Factors affecting the demand for high protein hard red spring wheat
by Allen B Richards

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of Master of Science in Agricultural Economics HhaTrvriflrT. 'Rrrflrrir irincr Hnmmr +,+.PPx^ Chairman, Examining Committee Approved? Bozeman, Montana January, 19#
Montana State University
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Abstract:
The following thesis is an attempt to gain a better perspective of the marketing problems facing the producer of high protein hard spring wheat by examining various factors which influence the demand for his product.

Part I introduces the problem and outlines the general methodological procedure used. It outlines the formulated hypotheses which were used as guideposts for the analysis..

A preliminary background for the analysis of the problem is contained in Part II. A brief history of flour milling is given. The various segments of the distribution system are outlined. The last two sections of this part describe the wheat used by the spring wheat millers and the types and properties of the various flours.

Part III contains the analysis of the problem and is broken into seven sections. Section A presents the theory of demand which becomes a framework from which to analyze the data. Section B discusses the role of the flour orders received by the miller in determining and affecting the demand for high protein spring wheat. Section C describes the effect of other wheat and flour markets on demand. Section D analyzes the variations in wheat shipments on the Great Lakes and their relationship to demand and price. Section E considers the fluctuating supplies of various proteins and their effect on the demand for high protein spring wheat. Section F covers the substitution of high protein spring wheat for durum wheat in the manufacture of macaroni products. Section G discusses changing technology in the baking and milling industries and its effect on the demand for high protein spring wheat.

The conclusions and implications of the study are contained in Part IV.

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at

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ABSTRACT

The following thesis is an attempt to gain a better perspective of the marketing problems facing the producer of high protein hard spring wheat by examining various factors which influence the demand for his product.

Part I introduces the problem and outlines the general methodological procedure used. It outlines the formulated hypotheses which were used as guideposts for the analysis.

A preliminary background for the analysis of the problem is contained in Part II. A brief history of flour milling is given. The various segments of the distribution system are outlined. The last two sections of this part describe the wheat used by the spring wheat millers and the types and properties of the various flours.

Part III contains the analysis of the problem and is broken into seven sections. Section A presents the theory of demand which becomes a framework from which to analyze the data. Section B discusses the role of the flour orders received by the miller in determining and affecting the demand for high protein spring wheat. Section C describes the effect of other wheat and flour markets on demand. Section D analyzes the variations in wheat shipments on the Great Lakes and their relationship to demand and price. Section E considers the fluctuating supplies of various proteins and their effect on the demand for high protein spring wheat. Section F covers the substitution of high protein spring wheat for durum wheat in the manufacture of macaroni products. Section G discusses changing technology in the baking and milling industries and its effect on the demand for high protein spring wheat.

The conclusions and implications of the study are contained in Part IV.

Part I

INTRODUCTION

A. The Problem

I. Introduction and Problem Situation

For thousands of years bread has been the staple diet of Western man and one of the world's most indispensable products. Even in recent years when our higher standards of living and increasing variety in foods have resulted in less reliance upon bread, it has, nevertheless, remained one of our basic foods.

Good bread, unfortunately, cannot be made out of every type of wheat produced. It must be wheat that contains the proper quality and quantity of protein. It has been only in the last three decades, however, that protein has been given recognition in the grain markets. In 1925, the first premiums for protein were established on the Minneapolis market. Since then, protein premiums have grown to occupy an important position in our agricultural economy. It has been estimated that in the state of Montana alone, if protein premiums were considered a separate commodity, they would represent the fifth largest crop, exceeded only by wheat, cattle, sheep, and dairy. 1/ Protein premiums are paid on "high protein" wheat which is generally considered to be wheat containing more than 12 per cent protein.

1/ H. R. Stucky and M. C. Taylor, Looking Ahead With Montana Farmers and Ranchers, Folder 22, Montana Extension Service, Montana State College, Bozeman, Montana, September 1, 1952.

The premiums are expressed as increasing premiums for every one-tenth or one-half per cent protein over 12 per cent.

The payment of protein premiums, even though it has helped the producer to increase his income, has caused additional uncertainty to the dealer and producer engaged in an already uncertain field. Wheat prices fluctuate daily but the effects of this fluctuation can be greatly minimized through hedging in the futures market. Protein premiums, however, cannot be hedged and thus cause additional anxiety on the part of those holding high protein wheat for which premiums have been paid.

The producer has questioned at times whether or not all of the premiums paid by the miller are being reflected back to himself. The payment of premiums have tended to establish protein as a separate commodity. The producer knows in a general way how his grain moves to market, yet there may be some question as to whether or not high protein wheat follows the same marketing pattern as that of ordinary wheat. Premiums, in themselves, represent an important part of the producer's income and for this reason it is to his advantage to know about them and how they are established.

On the production side, the producer has received help from industry, government, and educational institutions. Countless hours have been spent developing new varieties of wheat for the producer. Other measures have been taken to give the producer the best possible advantage in raising his crop. However, what happens to his grain after it is harvested is just as important to the producer. Unless he can sell his grain at a fair price, he is not benefiting fully from his production efforts. The producer, therefore, is interested in what happens to his high protein wheat when

it leaves his farm in the Northern Great Plains. He is interested in those who handle the wheat and aid its movement to market. He is interested in those who buy and sell the wheat after it has arrived on the market. In addition, he may want to know how the wheat is used, the products made from it, and the uses for these products. In general, the producer is interested in the movement of wheat from his farm to the ultimate consumer who uses wheat in its final form of bread and other baking products.

II. Statement of the Problem

This study is concerned with the factors behind the demand for high protein hard red spring wheat, the reasons for the fluctuations in demand, and the effect the demand factors have on price.

Prices are determined by various supply and demand factors. An examination of both must be made in order to analyze prices completely. However, this study is concerned only with the demand factors and their effect on the price the producer receives for his high protein spring wheat.

III. The Objective of this Study

The objective of this study is to isolate, examine, analyze, and describe the factors which affect the demand for high protein hard red spring wheat and their relationship to price.

A knowledge of the factors behind the market price for high protein spring wheat would be helpful to the producer and give him a better understanding of the complexity of market operations and explain why he receives a particular price for his wheat. Not only will the producer

benefit, but the rest of the grain trade and others affected by the price of high protein spring wheat will come to a greater appreciation for each other's problems.

The demand for high protein spring wheat is a derived demand from the consumers' demand for bread and other baking products. Since the objective is to analyze the demand factors, this study concerns mainly the milling and baking industries because they are the consumers and processors of wheat and wheat products. Therefore, further discussion will be located primarily in these areas.

B. Statement of Hypotheses

The demand for high protein hard red spring wheat is affected by the following major factors: (1) Flour orders received by the millers; (2) Other wheat and flour markets; (3) The seasonality of shipping on the Great Lakes; (4) The blending of protein; (5) The durum wheat crop, and; (6) Changing technology in the milling and baking industries.

(1) Flour orders received by the millers represent the major factor behind the demand for high protein spring wheat. The millers' demand for wheat is dependent on their sales of flour. The millers buy wheat to meet the flour commitments.

(2) Buyers from other market areas enter the spring wheat market for wheat and cause a shift in the demand curve as well as more elasticity. The reverse situation brings about substitutes for spring wheat and causes the demand for spring wheat to be more elastic.

(3) The seasonality of shipping on the Great Lakes causes a seasonal change in the demand for spring wheat. During the latter part of the open season there is a decrease in the elasticity of demand. The seasonality also shifts the demand curve--the amount and direction depending on the season.

(4) The necessity of blending proteins causes fluctuations in the demand for the individual proteins depending largely on the relative supplies.

(5) The shortage of durum wheat causes an alternative use for high protein spring wheat. This makes the demand for spring wheat more elastic.

(6) Changing technology in the milling and baking industries cause the demand to be more elastic by providing substitutes for high protein wheat.

C. Methodological Procedure

I. Data Used and Method of Analysis

The primary data used in this study were empirical evidence gathered by direct interview with members of the flour milling industry and by mail from members of the baking industry. The data received from the milling industry were by far the most exhaustive and representative.

Fifteen flour millers in Montana, North Dakota, and Minnesota were interviewed. These millers produce approximately one-third of all the flour produced in the United States, and approximately 65 per cent of the flour produced in the states of Montana, North Dakota, and Minnesota. They were selected because they are the largest millers in the Northern Great

Plains and their practices probably have more influence on the market than all the smaller mills. Most of the millers are national in size, and their policies and practices are indicative of the flour milling industry as a whole.

Members of the baking industry were contacted by mail. A mail questionnaire was sent to each of 28 bakers throughout the country. Nine completed questionnaires were returned. These nine are sufficiently scattered around the country so that a general picture of bakers' practices in several areas has been obtained.

The secondary data used came mostly from the grain trade and trade periodicals. Information gathered from the Northwestern Miller was extremely helpful. The Duluth and Minneapolis Boards of Trade provided excellent sources of information, particularly through the use of their Annual Reports.

The millers' schedules were first assembled and composite results obtained to all questions. Similar procedure was used in dealing with the bakers' questionnaires. These composite results were then analyzed and used to test the hypotheses, together with results of a statistical analysis of both primary and secondary data. After testing the hypotheses, inferences were drawn and some general conclusions were reached.

II. Procedure Used in this Study

The initial phases of this study were spent in reviewing literature in the field of wheat marketing in order to gain a better perspective of the problem. The amount of literature available, however, was found to be

rather small. Therefore, this study relies very greatly on empirical information.

From the over-all problem of high protein wheat marketing, the specific problem was selected. By limiting the study to the specific problem a detailed analysis can be made. At the same time, however, the specific problem is still broad enough so that it fits into the larger problem of high protein wheat marketing. The importance of the size of the specific problem to be attacked lies in the fact that another smaller problem could have been selected and examined from every conceivable aspect and in a much more thorough manner. Yet, a solution to such a small problem would be so small a part of the larger problem of high protein wheat marketing that it would contribute little to solving the larger problem. It is felt, therefore, that any solution of the problem with which this study is concerned will be meaningful and contribute something to the solving of the larger problem of high protein wheat marketing.

The next step was the formulation of hypotheses. A set of hypotheses was arrived at through deduction from the specific problem and through induction from the literature reviewed. These hypotheses were then used as guideposts in proceeding from the known into the unknown; i.e., proceeding into the actual analysis of the problem. Larrabee says hypotheses "go beyond the given to a possible patterning or arrangement or interpretation of it; and they do so provisionally, with a definite view to ultimate confirmation or rejection after testing". 2/

2/ Harold A. Larrabee, Reliable Knowledge, Houghton Mifflin Company, Cambridge, 1945, p. 168.

In order to examine the problem and test the hypotheses, empirical data were collected and secondary information gathered. This information was used to test the hypotheses, and to make some necessary adjustments in both the problem statement and the hypotheses.

Part III of this report covers the analysis of this data and the testing of the hypotheses. Part IV presents the conclusions and inferences drawn from the analysis. However, before proceeding into the analysis it will be helpful to have a picture of several phases of wheat marketing and their relation to this study, and a picture of the commodity, flour, with which this study is concerned. Therefore, Part II covers the necessary material to provide an adequate background for interpreting the specific points to be covered in Part III, the analysis of the data.

Part II

BACKGROUND TO THE ANALYSIS

A. The Market Structure

I. Introduction and History

There probably is no other industry which has a longer history in the United States than the flour milling industry. The first American manufacturing establishments were devoted to grain grinding. The history and growth of flour milling parallels the history and growth of our country.

The first known flour mill was founded on the Eastern seaboard in 1632. In subsequent years, flour milling grew up along the eastern coast and New York City established itself as the flour center of this period. As the nation expanded, wheat growing and flour milling spread throughout all the colonies. Poor milling facilities, and the high cost of transportation tended to make each area self-sufficient, and therefore, most of the mills were small custom mills, serving only local trade.

Westward expansion of the nation brought about a similar expansion in the milling industry. The wheat growing areas shifted to western New York and the Midwest with Philadelphia, Baltimore, and Rochester becoming the leading flour markets and milling centers. Further westward movement brought the wheat farmer out onto the great plains. Again the centers of milling and the flour markets moved with the crop. Cincinnati, St. Louis and New Orleans took their place in milling history as the centers for this period. Finally, the home market demand, the lack of transportation to the east, and the undeveloped state of transportation in the west tended to

bring about mill development in the western plains. 1/

Milling began at what is now Minneapolis as early as 1822-23 with the establishment of a small gristmill to serve the soldiers at Fort Snelling. Settlers moved very slowly into the area and for a number of years were outnumbered by trappers, lumbermen, and miners.

After 1851, there was a rapid increase of population in Minnesota. Flour and feed mills sprung up all over the state. By 1860 there were 81 mills turning out products worth over $1,200,000. The development of Minneapolis as a milling center was, up to 1870, the result of the movement of farmers and mills into the great plains. After 1870, the rapid rise of Minneapolis was due to a revolution in milling processes which resulted from the introduction of the purifier and roller system. These new processes brought supremacy in world trade to American flours and the Minneapolis millers in the period following 1870.

Commercial milling developed in North Dakota and South Dakota in the 1890's and in Montana after 1900. At the same time there was a concentration of mill ownership in those areas. The Russell-Miller Company was organized in 1897. In 1911 the Montana Flour Mills Company began operations in Harlowton, subsequently building a large mill at Lewistown.

