778
	1975	49240	272056	9808	5101	6445	0	54341	288309	342650
	1976	59531	253389	16400	4299	8671	40	63830	278500	342330
	1977	47318	157710	1105	1545	3343	0	48863	162158	211021
	1966	8430	15840	440	2721	259	90	11151	16629	27780
	1967	12340	22502	770	4120	765	210	16460	24247	40707
	1968	11965	25095	1350	2171	226	188	14136	26859	40995
	1969	13890	22955	700	2355	630	85	16245	24370	40615
	1970	9795	20295	1155	2578	630	90	12373	22170	34543
Eastern	1971	11600	25360	790	6175	623	102	17775	26875	44650
Oregon	1972	10098	25452	1540	4235	946	0	14333	27938	42271
	1973	10950	20236	1225	4791	607	20	15741	22088	37829
	1974	18971	29876	2224	8899	1145	45	27870	33290	61160
	1975	16812	32505	1470	9566	1549	118	26378	35642	62020
	1976	17770	21745	855	8466	2894	0	26236	25494	51730
	1977	13548	19766	700	6890	2873	64	20438	23403	43841
	1966	9440	3260	90	2519	1452	244	11959	5046	17005
	1967	10890	5460	330	2456	1562	157	13346	7509	20855
	1968	8811	7999	330	1580	936	0	10391	9265	19656
	1969	6109	7026	0	2953	1265	50	9062	8341	17403
	1970	5145	3063	0	2358	438	0	7503	3501	11004
South-central	1971	5798	4552	0	6483	2147	0	12281	6699	18980
Oregon	1972	5398	3647	0	4025	1296	36	9423	4979	14402
	1973	7691	3233	134	3768	1493	212	11459	5072	16531
	1974	11518	4359	386	8445	3485	90	19963	8320	28283
	1975	16360	3643	0	5265	3162	0	21625	6805	28430
	1976	14711	3879	30	4973	2998	0	19684	6907	26591
	1977	7816	2418	20	2850	2200	0	10666	4638	15304
	1966	80	0	370	0	0	90	80	460	540
	1967	190	0	440	0	0	80	190	520	710
	1968	170	450	860	0	0	30	170	1340	1510
	1969	433	175	863	0	0	53	433	1091	1524
	1970	195	125	582	0	0	0	195	707	902
South-	1971	150	128	768	0	0	80	150	976	1126
western	1972	145	0	405	50	0	30	195	435	630
Oregon	1973	126	0	328	91	0	69	217	397	614
	1974	70	0	677	0	0	35	70	712	782
	1975	216	353	998	130	0	163	346	1514	1860
	1976	470	21	2260	65	0	240	535	2521	3056
	1977	85	410	3905	20	0	162	105	4477	4582

Source: Statistical Reporting Service, USDA, Oregon State Office, Portland, Oregon.

TABLE A-4. Expected Prices of Wheat and Hypothesized Substitutes in Oregon by Region, 1966-1967.