Other large combines came about in this same period. The International Milling Company appeared at New Prague, Minnesota and rose to a present daily capacity of 53,400 sacks. (100# sacks). Commander-Larabee Corporation was founded by bringing together mills scattered about Minnesota and Kansas.

1/ Charles B. Kuhlmann, The Development of the Flour Milling Industry in the United States, Houghton Mifflin Company, New York, 1929.

Commander-Larabee now has a daily capacity of 38,640 sacks. The trend towards concentration has continued up to the present day with the large getting larger and the small dropping by the wayside. 2/

II. Marketing Channels

a. The Marketing Process

The first step in the marketing process is the delivery of wheat by the producer to the country elevator. The country elevator places the wheat in storage or loads it into a boxcar for immediate shipment. The country elevator generally buys the grain from the producer. However, in some cases it is stored in the producer's name. Storage for producers is not very prevalent today partly because the elevators are storing Commodity Credit Corporation wheat instead. The country elevator is a collection point for wheat produced in the surrounding area. Very little of the wheat moves directly from producer to terminal market.

The elevator contacts a commission firm at the terminal market, in this case Minneapolis or Duluth, and notifies it of the quantity and quality of wheat enroute to market or on hand. The commission firm hedges the wheat for the country elevator. When the wheat is received on the market it is tested for protein and quality. The commission firm then places a sample of the grain on the trading tables on the cash floor and proceeds to bargain with prospective customers.

The largest share of the cash wheat is purchased by processors like

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2/ Charles B. Kuhlmann, Ibid.

the flour miller. The miller grinds the wheat he buys on the cash floor into flour and feed, and sells these products to bakers, feed mills, and others desiring the products. The baker, in turn, makes bread from the flour and sells it to the consumer.

b. The Terminal Elevator

The terminal elevator firm today is primarily a grain merchandiser rather than just the supplier of a large storage warehouse for grain. The terminal elevator firm purchases wheat in its own name and proceeds to clean it and bin it by narrow ranges of protein. The large facilities permit it to store huge quantities of wheat, and other grains, and to be in a position to blend different wheats to satisfy particular customers.

c. The Commodity Broker

The commodity broker differs from the commission firm in that he operates only on the futures market. His job is to buy and sell contracts for future delivery of wheat and other commodities. The broker may be both a securities and a commodity broker, or he may specialize in commodities alone. His customers represent every segment of the marketing structure. Millers, terminal and country elevators, and speculators are among the broker's customers.

d. The Speculator

The speculator, as found in the commodity markets, is a person who buys and sells on the futures market in order to make a profit from the transactions. The speculator holds no commodities nor takes possession of any. Many feel that the speculator does more harm than good. However, without him there would be no futures market. It is the speculator who is

always present ready to buy when the country elevator wishes to hedge, or to sell when the elevator wishes to reverse the hedge. Naturally, it is not always the speculator who purchases the hedge, but without his presence, hedging as it is now practiced would be impossible.

III. Production Areas

There are four major wheat producing areas in the United States, each distinguished by the type of wheat that is predominant in the area: (1) The hard spring wheat area comprising North Dakota, South Dakota, Montana, and Minnesota; (2) The hard red winter wheat area of Texas, Oklahoma, Kansas, and Nebraska; (3) The soft red winter wheat area of Eastern Kansas, Central Texas, Missouri, Lower Illinois, Indiana, Ohio, and the Central Atlantic Coast states; and (4) The soft white wheat area of California, Oregon, Idaho, and Washington. These production areas each supply a particular milling center or market with a large part of its wheat. 3/

Stigler defines a market area to be "the area within which the price tends to uniformity, allowance being made for transportation costs". 4/ The Minneapolis price for wheat tends to be the price throughout the spring wheat production area with allowances for freight. Therefore, Minneapolis is the spring wheat market center. This study concerns itself with the hard spring wheat area and its particular milling centers which are Minneapolis and Buffalo. Duluth is the transit point for wheat moving to

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3/ Commodity Research Bureau, Commodity Yearbook, New York, 1952, p. 340.

4/ George J. Stigler, The Theory of Price, The Macmillan Company, New York, 1946, p. 92.

Buffalo, the largest spring wheat milling center. Minneapolis, however, is the world's largest cash wheat market.

IV. Size of Spring Wheat Milling Centers

As has been stated previously, Minneapolis and Buffalo are the two primary spring wheat milling centers. Minneapolis and Duluth are the spring wheat markets where prices are quoted daily on cash receipts of spring wheat.

Buffalo flour production amounted to 26,216,130 sacks in 1953. Minneapolis produced 13,578,063 sacks in the same year. By comparison, Kansas City produced 13,017,915 sacks in 1953 out of a total U. S. production of 221,852,000 sacks. This means that Buffalo produced approximately 12 per cent of the total U. S. flour in 1953, while Minneapolis and Kansas City each produced about 6 per cent.

Buffalo ranks No. 1 in total daily capacity with 94,700 sacks. Minneapolis is second with 68,800 sacks; Kansas City third with 54,420 sacks; Dallas-Ft. Worth fourth with 26,700 sacks; and Salina fifth with 15,000 sacks. 5/

V. Purchases and Practices of the Millers

a. Location and Method of Purchasing

Minneapolis millers obtain more than 75 per cent of their wheat from Montana and North Dakota. In 1952 and 1953, Montana was the largest supplier. Other Northern Great Plains millers purchase most of their wheat

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5/ The Miller Publishing Company, Northwestern Miller Almanack, Minneapolis, 1954, p. 24.

from these two states also. Table I shows the source of wheat purchased by 15 flour millers in the Northern Great Plains. Seven of these millers purchased 100 per cent of their wheat from Montana and North Dakota. The others purchased at least 75 per cent of their wheat in these states.

Table I.

Source of Wheat Milled by Northern Great Plains Millers
1952 Crop Year

	Company														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Per Cent of Total Purchases														
Mont.	35	50	40	25	75	25	50	60	40	100	100	100	100	100	25
N. Dak.	50	40	60	55		50	30	25	45						75
Pac. N.W.															
Kan., Okla.								10	5						
Minn., S. Dak.	15	10		20	25	25	20	5							

The millers generally purchase their wheat through commission firms on the cash market rather than buy direct from country elevators or producers. This way the miller can actually see the wheat he is buying and is dealing with a specialized agency. The commission firms generally represent the country elevators on the cash floor, although they may sell wheat for producers or terminal elevators. Twelve of the 15 millers interviewed purchased 90 per cent or more of their wheat through commission firms. Only two mills purchased more than one-fourth of their wheat direct from country elevators or producers.

The millers apparently try to purchase their wheat from the same areas and localities every year. Of course, this fluctuates because of changes in protein and wheat quality which is due primarily to the unpredictable weather found in these areas. Over the years the millers have established certain localities that produce the desired quality of wheat. The millers tend to favor these areas in their purchasing and try to buy from them before going elsewhere for their wheat. Country elevators, too, have established reputations with the millers, some good and some bad. These reputations are very important to the millers. The millers keep a close check on the wheat coming from the elevators and know which ones are delivering superior wheat. The millers regrettably find that some elevators attempt to ship plugged cars and wheat with excessive dockage. These elevators are soon known throughout the trade, and the trade prefers not to handle their wheat. The millers have stated that for awhile an elevator may get away with car plugging, but eventually the practice is discovered and further shipments from such an elevator are not accepted very readily, sometimes only at a discount. In the long run these practices may harm not only the elevators but also the farmers these elevators serve.

Most of the millers purchase all the wheat they can store during the harvest season. Buffalo millers try to get as much wheat as possible over the Great Lakes before they close. Thus their purchasing is done during the harvest season and in the post-harvest season as well.

The millers all do some contracting for future deliveries but these are usually short term contracts. Most of the contracting is done in the

late summer or early fall. The time and amount of contracting will depend upon the supplies available and the expected price movement.

b. Protein Content of Purchases

"Millers and bakers are not interested in the protein content of wheat and flour from a dietary viewpoint. Premiums are paid for high protein wheat because protein content is a crude measure of gluten quality." 6/ Protein content may be used as a measure of quality because it is simple and is a general indication of the gluten contained in the wheat. About 85 per cent of the dry gluten is protein, so the greater the protein content, the greater the gluten content.

The wheat purchased by the Northern Great Plains millers is generally that classified as high protein wheat. This is indicated by a 155 week period from 1951 to 1954 in which 76 per cent of the total car lots sold at Minneapolis tested more than 12.5 per cent protein. 7/

The mills generally buy to meet their own particular milling requirements. Most of the millers indicated that they like to buy the middle range of protein (13-15 per cent) before acquiring any other proteins. They tend to set their purchasing policy on high protein wheat according to the harvest every year. If there appears to be a large supply of high protein wheat they will hold off their purchases until they need the wheat for

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6/ E. R. Hehn, Protein of Wheat as a Measure of the Milling Characteristics of the Flour, Memo to members of Committee on Objectives of Research and Extension Education with reference to protein in Montana's hard wheats, October 12, 1951.

7/ Recorded from Daily Market Record, Minneapolis, April 23, 1951 to May 10, 1954.

milling. On the other hand, if the supply of high protein wheat appears to be short, they will try to stock up on it for future needs. Some mills try to get their high protein early while others buy as they need it according to available supplies.

A survey of the protein content of spring wheat purchased by 11 Northern Great Plains millers shows that only one company out of eleven purchased more than 8 per cent of its spring wheat below 12 per cent protein. The protein content of the wheat purchased by the various mills is indicated by Table II. Most of the companies purchased between 70 and 85 per cent of their spring wheat in the 13-15 per cent bracket.

Table II.

The Protein Content of Spring Wheat Purchased in 1952 by 11 Northern Great Plains Flour Millers

	Company										
	1	2	3	4	5	6	7	8	9	10	11
	Per Cent of Total Purchases										
11% and Below	5	8	5	-	5	5	5	-	30	-	-
12%	50	0		80	60	0	45	95		30	10
13%		80	70			75			60		85
14%	30			5 to 10	15		20	4		60	
15%						-					
16% and over	15	12	25	10	30	20	30	1	10	10	5

The winter wheat purchased by Northern Great Plains millers is lower in protein than the spring wheat purchased. Of the 8 mills that reported

purchasing winter wheat, most of them bought winter wheat under 14 per cent protein. A large part of their purchases was in the 11 per cent and below category, although the majority of the purchases fell in the 12-13 per cent range. Table III gives a picture of the winter wheat purchases.

Table III.

The Protein Content of Winter Wheat Purchased in 1952 by 9 Northern Great Plains Flour Millers

	Company								
	1	2	3	4	5	6	7	8	9
	Per Cent of Total Purchases								
11% and Below	50	Bulk			100		50	10	5
12%	50	Some		Bulk		100		70	90
13%							50		
14%	--	--						15	5
15%	--	--	100	Little				5	
16% and over	--	--							

All this would indicate that "wheat on the Minneapolis market" can be considered to be high protein wheat. Thus, this study concerns itself with "wheat on the Minneapolis market", and also wheat on the Duluth market. The data used in this study have been analyzed and discussed on the basis that Minneapolis and Duluth wheats are high protein wheats, and that the

base prices quoted on these markets are base prices for high protein wheat. Naturally, additional premiums are given for additional protein, but this study concerns itself mainly with demand factors and their relation to the base price of high protein hard red spring wheat.

B. Flour

I. Flour Types and Uses

The flour produced in the Northern Great Plains may be divided into three major groups: Bakery, family, and specialty flour. Bakery flour is flour sold to bakers for processing into bread. Family flour is flour sold at the retail level to the consumer for use in his home. Specialty flour is sold to bakers to make special products like french bread, whole wheat bread, kaiser rolls, and hard rolls. Bakery flour represents the largest proportion of the millers' total sales.

Twelve Northern Great Plains millers reported on the per cent of total output represented by the various types of flour. Bakery flour represents 40-50 per cent of the total output for 5 of the 12 millers. It represents 70 per cent or more of the total output for the remaining seven millers. Table IV gives a complete picture of the flour produced by these 12 millers.

Flours in general have names applied to them which indicate their quality and reflect the quality of the wheat from which they were milled. Names vary with the miller and are difficult to compare unless a comparison is made of flours produced by one miller. Flours can be grouped either as "patents" or "clears", but both groups overlap and will vary from one milling location to another. The term "patent" originated through the

Table IV.

Type of Flour Produced by 12 Flour Millers in the Northern Great Plains - 1953

	Company											
	1	2	3	4	5	6	7	8	9	10	11	12
	Per Cent of Total Output											
Bakery	44	95	70	95	85	80	40	50	48	90	75	40
Family	44	5	15	5	15	20	60	50	52	10	25	20
Specialty	12											40
Export			15									

invention of the middlings purifier. Prior to this time (1870) some of the high quality flour stock was left in the middlings. It was to the millers' advantage to be able to recapture this quality stock. This was accomplished through the invention of the middlings purifier. The purifier was patented and when added to the miller's machinery caused the miller to call his flour "patent" flour. Today the term has lost its original meaning because all the mills now use middlings purifiers. 8/

Flours of the same name will vary from one locality to the next. The miller must take the wheat that is available to him and grind it into flour. Since wheat differs in size, shape, quality, and protein, the flours produced will also vary. One miller's patent flour may not be as high in quality as another's first clear, therefore, the terms are only relative indications of the kind and quality of flour. This has caused millers to

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8/ Harry Snyder, Bread, The Macmillan Company, New York, 1930, p. 144.