Region	Year	Wheat ($/bu)	Barley ($/bu)	Alfalfa ($/bu)	Potatoes ($/cwt)	Orchard Grass ($/bu)	Red Clover ($/ton)
	1966	$1.39	$1.11	$ .00	$ .00	$21.28	$26.13
	1967	1.60	1.18	.00	.00	19.41	23.50
	1968	1.44	1.15	.00	.00	20.32	30.73
	1969	1.12	.98	.00	.00	26.74	40.59
	1970	1.31	.97	.00	.00	25.19	40.03
Willamette Valley	1971	1.49	1.06	.00	.00	25.16	34.18
	1972	1.44	1.11	.00	.00	24.94	29.32
	1973	2.05	1.48	.00	.00	24.09	46.40
	1974	4.56	2.39	.00	.00	35.91	83.72
	1975	4.50	3.00	.00	.00	34.07	65.54
	1976	3.68	2.50	.00	.00	27.97	55.08
	1977	2.81	2.26	.00	.00	31.98	79.38
	1966	1.38	1.11	27.00	3.03	.00	.00
	1967	1.59	1.19	27.46	2.22	.00	.00
	1968	1.43	1.15	28.40	1.87	.00	.00
	1969	1.33	1.01	30.48	1.98	.00	.00
	1970	1.32	.92	28.80	2.53	.00	.00
Columbia Basin	1971	1.47	1.06	27.92	2.15	.00	.00
	1972	1.44	1.10	36.74	1.86	.00	.00
	1973	2.06	1.47	34.62	2.84	.00	.00
	1974	4.67	2.38	58.32	4.64	.00	.00
	1975	4.45	3.03	68.86	3.84	.00	.00
	1976	3.84	2.56	66.40	3.27	.00	.00
	1977	2.84	2.32	73.28	2.57	.00	.00
	1966	1.28	1.01	26.17	2.15	.00	.00
	1967	1.48	1.08	29.33	2.31	.00	.00
	1968	1.31	1.05	24.38	2.23	.00	.00
	1969	1.25	.94	24.70	2.17	.00	.00
	1970	1.23	.91	24.67	2.63	.00	.00
Eastern Oregon	1971	1.36	.98	24.80	2.35	.00	.00
	1972	1.33	1.03	32.55	2.14	.00	.00
	1973	1.97	1.39	33.45	2.79	.00	.00
	1974	4.79	2.34	55.08	2.83	.00	.00
	1975	4.18	2.95	61.30	4.44	.00	.00
	1976	3.70	2.61	62.90	4.02	.00	.00
	1977	2.47	2.42	64.45	3.49	.00	.00
	1966	1.36	1.07	28.33	2.10	.00	.00
	1967	1.57	1.12	30.95	2.24	.00	.00
	1968	1.42	1.10	27.90	1.65	.00	.00
	1969	1.33	1.06	30.67	2.37	.00	.00
	1970	1.27	1.00	30.56	2.28	.00	.00
South-central Oregon	1971	1.42	1.00	30.00	1.71	.00	.00
	1972	1.39	1.06	33.99	1.86	.00	.00
	1973	1.99	1.42	37.70	3.07	.00	.00
	1974	4.67	2.51	58.65	4.69	.00	.00
	1975	4.45	3.06	65.37	3.65	.00	.00
	1976	3.77	2.56	65.24	3.57	.00	.00
	1977	2.68	2.31	72.60	3.78	.00	.00
	1966	1.28	1.00	33.33	2.08	.00	.00
	1967	1.46	1.07	35.30	2.24	.00	.00
	1968	1.32	1.03	31.37	1.66	.00	.00
	1969	1.30	1.09	34.00	2.54	.00	.00
	1970	1.25	1.13	33.63	3.28	.00	.00
Southwestern Oregon	1971	1.28	.95	33.37	2.37	.00	.00
	1972	1.67	1.16	37.77	2.68	.00	.00
	1973	1.94	1.61	40.63	3.52	.00	.00
	1974	4.25	2.34	57.53	5.41	.00	.00
	1975	4.35	2.89	68.77	4.46	.00	.00
	1976	3.76	2.63	67.57	3.86	.00	.00
	1977	2.95	2.39	75.03	3.38	.00	.00

Source: Oregon State Extension Economic Information Office, Oregon State University, Corvallis, Oregon.

TABLE A-5. Government Policy Variables for Wheat in Oregon: Announced Loan Rate, Effective Support Rate, Effective Diversion Rate, Acreage Allotment; Participating Acreage by Region, 1966-1977.