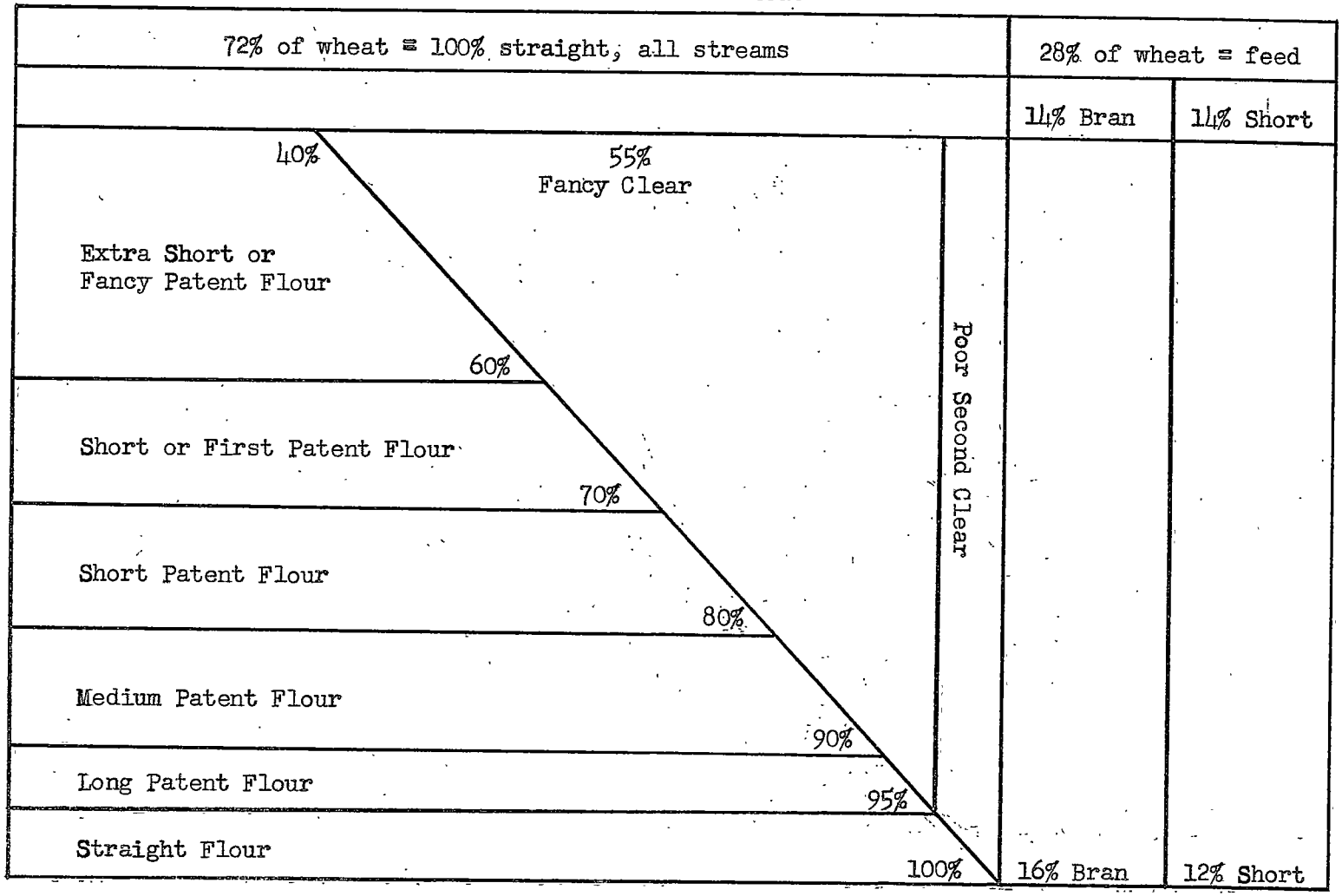
blend wheats from several sources in order to maintain a more uniform product year after year. The millers would like to be able to produce the same quality of flour every year, but this is not always possible since the raw material is never the same twice in a row. Blending thus becomes a method for reducing this variation.

C. O. Swanson modified a chart prepared by the American Institute of Baking to give a picture of the relationship between various grades of flour. 9/ The chart, shown in Figure 1, indicates that the grades merge into each other, making it difficult to identify the grades precisely. A 95 per cent long patent may be very similar or identical with 95 per cent straight flour. An 80 per cent short patent may be the same as an 80 per cent medium patent.

Swanson also found that approximately two-thirds of the protein contained in the wheat goes into the flour. One-third goes into the feed. Table V shows the relative protein per cents of products made from hard red winter wheat. The bran and shorts represent about 27.7 per cent of the wheat ground. Their protein content was 15.1 per cent as against 12.5 per cent for the raw wheat. This indicates that the flour from the center of the kernel or the highest quality flour, has a lower protein content than the whole wheat, and the flour from the outer parts of the endosperm near the bran, a higher protein content than the wheat. This has been found true of hard wheats but not of soft wheats.

9/ C. O. Swanson, Wheat and Flour Quality, Burgess Publishing Company, Minneapolis, 1938.

Figure 1
The Relationship Between Flour Grades
100 Pounds of Wheat*



*Source: C. O. Swanson, Wheat and Flour Quality, Burgess Publishing Company, Minneapolis, 1938, p. 145.

Table V.

Distribution of Protein in Products from Hard Red Winter Wheat*

Portions	Percent of Wheat Obtained in Milling	Protein Percents	Percent of Total Protein
Wheat	100.0	12.5	12.50
Midds. Flour	47.8	10.7	5.11
Break Flour	19.7	13.1	2.58
Tails Flour	3.8	12.5	.48
Bran and Shorts	27.7	15.1	4.33

*C. O. Swanson, Wheat and Flour Quality, Burgess Publishing Company, Minneapolis, 1938, p. 148.

Table VI shows the protein content of various flour streams as compared to the whole wheat. Here the 70 per cent patent had a protein content of 11.2 per cent as against 13.0 per cent for the wheat. The 27 per cent clear contained 13.7 per cent protein. The figure also shows the protein contents of the various breaks in the milling process. The first,

Table VI.

Variations in Protein Content of Mill Stream Flours*

Mill Stream	Protein Content	Mill Stream	Protein Content
Wheat	13.0	1st Sizings	10.8
Patent - 70%	11.2	2nd Sizings	11.4
Clear - 27%	13.7	1st Middlings	11.0
Low Grade - 3%	14.1	2nd Middlings	11.1
1st Break	11.5	3rd Middlings	11.5
2nd Break	12.7	4th Middlings	12.1
3rd Break	13.8	5th Middlings	12.0
4th Break	14.9	6th Middlings	12.3
5th Break	18.1	7th Middlings	12.7

*C. O. Swanson, op. cit., p. 146.

containing patent flour, had a 11.5 per cent protein content, while the fifth which is mostly bran, had a protein content of 18.1 per cent. It can

be said that on the average the flour obtained in the milling process contains about 1.25 per cent protein less than the wheat from which it is milled; i.e., a 13.5 per cent protein wheat would produce a 12.25 per cent protein flour.

II. Production and Consumption of Flour

The production and consumption of flour in the United States has remained relatively constant for the last 20 years. The 1935-39 average flour production in the U. S. was 101,749,000 barrels (196# barrels), and the 1950 production was 116,826,000 barrels. 10/ A similar result is obtained when comparing the production in Minneapolis and Buffalo for the years 1935 through 1953. 11/

A comparison of the consumption of flour in the U. S. shows results similar to those mentioned previously. In 1935, 194,007,000 sacks (100# sacks) of commercially produced flour were consumed. In 1952, 201,656,000 sacks were consumed. 12/ However, while the total consumption has remained nearly the same, the per capita consumption has decreased. In 1935, the per capita consumption of commercially produced flour was 150.4 pounds. In 1952, it was 129.7 pounds. 13/

10/ Commodity Research Bureau, Commodity Yearbook, New York, 1952, p. 354.

11/ For complete data, see Table I in the Appendix.

12/ For complete data, see Table II in the Appendix.

13/ For complete data, see Table III in the Appendix.

III. General Properties of Bread Flour

a. Gluten

The most important factor to be considered in a good bread flour is the gluten. The quality and quantity of the gluten, when considered jointly, have more to do with producing good bread than all other factors combined. 14/ The dry gluten mass contains about 85 per cent protein, 8 per cent of a phosphorized fat-like material that affects the physical binder qualities of the gluten, and approximately 6 per cent starch mixed with small amounts of other substances. The proteins in gluten are gliadin and glutenin, two of the main proteins in wheat. These proteins form the binder that makes bread dough.

Gliadin is the cement or binding material in the gluten, and glutenin is the necessary bulk or substance to which the gliadin particles adhere. When these two are combined in the right proportions, a well-balanced gluten is obtained. If there is too much gliadin, then the gluten becomes too soft and sticky. However, if there is too much glutenin, the dough cannot expand properly because there is not enough gliadin to hold the particles together and retain the gas which expands the dough. In good hard wheats approximately 60 per cent of the gluten is gliadin and 40 per cent is glutenin. 15/

When the right quantity and quality of gluten is present in a flour then the resulting dough will be elastic and possess good recoiling

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14/ Harry Snyder, Bread, The Macmillan Company, 1930, p. 235.

15/ Ibid.

properties. It is the gluten which determines the loaf volume and mixing tolerance. Generally, the stronger the gluten is, the longer the mixing time and the greater the tolerance.

b. Protein and Ash

Besides the two gluten proteins, there are four other and minor proteins in wheat flour that are not a part of the gluten, but form a part of the protein. It is the proteins in the flour that combine physically and possibly chemically with water to form bread dough. 16/

"Ash is the non-combustible matter remaining after flour has been incinerated in a furnace at a high temperature, and is an indication of the flour extraction and grade." 17/ Generally speaking, the lower the ash content, the higher is the quality of the flour. However, like other properties of flour, the ash content in itself does not always indicate quality flour. It must be taken into consideration along with other factors.

c. Other Properties

Besides the gluten, protein, and ash there are other general characteristics that indicate good bread flour. These characteristics are either connected with the gluten and protein in some way or else are subjective qualities that can only be determined after the bread is baked.

16/ Ibid.

17/ Letter from Mr. T. R. Aitken, Chemist, Board of Grain Commissioners for Canada, Grain Research Laboratory, Winnipeg, Canada, March 2, 1953.

"Mellowness" is a characteristic that is highly desired in modern bread flours. Mellowness refers to the elastic properties of the dough. A strong glutenous flour produces a dough that is tough and resilient. A mellow flour produces a dough that is not as tough or resilient as dough made from strong flours, and is more adaptable to modern mass production.

A good bread flour will have good "water-absorbing" characteristics. The absorption of a flour is the amount of water used in making bread dough. The more water a given amount of flour will absorb, the larger the loaf will be. A large loaf is desirable in modern baking. Similarly, the greater the water absorption, the greater the loaf weight will be for a given amount of flour.

"Mixing time" is another criterion of bread flour. Today, with modern machinery the bakers are generally looking for a shorter mixing time than they were 10 to 15 years ago. Mixing time is related to the quality of the gluten. The stronger the gluten, the longer the mixing time will be.

Closely related to mixing time is the dough "tolerance". Tolerance is the amount of leeway a baker has between the time the dough is made and the time it is baked. Strong flours produce doughs with relatively large tolerances. This means that the baker has a relatively long time after making the dough before the dough will break down and deteriorate in quality. This is extremely important to the small baker, but not as much so to the large baker using complex modern machinery.

Fermentation time is the amount of time it takes for the dough to rise. The right fermentation must take place in order to conform to the other

requirements set up by the baker. All of these properties are generally dependent upon each other and connected to the quality and quantity of gluten.

The millers and bakers feel that the only true measure of a good flour is the subjective qualities of the finished loaf. In general, a good bread loaf must have the right color, texture, and good eating qualities. These are the ultimate qualifications for good flour and the only positive way of telling what is good bread flour. These qualifications, like most of the others, are subject to a good deal of opinion. What may be good flour in one part of the country may not be good in another. In the final analysis, there is no precise and universal way of determining good bread flour.

Part III

ANALYSIS OF THE DATA

Part III is concerned with analysis and interpretation of the data collected. The important objectives of Part III are to (1) describe the demand factors, (2) indicate the importance of these factors and their influence upon price and (3) to measure the relationship and the effect on demand and price and where possible to determine statistically if a significant relationship exists.

Section A is concerned with establishing a theoretical framework from which to analyze the data. Certain basic concepts are discussed and their relationship to the demand for high protein wheat indicated. The other six sections of Part III draw upon the theoretical foundation in the analysis of the individual demand factors.