Region	Year	Loan Rate ($/bu)	Support Rate ($/bu)	Diversion Rate ($/bu)	Allotment (acres)	Participating Acreage (acres)
	1966	1.34	1.72	.17	92614	50078
	1967	1.34	1.75	.00	121459	70109
	1968	1.34	1.76	.00	105715	64859
	1969	1.34	1.76	.22	92329	62083
	1970	1.34	1.56	.19	81584	54252
Willamette Valley	1971	1.34	1.75	.00	29485	25526
	1972	1.34	1.68	.04	28324	25059
	1973	1.34	1.51	.17	26486	24448
	1974	1.51	1.99	.00	99990	0
	1975	1.50	1.96	.00	75186	0
	1976	1.66	1.69	.00	86440	0
	1977	2.40	2.57	.00	86816	77246
	1966	1.30	1.68	.17	519646	505412
	1967	1.30	1.71	.00	689393	673174
	1968	1.30	1.72	.00	597420	583636
	1969	1.30	1.72	.21	522542	507023
	1970	1.30	1.53	.19	458206	448009
Columbia Basin	1971	1.30	1.71	.00	202246	199372
	1972	1.30	1.64	.04	204714	202748
	1973	1.30	1.47	.17	196716	195777
	1974	1.48	1.96	.00	49995	0
	1975	1.48	1.94	.00	576807	0
	1976	1.64	1.67	.00	662867	0
	1977	2.38	2.55	.00	665661	597858
	1966	1.23	1.61	.16	90180	74608
	1967	1.23	1.64	.00	120246	102357
	1968	1.24	1.66	.00	103652	88628
	1969	1.24	1.65	.20	91011	80100
	1970	1.23	1.47	.18	79704	69072
Eastern Oregon	1971	1.23	1.64	.00	32396	30911
	1972	1.23	1.57	.04	32883	30865
	1973	1.23	1.40	.16	31640	29564
	1974	1.38	1.86	.00	39996	0
	1975	1.38	1.84	.00	89923	0
	1976	1.54	1.57	.00	102378	0
	1977	2.29	2.46	.00	104450	98525
	1966	1.27	1.65	.17	62563	47670
	1967	1.27	1.68	.00	82793	66019
	1968	1.28	1.70	.00	71955	56530
	1969	1.28	1.69	.21	62812	50557
	1970	1.27	1.50	.18	55573	44865
South-central Oregon	1971	1.28	1.69	.00	21801	20005
	1972	1.28	1.62	.04	27097	20486
	1973	1.28	1.45	.16	20529	19568
	1974	1.43	1.91	.00	79992	0
	1975	1.43	1.89	.00	60002	0
	1976	1.59	1.62	.00	69144	0
	1977	2.33	2.50	.00	79941	63455
	1966	1.17	1.55	.15	1673	451
	1967	1.17	1.58	.00	2179	440
	1968	1.17	1.59	.00	1894	355
	1969	1.17	1.59	.19	1669	473
	1970	1.17	1.42	.17	1470	332
Southwestern Oregon	1971	1.17	1.58	.00	356	149
	1972	1.17	1.51	.04	320	146
	1973	1.17	1.34	.15	268	188
	1974	1.31	1.79	.00	29997	0
	1975	1.30	1.76	.00	572	0
	1976	1.46	1.49	.00	601	0
	1977	2.20	2.37	.00	605	592

Source: Statistical Reporting Service, USDA, Oregon State Office, Portland, Oregon.

TABLE A-6. Washington Planted Wheat Acreage by Region, 1966-1977 (Acres).

Region	Year	AWPIRRW	AWPSFALW	AWPCCW	AWPIRRS	AWPSFALS	AWPCCS	AWPIRR	AWPDRY	SUMAWP
	1966	12600	944400	49100	500	11600	1900	13100	1007000	1020100
	1967	19300	1129400	52500	600	24300	5500	19900	1211700	1231600
	1968	21200	1097600	45800	1100	6200	3000	22300	1152600	1174900
	1969	30100	1002900	23400	1400	26800	200	31500	1053300	1084800
	1970	14900	917400	39500	1000	4400	900	15900	962200	978100
Southeastern	1971	12500	897100	32700	400	18100	4400	12900	952300	965200
Washington	1972	12900	1113900	73900	0	4700	400	12900	1192900	1205800
	1973	18300	769600	69600	5000	286300	51200	23300	1176700	1200000
	1974	22200	926900	166400	5100	114600	126200	27300	1334100	1361400
	1975	24700	906300	264500	2400	67600	81900	27100	1320300	1347400
	1976	41000	863100	326200	4500	29800	109280	45500	1328380	1373880
	1977	53100	846500	233100	2000	9400	13900	55100	1202900	1258000
	1966	94900	896600	7500	9700	22300	0	104600	926400	1031000
	1967	153800	964700	41800	6500	59900	3500	160300	1069900	1230200
	1968	177200	961100	18400	3000	21500	200	180200	1001200	1181400
	1969	103700	810200	7400	22100	124900	5200	125800	947700	1073500
	1970	80100	784100	21500	18200	35300	0	98300	840900	939200
Washington	1971	80500	868600	14300	17800	60100	6000	98300	949000	1047300
Columbia Basin	1972	94900	925700	15400	27600	37200	200	122500	978500	1101000
	1973	91300	777500	58200	49200	190500	12500	140500	1038700	1179200
	1974	168600	977200	51300	37300	73000	4800	205900	1106300	1312200
	1975	183800	950400	66400	47200	48460	2800	231000	1068060	1299060
	1976	215250	992850	70500	56620	53750	4900	271870	1122000	1393870
	1977	199800	984400	59900	75700	61100	2100	275500	1107500	1383000
	1966	15600	79200	3200	6800	12200	400	22400	95000	117400
	1967	30300	104600	4900	5200	15500	7400	35500	132400	167900
	1968	22300	116300	1000	3600	17400	3100	25900	137800	163700
	1969	15200	105000	700	4900	4700	500	20100	110900	131000
	1970	14800	95300	1400	5100	4200	300	19900	101200	121100
Central	1971	18200	92200	600	4000	9400	1300	22200	103500	125700
Washington	1972	14000	106600	100	7700	5200	500	21700	112400	134100
	1973	20200	111100	8400	7000	4900	900	27200	125300	152500
	1974	46100	115300	0	19000	11400	600	65100	127300	192400
	1975	49700	135100	8000	24500	13000	4140	74200	160240	234440
	1976	54300	121470	4930	29400	17490	1210	83700	145100	228800
	1977	31800	108600	0	16100	6200	1200	47900	116000	163900
	1966	1900	177400	2400	200	50600	1100	2100	231500	233600
	1967	3200	239800	600	600	41200	4100	3800	285700	289500
	1968	1100	226600	1900	200	18300	2400	1300	249200	250500
	1969	1200	250200	0	200	18400	800	1400	269400	270800
	1970	1100	178500	900	400	35400	2200	1500	217000	218500
Northeastern	1971	1100	191400	1700	400	40700	1700	1500	235500	237000
Washington	1972	1000	209900	400	500	38500	2100	1500	250900	252400
	1973	1100	269600	0	500	6000	400	1600	276000	277600
	1974	1500	190800	4000	1400	77900	8100	2900	280800	283700
	1975	1200	214400	6900	800	32600	2700	2000	256600	258600
	1976	1710	241490	4400	1510	6190	1950	3220	254030	257250
	1977	1400	267800	4500	1400	2900	600	2800	275800	278600
	1966	0	0	3700	0	0	700	0	4400	4400
	1967	0	0	3100	0	0	700	0	3800	3800
	1968	0	0	3500	0	0	1000	0	4500	4500
	1969	0	0	3000	0	0	900	0	3900	3900
	1970	0	0	2700	0	0	600	0	3300	3300
Western	1971	0	0	3100	0	0	700	0	3800	3800
Washington	1972	0	0	3300	0	0	400	0	3700	3700
	1973	0	0	9100	0	0	600	0	9700	9700
	1974	0	0	16750	0	0	550	0	17300	17300
	1975	0	0	13600	0	0	1900	0	15500	15500
	1976	0	0	12800	0	0	8400	0	21200	21200
	1977	0	0	16100	0	0	7400	0	23500	23500

Source: Statistical Reporting Service, USDA, Washington State Office, Seattle, Washington.

TABLE A-7. Washington Wheat Acreage Harvested for Grain by Region, 1966-1977 (Acres).