A. Theory of Demand

I. Derived Demand

The demand for wheat is a derived demand. It is derived from the bakers' demand for bread flour and the demand for mill feed. However, in this discussion only the demand for flour will be considered. The demand for flour is a function of the consumers' demand for bread and other baking products. Boulding gives four propositions concerning derived demand: "(1) An expected rise in the demand for a product will cause a rise in demand for the type of (factor) which produces the product; (2) the smaller the part played by a factor of production in the production of a commodity,

the more inelastic is the demand for it likely to be; (3) the more elastic the demand for a product, the more elastic is likely to be the demand for the types of (factors) which go to make this product; (4) the better, and the cheaper, the substitutes for a factor of production the more likely is it to have an elastic demand". 1/

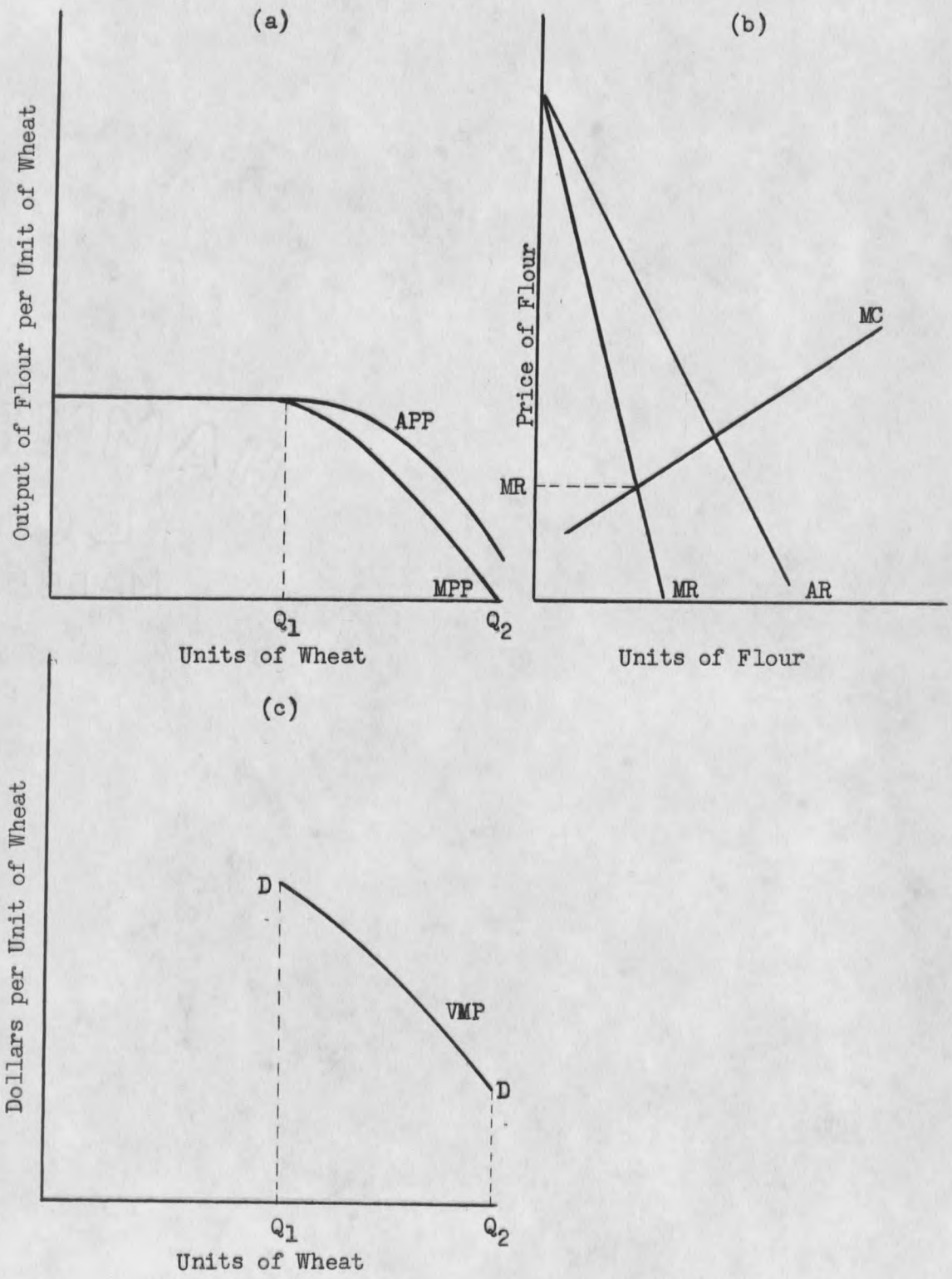
Applying these propositions to the demand for wheat, an expected rise in the demand for flour will cause a rise in the demand for wheat, the major factor of production. Since wheat plays a large part in the production of flour, its demand under proposition (2) will be less inelastic than, say, that of mill labor or power costs. However, because of proposition (3), the demand for wheat is relatively inelastic. The demand for bread is inelastic because the consumer does not respond very much to a change in price. Therefore, large changes in price are accompanied by only a small change in quantity purchased. The inelasticity of demand for bread reflects itself back to the bakers' demand for flour and the millers' demand for wheat, causing these demands to be relatively inelastic. The more substitutes and alternative uses that can be found for wheat, the greater will be the elasticity.

Figure 2 shows graphically the derived demand for wheat. Figure 2b shows the assumed AR and MR for flour and the MC for flour. The intersection of MC and MR curves gives the MR for flour at the equilibrium position. Figure 2a shows the assumed MPP and APP for wheat. The relevant range on

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1/ Kenneth E. Boulding, Economic Analysis, Harper and Brothers Publishers, New York, 1948, pp. 222-24.

Figure 2
Derivation of the Demand Curve for Wheat



the MPP curve is Q_1Q_2 or between the point on the MPP curve where the APP is a maximum and the point where the MPP is zero. To obtain the demand curve for wheat (DD) as shown in Figure 2c, the relevant portion of the MPP curve is multiplied by the MR of flour obtained in 2b. This arrives at the demand (MVP) for wheat as derived from the demand for flour. The demand for flour can be derived from the demand for bread by a similar process.

One thing important to note is that however elastic the demand for flour is, the MR for flour will be less elastic in every case. This will tend to make the demand for wheat less elastic than the demand for flour. Of course, the elasticity of the MPP curve for wheat affects the elasticity of demand for wheat and may be elastic enough to offset the effect of the MR for flour.

Another method for deriving the demand for high protein wheat is to consider the supply and demand curves of flour and the supply curve of wheat.

Figure 3.

Derivation of the Demand Curve for Wheat

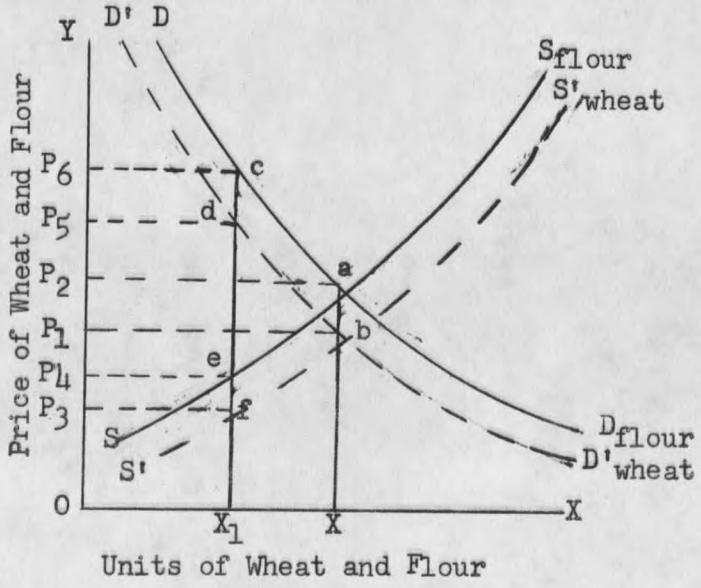


Figure 3 shows the supply (SS) and demand (DD) curves of flour and the supply ($S'S'$) curve of wheat. The position of these curves has been set arbitrarily. The equilibrium point for flour is a and OX is the quantity of flour that will be taken at point a. P_2 is the price at which OX pounds of flour will be sold, P_1 is the price of OX pounds of wheat needed to make OX pounds of flour. (This assumes that millfeed is considered part of the flour, otherwise more than OX pounds of wheat would be needed to grind OX pounds of flour). $P_2 - P_1$ is the price per unit of wheat and flour of all other manufacturing units. Let any line cX_1 drawn parallel to the Y axis cut DD, SS, and $S'S'$ at points c, e, and f. Then P_6 is the demand price for flour, P_4 is the supply price for flour, and P_3 is the supply price for that quantity of wheat. Establish point d so that cd is equal to ef. The distance ef is the price per unit of wheat and flour of all other manufacturing units. This price is the difference between the demand price of wheat and the demand price of flour. Then P_5 is the demand price for wheat because it is the difference between P_6, the demand price for flour and $P_4 - P_3$ which is the supply price per unit of wheat and flour for all other manufacturing units. Then the locus of all points such as d becomes the derived demand curve ($D'D'$) for wheat and passes through point b forming an equilibrium point here. 2/

From these examples it follows that the demand for high protein wheat is derived directly from the demand for flour. When the demand curve for flour shifts the demand curve for high protein wheat will shift also and

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2/ Alfred Marshall, Principles of Economics, Macmillan and Company, London, 1946, pp. 383 and 384.

in the same direction. If the demand for flour becomes more elastic the demand for high protein wheat will also become more elastic. This relationship between flour demand and high protein wheat demand will be examined in section B.

II. Changes in Demand

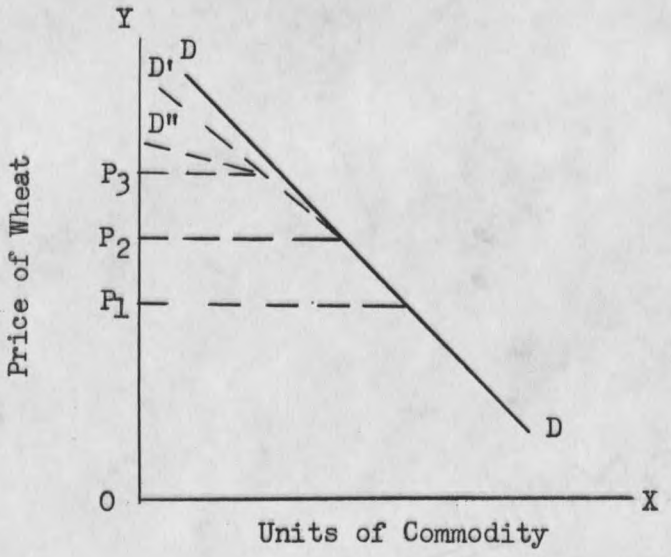
Changes in demand generally arise from one or more of five areas: (1) Changes in the intensity of desire for a commodity; (2) Changes in income; (3) Changes in prices of other commodities, especially substitutes (this may be said to include complementary commodities as well); (4) Changes in expectations concerning future prices; and (5) Changes in the number of potential consumers. Since the demand for high protein wheat is a derived demand it is only indirectly affected by changes in desire, income, and potential consumers. These changes would affect the demand for bread more directly and therefore will not be considered here.

Changes in the prices of other substitute commodities will affect the demand for a given commodity. "The elasticity of demand for a commodity depends primarily on the extent to which substitutes are obtainable. If a commodity has good substitutes, a rise in price will divert the expenditures of consumers to the substitutes, and their purchases of the original commodity will decline. . . . . The demand will therefore be elastic. If, on the other hand, a commodity has poor substitutes, consumers will be unable to respond to a rise or fall in price, and the demand will tend to be inelastic". 3/

3/ Kenneth E. Boulding, Economic Analysis, Harper and Brothers Publishers, New York, 1948, p. 133.

Figure 4

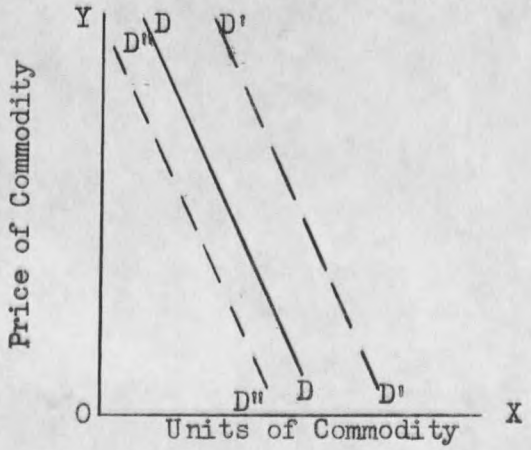
Theoretical Demand Curves for a Commodity



In Figure 4, DD is the demand curve for a commodity. Price P_1 is the initial price for this commodity. At P_2 a new substitute for the given commodity appears. The appearance of the new substitute at P_2 changes the original demand curve and may alter it as shown in Figure 4 to D'D. If the price of the given commodity rises another substitute appears at P_3. This may alter the demand curve again as shown in Figure 4 to D"D.