Region	Year	AHGIRRW	AHGSFALW	AHGCCW	AHGIRRS	AHGSFALS	AHGCCS	AHGIRR	AHGDRY	SUMAHG
	1966	12300	895200	47600	500	9500	1600	12800	953900	966700
	1967	19200	1108700	52100	600	23400	5300	19800	1189500	1209300
	1968	21000	1086800	45200	1100	5700	2800	22100	1140500	1162600
	1969	28600	922300	22100	1400	26100	200	30000	970700	1000700
	1970	14700	888200	39100	1000	4200	800	15700	932300	948000
Southeastern	1971	12500	888000	32500	400	18000	4300	12900	942800	955700
Washington	1972	12400	1080400	70400	0	4000	400	12400	1155200	1167600
	1973	17900	732000	67900	5000	281900	49500	22900	1131300	1154200
	1974	22200	924900	165700	4100	112900	123500	27300	1327000	1354300
	1975	24400	883200	248900	2400	66000	79000	26800	1277100	1303900
	1976	40300	844400	318000	4400	28400	106600	44700	1297400	1342100
	1977	52500	924500	222000	2000	8900	12900	54500	1168300	1222800
	1966	93400	826900	7100	8500	19700	0	101900	853700	955600
	1967	150200	947700	41100	6000	59200	3200	156200	1051200	1207400
	1968	175100	911500	17400	3000	20400	200	178100	949500	1127600
	1969	99900	717400	6300	21400	120000	3700	121300	847400	968700
	1970	78000	707400	20600	17800	34000	0	95800	762000	857800
Washington	1971	78400	854500	13800	17600	58700	6000	96000	933000	1029000
Columbia Basin	1972	91600	900300	14700	26500	32000	100	118100	947100	1065200
	1973	88800	745800	57400	48800	183100	12500	137600	998800	1136400
	1974	167100	968200	51200	37200	71500	4700	204300	1095600	1299900
	1975	177000	931700	64300	46300	46500	2700	223300	1045200	1268500
	1976	212500	976000	65500	55600	51800	4500	268100	1097800	1365900
	1977	198000	949600	58000	74000	53300	1900	272000	1062800	1334800
	1966	15600	72900	3100	6200	11000	400	21800	87400	109200
	1967	28700	98800	4500	5100	14600	6900	33800	124800	158600
	1968	22100	101600	1000	3500	14700	2800	25600	120100	145700
	1969	14200	89000	600	4500	3600	300	18700	93500	112200
	1970	14000	82900	1300	5000	3100	100	19000	87400	106400
Central	1971	17800	88500	600	3900	8400	1100	21700	98600	120300
Washington	1972	13400	100800	100	6900	4500	400	20300	105800	126100
	1973	19900	107600	7900	6800	4500	800	26700	120800	147500
	1974	45800	113800	0	18600	10700	500	64400	125000	189400
	1975	48100	127100	7600	23800	12600	4000	71900	151300	223200
	1976	52700	118500	4800	28700	16700	1100	81400	141100	222500
	1977	30800	83400	0	14600	4800	1000	45400	89200	134600
	1966	1900	151800	2350	200	42800	1000	2100	197950	200050
	1967	3200	231000	500	600	40600	3900	3800	276000	279800
	1968	1100	219900	1800	200	17500	2300	1300	241500	242800
	1969	1000	208400	0	200	17300	700	1200	226400	227600
	1970	1100	154900	900	400	34000	2100	1500	191900	193400
Northeastern	1971	1100	173100	1600	400	39000	1600	1500	215300	216800
Washington	1972	800	202100	300	500	34500	1800	1300	238700	240000
	1973	900	265500	0	500	5700	400	1400	271600	273000
	1974	1400	180400	3700	1200	76600	7000	2600	267700	270300
	1975	1100	208700	6100	800	31600	2600	1900	249000	250900
	1976	1600	235700	4000	1500	5800	1900	3100	247400	250500
	1977	1400	262200	4000	1300	2700	600	2700	269500	272200
	1966	0	0	2870	0	0	600	0	3470	3470
	1967	0	0	2300	0	0	600	0	2900	2900
	1968	0	0	2500	0	0	800	0	3300	3300
	1969	0	0	2200	0	0	600	0	2800	2800
	1970	0	0	1900	0	0	500	0	2400	2400
Western	1971	0	0	2600	0	0	600	0	3200	3200
Washington	1972	0	0	2700	0	0	400	0	3100	3100
	1973	0	0	8400	0	0	500	0	8900	8900
	1974	0	0	15640	0	0	460	0	16100	16100
	1975	0	0	11800	0	0	1700	0	13500	13500
	1976	0	0	11000	0	0	8000	0	19000	19000
	1977	0	0	13600	0	0	7000	0	20600	20600

Source: Statistical Reporting Service, USDA, Washington State Office, Seattle, Washington.

TABLE A-8. Washington Wheat Production by Region, 1966-1967 (100 bushels).

Region	Year	PRDIRRW	PRDSFALW	PRDCCW	PRDIRRS	PRDSFALS	PRDCCS	PRDIRR	PRDDRY	TOTPROD
Southeastern Washington	1966	9744	287712	156254	242	2387	445	9986	446798	456784
	1967	13402	513182	26816	278	5309	1326	13680	546633	560313
	1968	13890	473139	20736	560	1566	796	14450	496237	510687
	1969	19302	461669	10995	700	5028	66	20002	477758	497760
	1970	10825	466508	21257	480	937	216	11305	488918	500223
	1971	9980	521694	20211	248	6578	1558	10228	550041	560269
	1972	9179	606148	42884	0	1277	118	9179	650427	659606
	1973	12119	275163	28551	2550	68941	12079	14669	384734	399403
	1974	15105	412752	87878	2177	28526	37772	17282	566928	584210
	1975	15370	455528	122230	1280	20528	23192	16650	621478	638128
	1976	28424	397432	157864	2438	8670	34046	30862	598012	628874
	1977	41020	333395	66810	790	965	1544	41810	402714	444524
Washington Columbia Basin	1966	78140	241331	3208	5141	4325	0	83281	248864	332145
	1967	106404	284909	15957	3333	10693	221	109737	311780	421517
	1968	136947	252821	6262	1880	3484	34	138827	262601	401428
	1969	71428	186469	2213	10754	18081	629	82182	207392	289574
	1970	59758	255928	8714	9188	4352	0	68946	268994	337940
	1971	64579	348394	4623	10537	14152	1200	75116	368369	443485
	1972	70788	329630	5172	14853	5199	31	85641	340032	425673
	1973	71276	227698	13376	31288	26266	1830	102564	269170	371734
	1974	125842	321836	16636	21355	11129	789	147197	350390	497587
	1975	145080	421528	30057	27020	8503	744	172100	460832	632932
	1976	170725	372716	29139	33124	8127	1004	203849	410986	614835
	1977	154120	233754	12100	38805	6137	184	192925	252175	445100
Central Washington	1966	12668	22427	931	3518	1881	116	16186	25355	41541
	1967	21994	30002	1350	2790	2213	1159	24784	34724	59508
	1968	17835	26090	250	2108	2316	440	19943	29096	49039
	1969	10392	19967	132	2228	621	54	12620	20774	33394
	1970	10599	19427	208	2672	438	11	13271	20084	33355
	1971	14475	30239	222	2208	1827	263	16683	32551	49234
	1972	11181	34734	18	4657	896	72	15838	35720	51558
	1973	16104	27296	1580	4609	635	123	20713	29634	50347
	1974	32678	30140	0	12694	1374	80	45372	31594	76966
	1975	42611	46138	2059	14162	2766	768	56773	51731	108504
	1976	44934	36325	1238	15843	3262	188	60777	41013	101790
	1977	21990	18385	0	7751	500	105	29741	18990	48731
Northeastern Washington	1966	1126	48327	556	82	10978	234	1208	60095	61303
	1967	2013	84561	199	285	8699	895	2298	94354	96652
	1968	726	65865	657	94	3815	597	820	70934	71754
	1969	713	60239	0	116	3367	163	829	63769	64598
	1970	823	46559	342	200	6560	474	1023	53935	54958
	1971	883	65879	668	188	10142	464	1071	76153	77224
	1972	648	82888	150	252	10005	567	900	93610	94510
	1973	633	61320	0	230	1205	48	863	62573	63436
	1974	867	49733	851	544	13688	1247	1411	65519	66930
	1975	703	77245	2245	444	7999	702	1147	88191	89338
	1976	1043	78339	1350	766	1166	398	1809	81253	83062
	1977	1040	58930	1320	617	371	99	1657	60720	62377
Western Washington	1966	0	0	1437	0	0	231	0	1668	1668
	1967	0	0	1291	0	0	199	0	1490	1490
	1968	0	0	1511	0	0	310	0	1821	1821
	1969	0	0	1283	0	0	194	0	1477	1477
	1970	0	0	1303	0	0	222	0	1525	1525
	1971	0	0	1639	0	0	249	0	1888	1888
	1972	0	0	1779	0	0	154	0	1933	1933
	1973	0	0	6884	0	0	197	0	7081	7081
	1974	0	0	9607	0	0	201	0	9808	9808
	1975	0	0	9206	0	0	692	0	9898	9898
	1976	0	0	7571	0	0	4368	0	11939	11939
	1977	0	0	9138	0	0	3182	0	12320	12320

Source: Statistical Reporting Service, USDA, Washington State Office, Seattle, Washington.

Table A-9. Expected Prices of Wheat and Hypothesized Substitutes in Washington, 1966-1977.