Figure 5

Theoretical Demand Curves for a Commodity

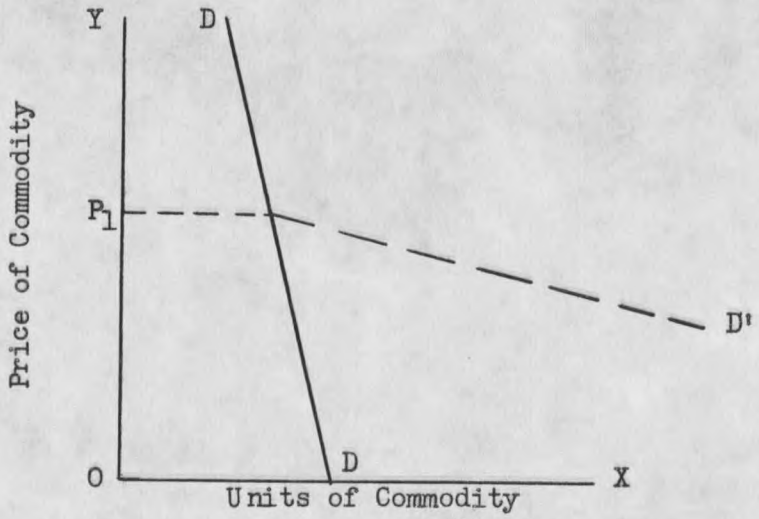


Similarly, in Figure 5, if the commodity demand curve is DD and there is a sudden increase in the price of a substitute, the demand curve will shift to the right (D'D'). A fall in the price of a substitute might, on the other hand, cause the demand curve to shift to the left (D"D").

An alternative use for the commodity would have a similar effect. In Figure 6, at Price P_1 an alternative use appears. This would be a case where above P_1 it would not be worth the cost of putting the commodity to the alternative use, but below P_1 it would be profitable. Therefore, below P_1 the demand for the commodity will be more elastic than before, but above P_1 it remains the same.

Figure 6

Theoretical Demand Curves for a Commodity



Boulding states "that the stability or instability of prices depends also on another factor, which we call the stability of demand or supply. A demand curve may be said to be stable if the quantity which would be bought at any given price is not much affected by changes in the factors

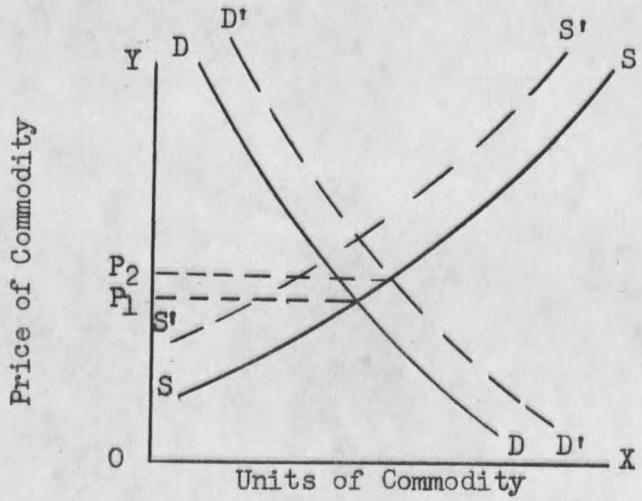
which determine it". 4/ In the case of high protein wheat the demand curve can be said to be relatively unstable because the quantity that is purchased at a given price is affected considerably by the factors that determine it. A change in the price of a substitute is liable to have a marked effect on the quantity of high protein wheat demanded.

Expectations play a large part in the movement of the demand curve for high protein wheat. Expectation of future price movements is one of the determinants of demand. A large share of these expectations concern themselves with the future supply of wheat. Expectations as to what the future supplies of wheat will be, constantly change the demand for wheat.

In Figure 7, DD is the initial demand curve and SS the supply curve. If those purchasing wheat "expect" that the supply curve will move to the left or the supply will not be as great, then the demand curve might move,

Figure 7

Theoretical Demand and Supply Curves for a Commodity



4/ Kenneth E. Boulding, op. cit., p. 147.

at least temporarily, to D'D'. This would be a case where SS is the current market supply curve and DD the market demand curve. Then, if say the new crop is expected to be small and the new supply curve S'S', the demand curve will shift to some position D'D' to the right of the old. Then the purchasers would step up their purchases to the new equilibrium point at the intersection of D'D' and SS in order to purchase for future needs at a price (P_2) lower than they expect for the future.

In general, the demand for wheat is highly inelastic. The elasticity of demand for wheat at Chicago was estimated at .36 for 1896-1913 and .24 for 1921-1934. The elasticity for the United States farm wheat was estimated at .21 for 1921-1934. The demand for high protein spring wheat 5/ can be considered more elastic than these figures because it has more substitutes. This study is concerned with locating the factors that determine the demand for high protein hard red spring wheat and examining how they change the demand.

The changes in demand that this study is concerned with are those that come about through substitution, alternative use, and expectations. Sections B, C, D, E, and F are concerned with these types of changes and their effect on the demand for high protein hard red spring wheat.

B. Flour Orders Received by the Miller

I. The Effect on Demand

In Section A it was shown how the demand for high protein spring wheat is derived from the demand for flour. It was indicated how the demand for

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5/ W. C. Waite and H. C. Trelogan, Agricultural Market Prices, John Wiley and Sons, Inc., New York, p. 46.

high protein wheat shifts as the demand for flour shifts. If the demand for flour becomes more elastic, the demand for high protein wheat will become more elastic. The demand for bread flour is the greatest single determinant of the demand for high protein spring wheat.

The millers interviewed stated that they use sales forecasts (flour sales) or estimates of flour orders to determine their estimated demand for high protein spring wheat. Out of five companies reporting on the breakdown of their sales, one company reported 70 per cent of sales represented by flour, two companies had 75 per cent of sales represented by flour, and two reported 90 and 95 per cent of sales represented by flour.

The millers purchase most of the high protein spring wheat. The sales of flour or flour orders received by the millers largely determine the demand for high protein spring wheat. The following discussion attempts to present empirical evidence to demonstrate how and why flour orders fluctuate and in turn cause the demand for high protein spring wheat to fluctuate.

II. Flour and Flour Sales Made by the Millers

Millers place their orders for wheat for the most part after they have received orders for flour. These orders are usually hedged by purchasing a futures contract. The futures contract enables the miller to guarantee the maximum he will pay for the wheat to be milled for every order of flour received. This is necessary since the price of flour is largely determined by the price of wheat. Holbrook Working says, "There are three elements in the calculation of the price of flour: (1) the milling margin judged to be available in the current state of mill competition; (2) the prices at which mill by-products can be sold; and (3) the

cost of the raw material wheat. The last is the largest of the three items." 6/ The miller, in quoting a flour price, must base this on the current price of wheat. The only way the miller can insure purchasing wheat at the current price is to buy a futures contract and then buy in the cash market whenever the desired type of wheat appears. At the time the cash purchase is made, the futures contract is reversed. 7/

Table IV indicates the type of flour produced by the Northern Great Plains millers. This flour ranges in protein from 12 to 13 per cent for bakery flour and 11 to 12 per cent for family. Table VII gives a complete picture of the millers reporting on the protein content of their flour. These flours and their protein contents are peculiar to the spring wheat millers. Millers in other areas have their own types of flour and protein contents. The Southwestern millers, for instance, may have bakery flour as low as 11.3 per cent protein and family flour with 9.0 per cent protein.

Table VIII shows the protein content of wheat used by Northern Great Plains millers in the production of different types of flour. The protein content of the wheat used for the various products corresponds very closely to the proteins shown in Table VII. The proteins in the wheat will be higher than those in the flour since there is a drop of about 1.25 per cent protein in the production of flour. The millers state that the only way they can hedge the protein premiums that they have to pay is through forward

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6/ Holbrook Working, "Hedging Reconsidered," Journal of Farm Economics, Vol. 35, No. 34, November, 1953, p. 544.

7/ Ibid.

flour sales. They can hedge the base price of the wheat through the futures market but there is no provision for hedging protein premiums.

Table VII

The Protein Content of the Majority of Flour Produced by 14 Flour Millers in the Northern Great Plains

Company	Bakery (Per Cent)	Family (Per Cent)
1	12.0	- - -
2	12.0 - 12.3	11.0 - 11.3
3	12.4	12.0
4	12.0 - 12.75	11.0 - 11.75
5	11.5 - 12.0	10.0 - 11.0
6	12.4	- - -
7	12.6	12.0
8	12.75	11.0 - 11.5
9	12.2	12.0
10	12.5	12.1
11	12.0	11.5
12	12.0 - 12.5	11.75
13	12.5	- - -
14	11.4	12.0

III. Bakers and Their Practices

The bakers prefer to use a blended flour because they feel it gives better handling qualities in the type of product in which it is used. Of

course, this blend varies according to its use and also according to the location of the baker.

Table VIII

Different Protein Content Wheat Used for the Production of Several Types of Flour by 14 Flour Milling Companies in the Northern Great Plains

	Winter Wheat Protein Content (Per Cent)				Spring Wheat Protein Content (Per Cent)			
	8-10	11-12	13-15	16 and over	8-10	11-12	13-15	16 and over
Bakery Flour		7	9	3		11	14	8
Family Flour	2	8	7		2	12	10	1
Kaiser Roll Flour							1	10
Whole Wheat Flour							7	2
French Bread Flour							1	9

Four of the bakers interviewed who are located east of the Rocky Mountains purchase their flour at Minneapolis and Kansas City. They probably purchase a little more flour at Kansas City than at Minneapolis. One baker stated that he purchased 60 per cent of his flour from Kansas City and 40 per cent from Minneapolis. Another baker purchased half of his flour from each location. Another baker bought part of his flour from Buffalo.

In determining the price they will pay for flour the bakers consider such factors as the price of wheat on the market, their own specifications for flour, the protein and ash content of the flour, the section of the country in which the wheat is grown, the cost of transportation, and the

quality and quantity of the gluten. These factors, jointly considered, cause the bakers to buy flour in both the major markets in order to obtain the most advantageous price and to obtain the best blend of flour properties.

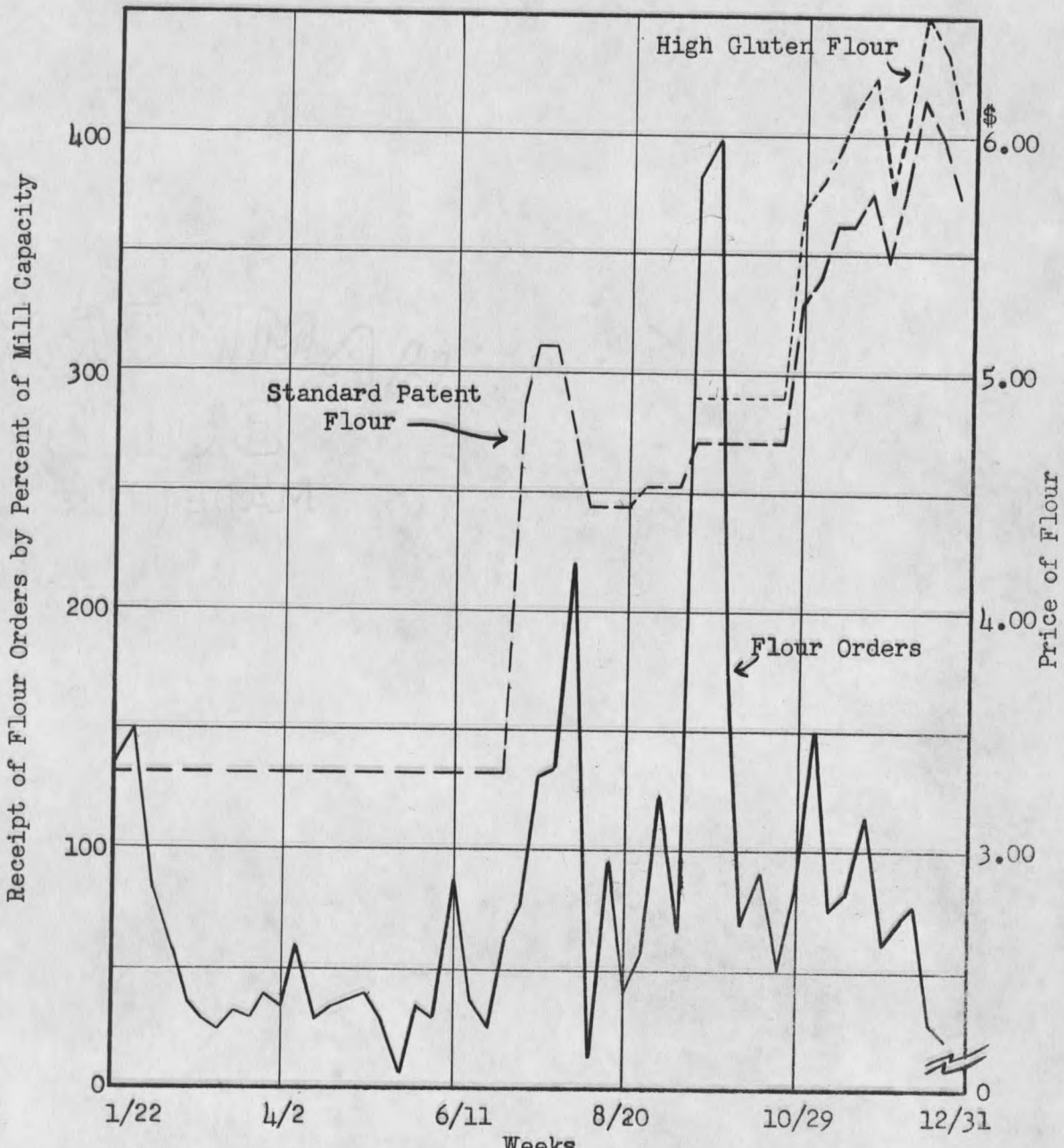
Flours used to be blended mainly by the bakers but there is more of a trend today toward blending at the miller level. This enables the baker to order flour with very exact specifications. However, there is also somewhat of a tendency to set just enough requirements to give the miller an idea of the exact type of flour desired. Then, it is up to the miller to supply a flour that will produce a good bread loaf. This attempt by the miller to produce a flour satisfactory to the individual baker at times may cause the miller to pay more for a particular protein wheat than is warranted by the price he receives for his flour.