Year	Wheat ($/bu)	Barley ($/bu)	Alfalfa ($/bu)	Peas ($/cwt)	Sugarbeets ($/ton)
1966	1.33	1.05	38.50	4.35	12.30
1967	1.56	1.08	39.50	4.65	12.80
1968	1.43	1.06	41.00	4.45	13.70
1969	1.30	.96	42.00	4.70	14.20
1970	1.29	.88	40.00	4.35	15.00
1971	1.48	1.00	39.50	4.20	17.00
1972	1.34	.97	37.00	3.45	17.90
1973	2.20	1.35	54.00	5.55	32.40
1974	4.90	2.50	104.00	19.50	45.50
1975	4.20	2.60	77.00	10.00	26.10
1976	3.85	2.55	67.00	7.60	18.00
1977	2.85	2.30	118.00	11.30	23.00

Sources:

wheat, barley, alfalfa: Agricultural Prices Annual Summary, Crop Reporting Board, USDA; Washington D.C., 1966-1977.

peas: Field and Seed Crops, Revised Estimates, 1964-1969, Statistical Bulletin No. 313, Crop Reporting Board, SRS/USDA; Washington D.C., March 1973.
Field Crops, Crop Reporting Board, SRS/USDA; Washington D.C., 1973-1977.

sugarbeets: Washington Agricultural Statistics Annual Crop Report, 1971, State of Washington Department of Agriculture, Seattle, Washington.
Washington Agricultural Statistics, Washington Crop and Livestock Reporting Service, Seattle, Washington, 1974-1976.

TABLE A-10. Government Policy Variables for Wheat in Washington: Announced Loan Rate, Effective Support Rate, Effective Diversion Rate, Acreage Allotment and Participating Acreage by Region, 1966-1977.

Region	Year	Loan Rate ($/bu)	Support Rate ($/bu)	Diversion Rate ($/bu)	Allotment (acres)	Participating Acreage (acres)
Southeastern Washington	1966	$1.25	$1.63	$.16	798612	748383
	1967	1.25	1.66	.00	1052286	1018917
	1968	1.25	1.67	.00	918245	888766
	1969	1.25	1.67	.20	797738	774163
	1970	1.25	1.48	.18	703671	685398
	1971	1.26	1.67	.00	308510	305137
	1972	1.26	1.60	.04	314846	311924
	1973	1.26	1.43	.16	299676	295972
	1974	1.43	1.91	.00	894284	0
	1975	1.44	1.90	.00	878932	0
	1976	1.59	1.62	.00	59994	0
	1977	2.33	2.50	.00	1784907	838427
Washington Columbia Basin	1966	1.28	1.66	.17	702614	651665
	1967	1.28	1.69	.00	930837	881540
	1968	1.28	1.70	.00	807646	766897
	1969	1.28	1.70	.21	705952	673731
	1970	1.28	1.51	.19	621758	591153
	1971	1.28	1.69	.00	265644	260258
	1972	1.28	1.62	.04	276699	272233
	1973	1.28	1.45	.16	264426	261589
	1974	1.45	1.93	.00	786554	0
	1975	1.47	1.93	.00	771551	0
	1976	1.62	1.65	.00	49995	0
	1977	2.36	2.53	.00	1590348	871188
Central Washington	1966	1.32	1.69	.17	110499	86615
	1967	1.32	1.73	.00	145603	115097
	1968	1.31	1.73	.00	127218	105625
	1969	1.32	1.73	.22	144742	97179
	1970	1.32	1.54	.19	103228	86977
	1971	1.31	1.72	.00	41531	39015
	1972	1.31	1.65	.04	41793	39788
	1973	1.31	1.48	.17	39601	37727
	1974	1.48	1.96	.00	118581	0
	1975	1.49	1.95	.00	113247	0
	1976	1.64	1.67	.00	49995	0
	1977	2.38	2.55	.00	230268	113680
Northeastern Washington	1966	1.26	1.64	.16	174519	162252
	1967	1.26	1.67	.00	230359	214097
	1968	1.26	1.68	.00	200525	177614
	1969	1.26	1.68	.21	174974	162838
	1970	1.26	1.49	.18	153483	144869
	1971	1.26	1.67	.00	65379	64089
	1972	1.26	1.60	.04	67263	65957
	1973	1.26	1.43	.16	64174	63226
	1974	1.43	1.91	.00	190264	0
	1975	1.45	1.91	.00	187882	0
	1976	1.60	1.63	.00	39996	0
	1977	2.34	2.51	.00	305296	214619
Western Washington	1966	1.28	1.66	.17	6162	2282
	1967	1.27	1.68	.00	8102	2825
	1968	1.27	1.69	.00	7081	2529
	1969	1.27	1.69	.21	6136	2444
	1970	1.28	1.50	.18	5312	1959
	1971	1.33	1.74	.00	1273	904
	1972	1.33	1.67	.04	1204	875
	1973	1.34	1.51	.17	1084	838
	1974	1.51	1.99	.00	3250	0
	1975	1.51	1.97	.00	2469	0
	1976	1.67	1.70	.00	109989	0
	1977	2.43	2.60	.00	52668	2759