The orders placed with the spring wheat millers fluctuate every day partly in response to the bakers' opinion of the wheat market. Not only are the millers and others actually purchasing wheat on the market trying to buy at the most favorable time, but also the bakers are attempting to place their orders based on the most favorable market conditions. The bakers know that the price they pay for flour is to a large extent determined by the price the millers have to pay for wheat at the moment of receiving an order for flour. Figures 8 and 9 show the great variations that take place in the receipt of flour orders by the millers and in the price of flour.

The period June 1, 1947 to July 15, 1947 is a good example of the reactions of the bakers to the market price of wheat. In early June the millers remarked that it had been many years since the trade (bakers) had

Figure 8

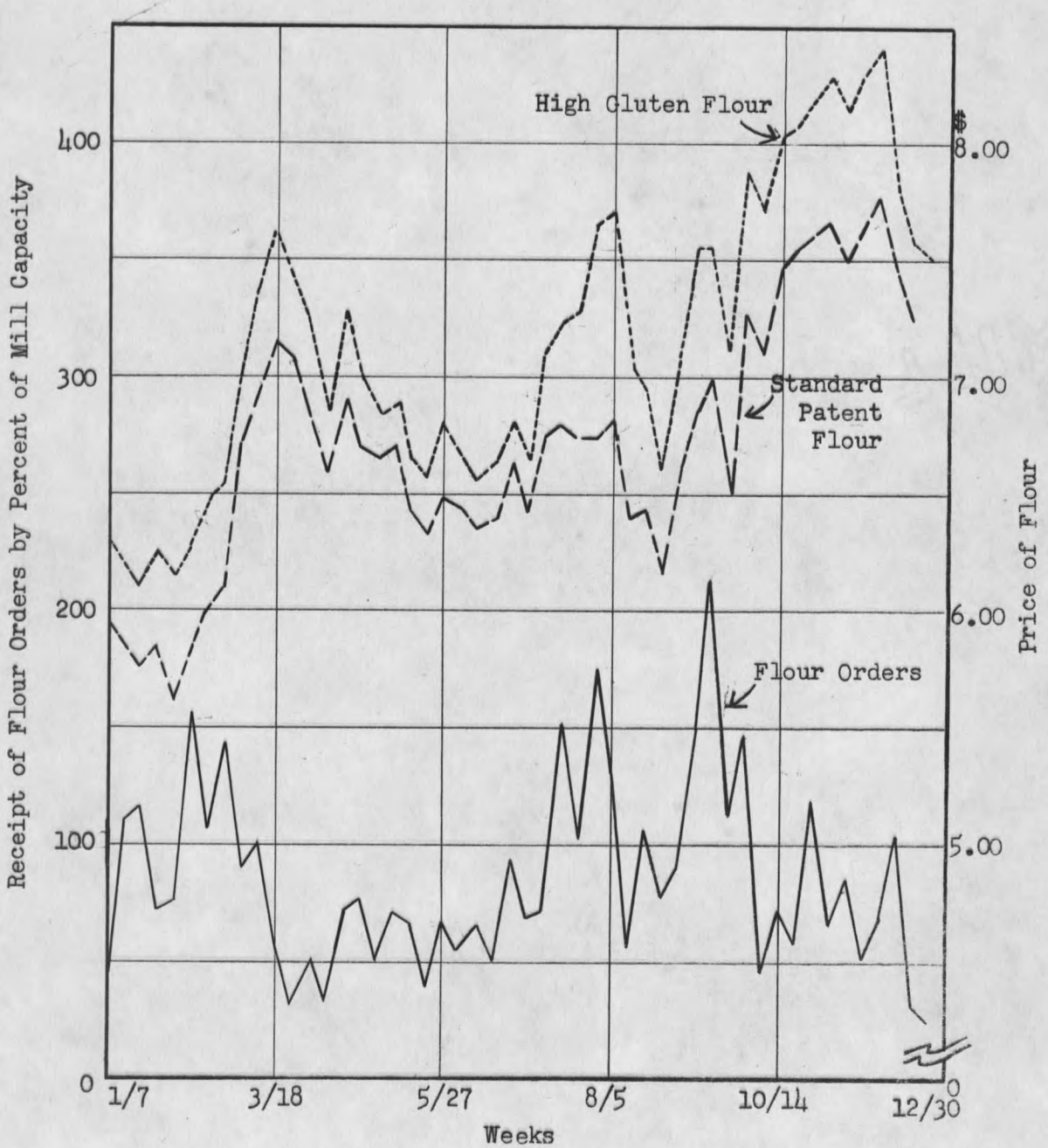
The Price of Flour at Minneapolis as Compared to the Receipt of Flour Orders at Minneapolis by Weeks for the Year 1946 a/



a/ The Northwestern Miller, Miller Publishing Company, Minneapolis, January 1, 1946 to December 31, 1946

Figure 9

The Price of Flour at Minneapolis as Compared to the Receipt of Flour at Minneapolis by Weeks for the Year 1947 a/



a/ The Northwestern Miller, Miller Publishing Company, Minneapolis, January 1, 1947 to December 31, 1947.

shown so little interest in forward needs at this time. The order received by the millers were running a little over 50 per cent of capacity at that time. (See Figure 9). The first week in July found buying of flour at a low ebb with the bakers all expecting lower prices. The second week of July showed a heavy receipt of wheat on the market. In one day the price of No. 1 Dark Northern Spring Wheat declined from an average closing price of $2.90 to an average closing price of $2.64. Other grades of wheat declined correspondingly on the Minneapolis market. 8/ Immediately, the bakers moved in and placed orders in large volume. The average bookings for the week ended July 15 were 150 per cent of capacity in contrast to 72 per cent the week before. However, the price drop was short lived because the C. C. C. moved in quickly and brought the price back up. With a price increase the bakers quit buying in large quantities. This is indicated by the drop in flour orders for the week ended July 22. The increase in the next week was due more to two large buyers than the baking trade as a whole. The bakers who did not get in on the price break continued to hold back their orders. 9/

The bakers' purchases of flour are based upon their current needs for flour, their expectation of future needs of flour, the current price of wheat, and their expectation of the future price of wheat. However, taken

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8/ Minneapolis Grain Exchange, "Daily Closing Prices of Cash Wheat", Sixty-fifth Annual Report, December 31, 1947, p. 20.

9/ The Miller Publishing Company, "Comments on the Flour Trade," U.S. Flour Markets, The Northwestern Miller, June 3, 1947 through July 29, 1947.

on the basis of a year the flour orders will average out to a total quantity that remains relatively constant from year to year.

IV. Graphical and Statistical Comparison

Figures 8 and 9 indicate the great variations that take place in flour prices and orders received. In Figure 10 a comparison is made of spring wheat price index at Minneapolis and the Minneapolis Standard Patent Flour price index. They both appear to follow the same pattern and the relationship between the two is close with the exception of the period before July 1. Prior to July 1, there was a price ceiling on both wheat and flour. The price of wheat fluctuated some below the ceiling and up to it, while the price of flour remained at the ceiling for the first part of 1946. This is the cause of the steadily declining flour price index in the first six months of 1946 and the tremendous increase in July, 1946. The rest of 1946 and all of 1947 shows the normal relationship between the two indexes. This indicates that the price of flour is very closely tied to the price of wheat as was mentioned previously.

A correlation was made between the Minneapolis flour price index and the flour orders received at Minneapolis each week in 1946 and 1947. The coefficient of correlation obtained is .3. This is not a very high correlation, however, it does explain 10 per cent of the movement of flour prices. Figure 11 shows a scatter diagram and a least squares line of regression of this same data. The figure shows a positive relationship between flour price index and flour orders received. The line of regression indicates that for every increase of 100 per cent of mill capacity in flour

Figure 10

Comparison of Minneapolis Flour and Wheat Price Indexes by Weeks for the Years 1946 and 1947

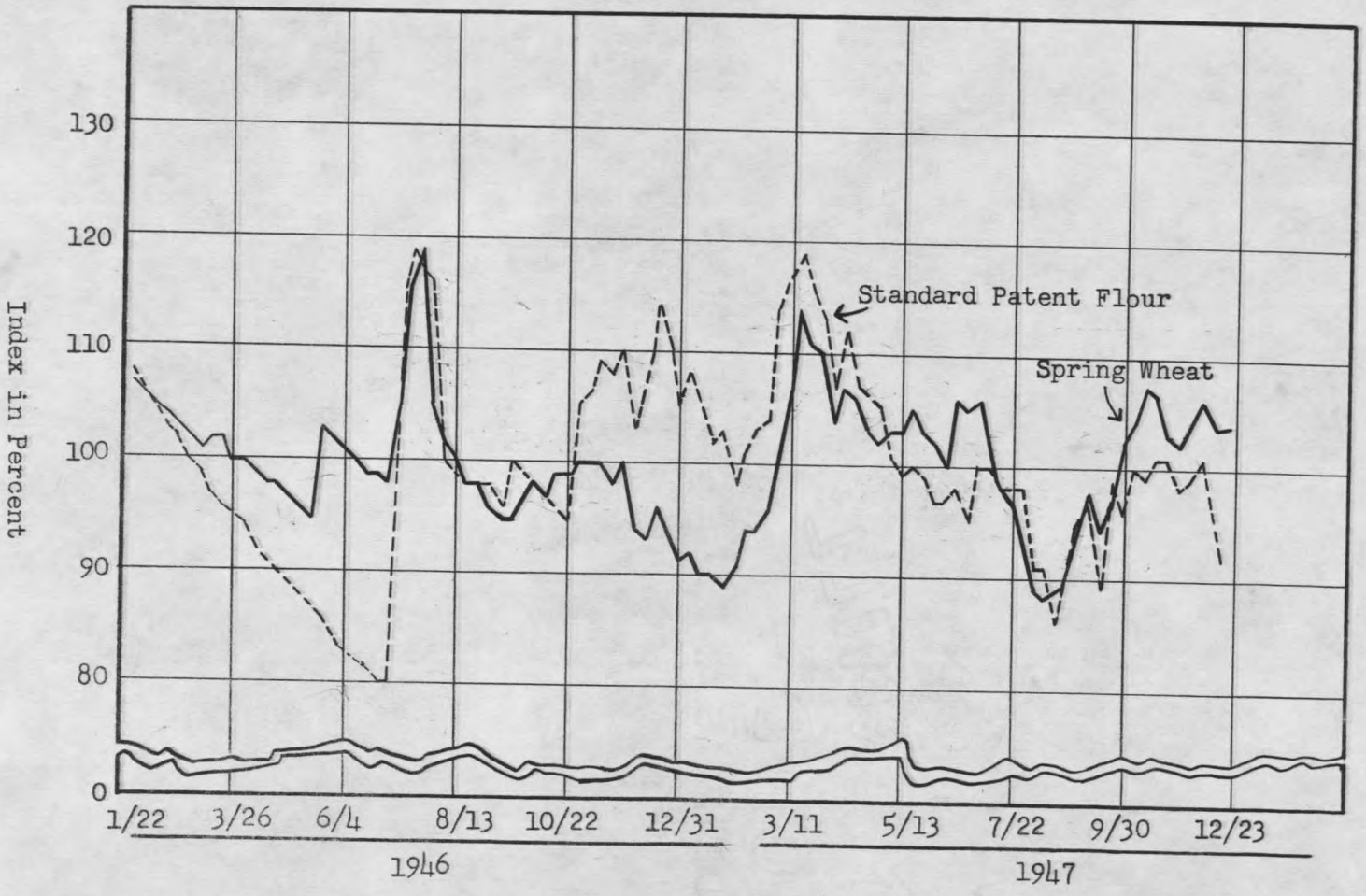
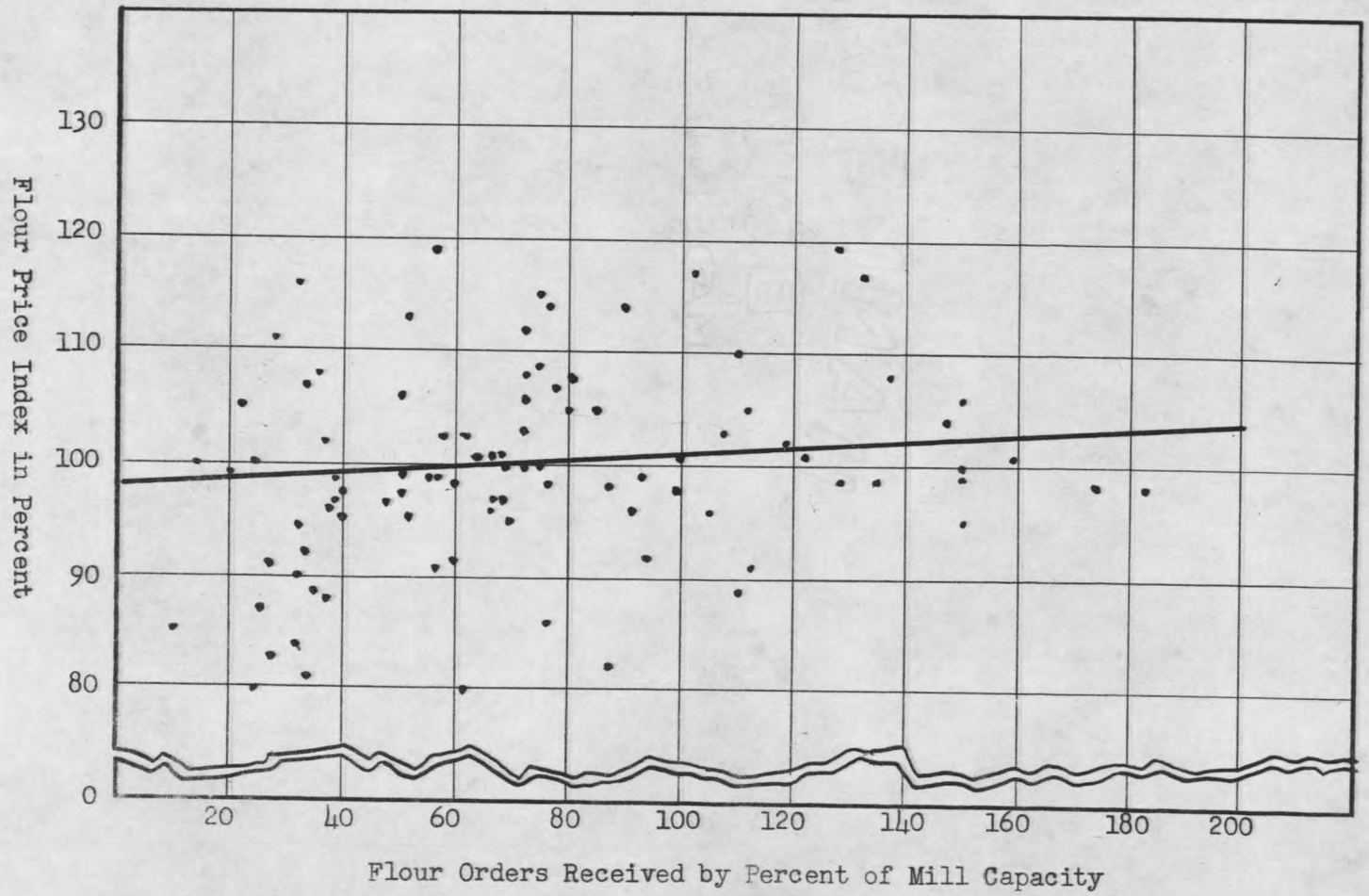


Figure 11

A Comparison of Minneapolis Flour Price Index and Flour Orders Received in Minneapolis by Weeks for the Years 1946 and 1947



orders, the flour price index increases 2.6 per cent. Since there appears to be a fairly close relationship between wheat and flour price indexes, the relationship between flour orders and flour price indexes might be applied to wheat price indexes and flour orders as well.

There undoubtedly are many other factors which affect the price of flour and wheat as well as the receipt of flour orders but a complete determination of every factor may not be possible because, as has been shown earlier, a large part of the movement is due to the expectations and opinions of the bakers, millers, and others actively engaged in the market. However, the close relationship that exists between the demand for flour and the demand for high protein spring wheat has been indicated. Any movement of the demand curve for flour will cause a similar movement in the demand curve for high protein spring wheat.

C. Other Wheat and Flour Markets

I. The Movement Between Markets

The spring wheat market is not the only market which uses high protein spring wheat. Every year large quantities of spring wheat are shipped to the West Coast for blending with wheat grown in the coastal and intermountain areas. Seventy per cent of the wheat produced in the Pacific Northwest is white wheat and forty per cent is soft white wheat. Only 25 per cent of their wheat crop is represented by hard red winter wheat. 10/ The amount of spring wheat which goes to the West Coast every year will depend upon

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10/ Willard N. Crawford, "Wheat Production in the Pacific Northwest", The Northwestern Miller, Production Section, February 11, 1947.

the protein content of the wheat from the Pacific Northwest and neighboring states. If their protein is higher than usual for one year only enough spring wheat will be shipped in to give the necessary strength to the resulting bread flour. However, if the protein content is lower than usual, then more high protein spring wheat will move to the West Coast in order to make up for the deficiency in their protein.

A similar reaction will take place between the hard red winter wheat area and the spring wheat market. Here again, in years when the Southwest is deficient in protein, these millers enter the spring wheat market and purchase high protein spring wheat. An example of this happened in 1953 when there was a large supply of high protein spring wheat in Montana and yet the protein premiums were high. This can be partly attributed to the fact that there was a lack of protein in the hard winter wheat area as well as much of the spring wheat area, and the winter wheat millers entered the spring wheat market to purchase high protein spring wheat. This entry into the spring wheat market by buyers from other markets represents alternative uses for high protein spring wheat.

If the situation were reversed and the spring wheat millers were entering other market areas for their wheat then other types of wheat would become substitutes for high protein spring wheat. There is good indication that spring wheat millers do go into the hard red winter wheat area for part of their wheat requirements when there is a price advantage or a shortage of spring wheat protein. There is little reason to believe that the spring wheat millers ever go into the soft wheat areas for any wheat because soft wheat does not produce a bread flour satisfactory to the

spring wheat millers and there is generally enough hard wheat to meet milling needs.

II. The Elasticity of Substitution.

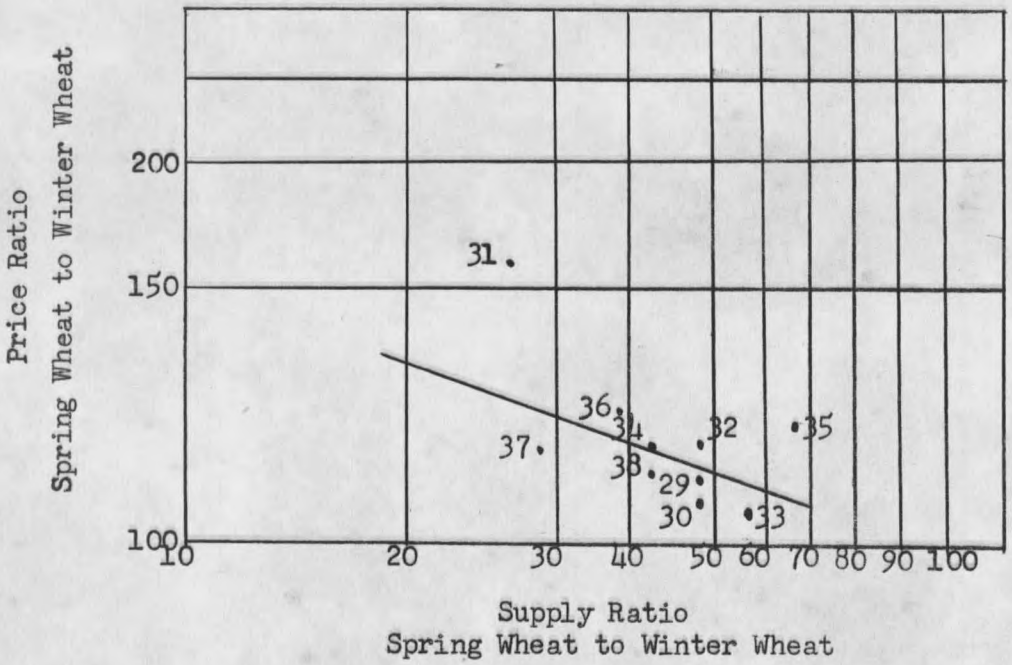
Kaldor, in an analysis of the elasticity of substitution between various classes of wheat, showed the possibility of considerable substitution between hard red spring wheat and hard red winter wheat. 11/ He arrived at a substitution elasticity of about -6.5 which indicates that a small change in the relative prices of hard red spring wheat and hard red winter wheat causes a large change in the quantities utilized by millers. (See Figure 12). Kaldor also arrived at a substitution elasticity of -2.2 between hard spring wheat and soft red winter, and -3.44 between soft white wheat and hard spring wheat. This would indicate that for a given change in price ratios the change in quantities utilized between hard spring wheat and soft red winter would be about one-third as much as the change in quantities utilized between hard spring and hard winter wheat. In other words, for a given change in price ratios three times as much hard winter wheat as soft red winter would be substituted for hard spring wheat. Similarly, twice as much hard winter wheat would be substituted for hard spring wheat as would hard spring wheat be substituted for soft white wheat with a given change in price ratios. This is substantiated by the fact there is more substitution between spring wheat and white wheat than between soft winter and spring wheat while neither approaches the amount of substitution carried on between the hard spring wheat area and the hard winter wheat area.

11/ D. R. Kaldor, unpublished marketing study, Economics Department, Iowa State College, 1940.

Production and price ratios were computed for the years 1941 through 1950 for hard red winter and hard red spring wheat. The price of No. 1 Dark Northern Spring wheat at Minneapolis and the price of No. 2 Hard Winter at Kansas City were used to compute the price ratios. Figure 13 shows these ratios for the years indicated as well as for the years 1934-1937. 12/ The substitution elasticity arrived at is approximately -6.5. This compares very closely with the figures given by Kaldor. The points

Figure 12

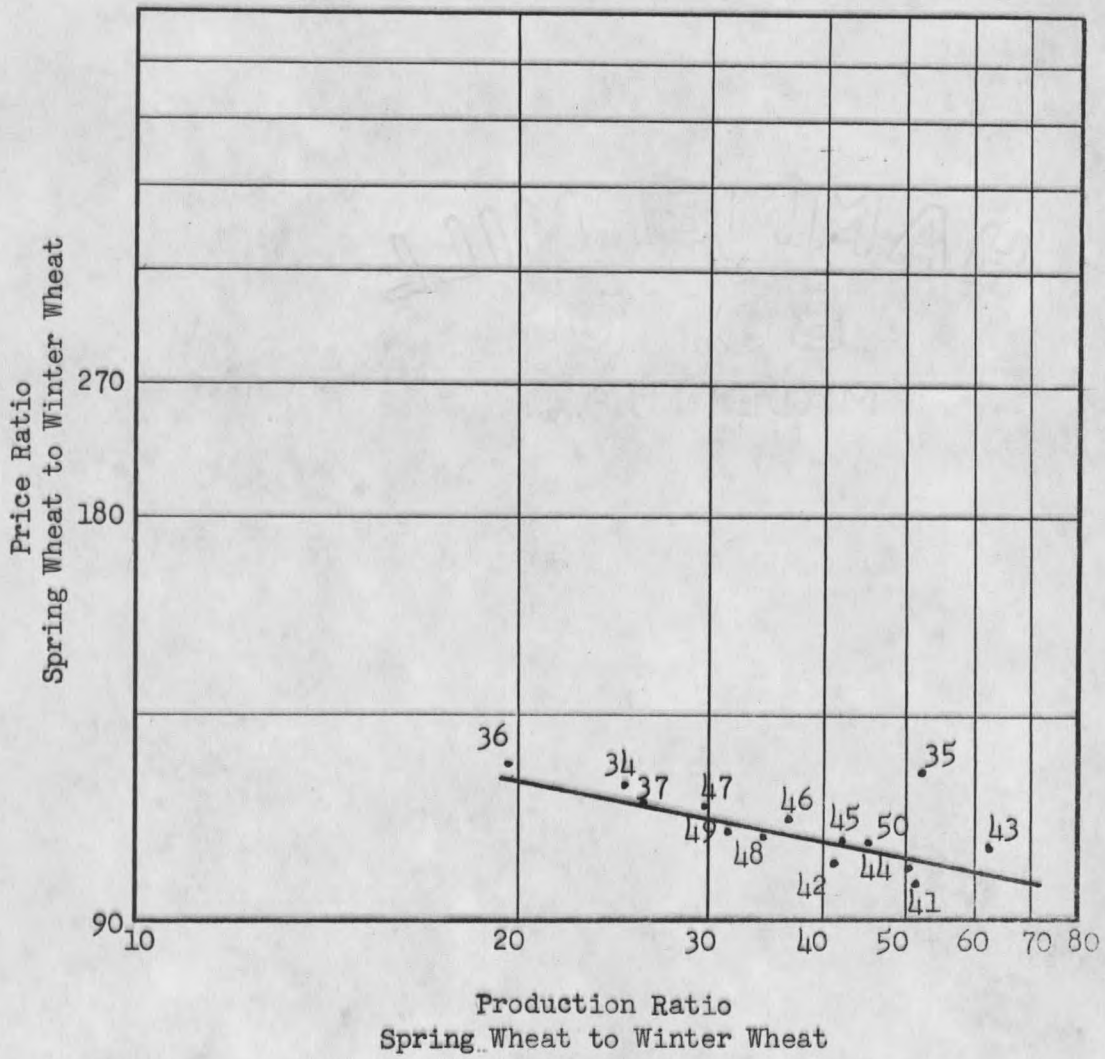
The Elasticity of Substitution between Hard Red Spring Wheat and Hard Red Winter Wheat, 1929-1938



12/ The data used were taken from the Agricultural Statistics, United States Department of Agriculture, 1952. First, the percent of total production for each class of wheat was obtained. The percent of one class was divided into the percent of another to obtain the production ratios. The price ratios were obtained by dividing the yearly average price for one class into the yearly average price for another class.