Source: Agricultural Stabilization and Crop Service, USDA; Washington State Office, Spokane, Washington.

TABLE A-11. Variable Definitions

AWPIRRW	=	Acreage planted of irrigated winter wheat
AWPSFALW	=	Acreage planted of summer-fallow and after-legumes winter wheat
AWPCCW	=	Acreage planted of continuously cropped winter wheat
AWPIRRS	=	Acreage planted of irrigated spring wheat
AWPSFALS	=	Acreage planted of summer-fallow and after-legumes spring wheat
AWPCCS	=	Acreage planted of continuously cropped spring wheat
AWPIRR	=	Acreage planted of all irrigated wheat
AWPDRY	=	Acreage planted of all dryland wheat
SUMAWP	=	Acreage planted of all wheat
AHGIRRW	=	Acreage harvested for grain of irrigated winter wheat
AHGSFALW	=	Acreage harvested for grain of summer-fallow and after-legumes winter wheat
AHGCCW	=	Acreage harvested for grain of continuously cropped winter wheat
AGHIRRS	=	Acreage harvested for grain of irrigated spring wheat
AHGSFALS	=	Acreage harvested for grain of summer-fallow and after-legumes spring wheat
AHGCCS	=	Acreage harvested for grain of continuously cropped spring wheat
AHGIRR	=	Acreage harvested for grain of all irrigated wheat
AHGDRY	=	Acreage harvested for grain of all dryland wheat
SUMAHG	=	Acreage harvested for grain of all wheat
PRDIRRW	=	Production of irrigated winter wheat; (100 bushels)
PRDSFALW	=	Production of summer-fallow and after-legumes winter wheat; (100 bushels)
PRDCCW	=	Production of continuously cropped winter wheat; (100 bushels)
PRDIRRS	=	Production of irrigated spring wheat; (100 bushels)
PRDSFALS	=	Production of summer-fallow and after-legumes spring wheat; (100 bushels)
PRDCCS	=	Production of continously cropped spring wheat; (100 bushels)
PRDIRR	=	Production of all irrigated wheat; (100 bushels)
PRDDRY	=	Production of all dryland wheat; (100 bushels)
TOTPROD	=	Production of all wheat; (100 bushels)
WHEAT	=	Weighted regional price of wheat in year t-1; (dollars per bushel)
BARLEY	=	Average of county prices of barley in year t-1; (dollars per bushel)
ALFALFA	=	Average of county prices of alfalfa in year t-1; (dollars per ton)
POTATOES	=	Average of county prices of potatoes in year t-1; (dollars per cwt)
ORCHARD GRASS	=	Average of county prices of orchard grass in year t-1; (dollars per bushel)
RED CLOVER	=	Average of county prices of red clover in year t-1 (dollars per ton)
PEAS	=	Price of dry edible peas in year t-1; (dollars per cwt)
SUGARBEETS	=	Price of sugarbeets in year t-1; (dollars per ton)
LOAN	=	Weighted regional announced support rate for wheat in year t; (dollars per bushel)
HES	=	Effective support rate for wheat in year t as formulated by Houck et al; (dollars per bushel)

TABLE A-11. (Cont)

HED	=	Effective diversion rate for wheat in year t as formulated by Houck, et al.; (dollars per bushel)
ALLOTMENT	=	Sum of county allotments for wheat; (acres)
PARTICIPATING ACREAGE	=	Acreage on which government payments under the wheat programs were made.