Figure 13

The Elasticity of Substitution between Hard Red Spring Wheat and Hard Red Winter Wheat, 1934-1937 and 1941-1950



for the years 1934-37 fall in line with those of the later period and thus seem to confirm Kaldor's figures. It is apparent also that there has been very little change in the relationship between hard winter and hard spring wheat in the last 20 years. Supply ratios were also computed for the period 1941-1950. These, however, do not check with Kaldor's figures. This is because it was not possible to obtain comparable supply data, whereas it was possible to obtain comparable production data. An attempt to recompute Kaldor's 1934-37 supply ratios was not successful. It was successful in the case of the production ratios. Therefore, it is assumed that for the present it is not possible to compare the results when using supply ratios.

While it is difficult to obtain definite empirical evidence of the interplay of the various wheat markets, Kaldor's figures and the ones mentioned above suggest definite substitution. Comments from members of the grain trade indicate that this substitution exists.

III. The Effect on Demand

Substitution increases the elasticity of demand for high protein spring wheat and the greater the number of substitutes, the more elastic its demand will be. In like manner, when buyers from other areas enter the spring wheat market to buy hard spring wheat for blending with their wheats they create alternative uses for high protein spring wheat. Alternative uses will increase the elasticity of demand also.

In Section A a number of examples were given on the effects of substitutes and alternatives. The action of the various markets on each other would tend to be a situation where the demand curve for high protein spring

wheat be more elastic above a certain price and less elastic below than it might otherwise be without this influence. (See Figure 4). The close connection between these markets tends to keep the various prices in line with each other. If the demand curve above a certain relative price is more elastic because of the possibility of substitution, the price will tend to remain near this relative level. If it does not, a large amount of substitution will take place until the price returns to the equilibrium level. The fact that this substitution probably exists indicates that the demand curve for a certain range is more elastic than it might be otherwise.

D. The Variations in Wheat Shipments on the Great Lakes

I. Shipping on the Great Lakes

Every year the Great Lakes freeze and all shipping on these waters cease for a period of about three months. Buffalo is the largest spring wheat milling center, exceeding the 5-day week capacity at Minneapolis by almost 200,000 bushels. Buffalo depends very heavily on the cheap transportation provided by the Great Lakes to obtain its supply of wheat. During the time that the Great Lakes are closed the Buffalo millers must use wheat that was received and stored before the closing or resort to higher transportation costs over the land routes. For this reason it is economically sound for the Buffalo millers to store all the wheat they can before the Lakes close each winter. Each fall this rush to get wheat to the Great Lakes drives the price of spring wheat up. The millers would be willing to pay a price differential equal to the difference in freight between land and water transportation if necessary. The price of spring wheat at Duluth

seems to reflect the conditions on the Great Lakes and to some extent so does the price at Minneapolis.

II. Statistical Relationships

In order to determine what relationship exists between the Great Lakes and the price of spring wheat, an 11-year monthly average price for No. 1 Dark Northern spring wheat was calculated. This was obtained by using the monthly average for each month of each year computed from the daily closing prices at Duluth and finding the mean of these monthly averages for the 11-year period. 13/ These average prices were compared to the 9-year average monthly shipments from Duluth. A 9-year average was used here simply because data for 11 years was not available. The shipments from Duluth contain figures for land shipments as well as that over the Great Lakes but the amount going over land is so insignificant that it does not alter the picture any.

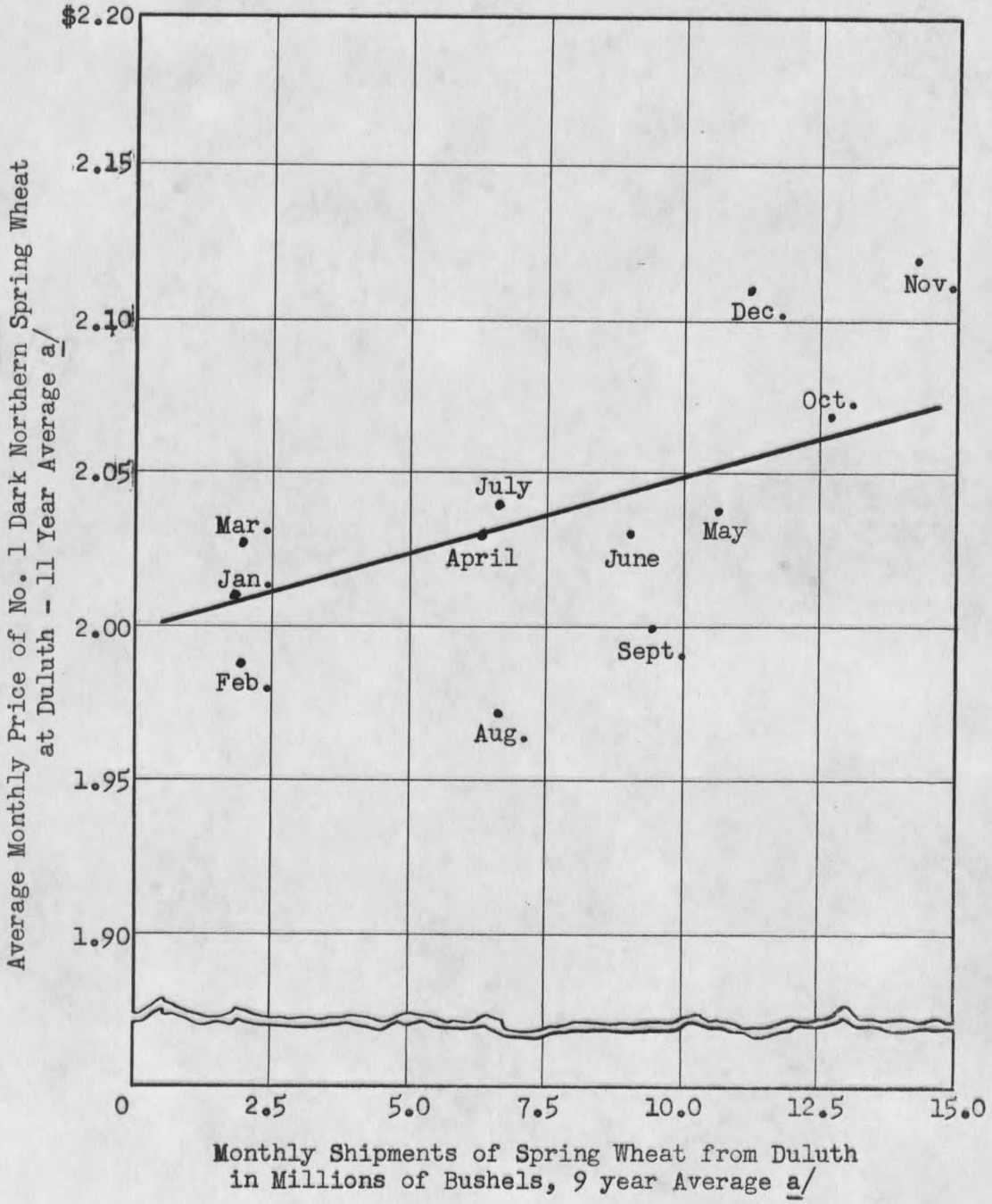
These averages are plotted in Figure 14, and a least squares line mathematically fitted to them. The result shows a definite positive relationship between the quantity shipped over the Great Lakes and the price of spring wheat at Duluth. To make a comparison with other markets similar figures were plotted on two graphs: One, the prices received by the U.S. farmers against the quantity received at 12 primary interior markets; and the other the price of No. 1 Dark Northern Wheat at Minneapolis against the quantity of wheat received on the Minneapolis market. Both of these show a

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13/ The years 1942 through 1953 were used except for 1949. The data for 1949 were incomplete so the year was eliminated from the calculations.

Figure 14

The Price of Spring Wheat on the Duluth Market as Compared to the Shipments of Wheat from Duluth for the Years 1942 - 1953



a/ Annual Reports, Duluth Board of Trade, Duluth, 1942-1953.

negative relationship between the quantity received and the price, although the relationship is not so pronounced at Minneapolis as it is for the U.S. as a whole. (See figures 15 and 16). This would suggest that the Minneapolis market is affected to some extent by the Duluth market. Figure 17 shows that January, February, and March, the months when the Lakes are generally closed, are the lowest both in price and quantity of shipments. The shipments in this period undoubtedly consist of land transportation. October, November, and December, the months just previous to the closing of the Lakes, are conspicuous by their place at the other end of the chart. Here, all three prices are high and the shipments the highest of the year.

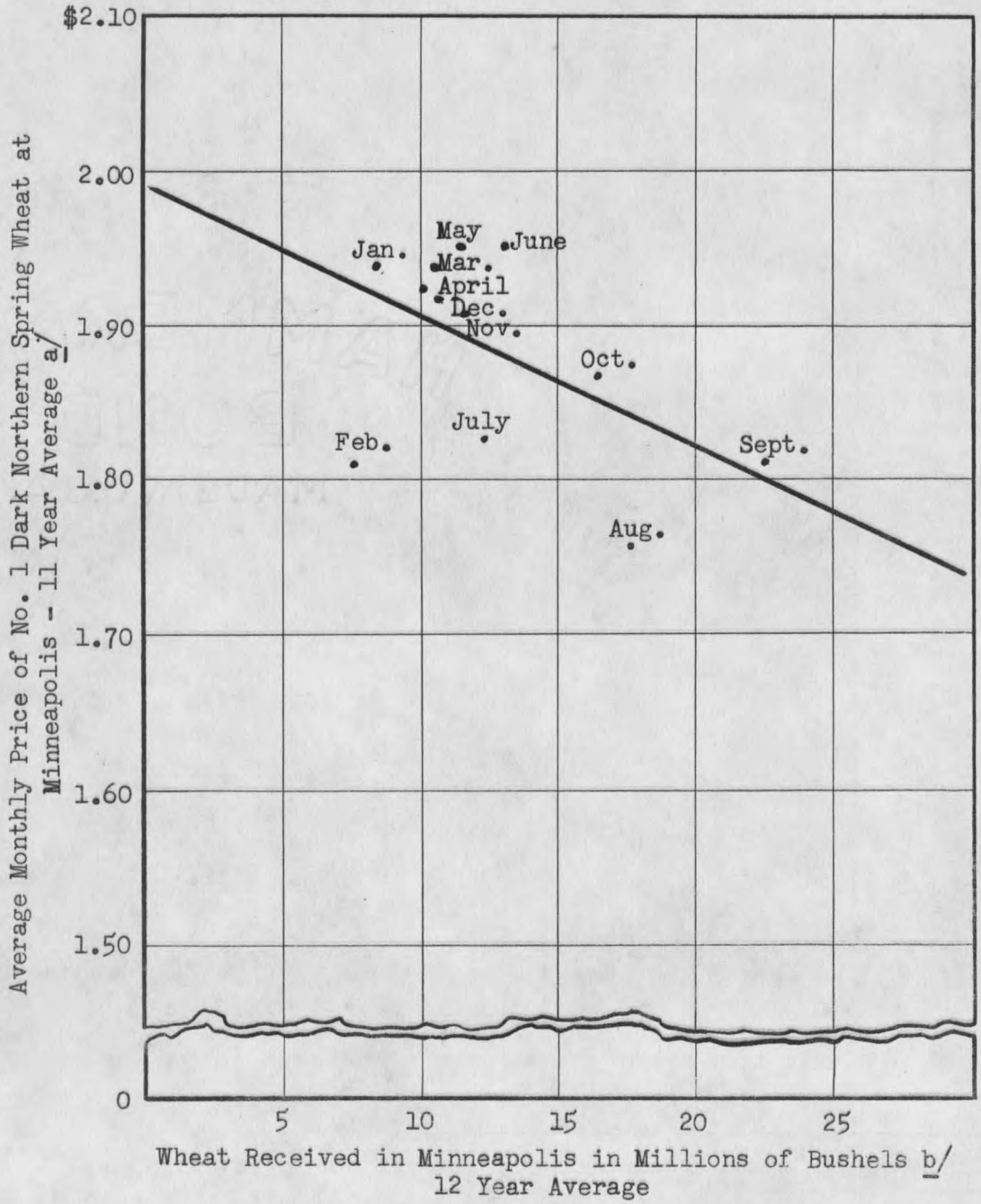
A look at the movement of the Duluth prices shows an increase from August to December with a drop in January and February, and some recovery in March. April, the month when the Lakes generally open, shows an increase in price which suggests that the desire of the Buffalo millers to get wheat moving across the Lakes as soon as possible tends to raise the price at this time. The price increases in May, drops off in June, and rises slightly in July before the August drop. The 20-year average of spring wheat prices at Great Falls, Montana, shows a similar movement which may be partly due to the fact that a large part of Montana spring wheat moves over the Great Lakes.

A similar look at the movement of the U.S. and Minneapolis prices shows a different seasonal pattern. There is a tendency for the U.S. wheat prices to rise from August through May of the next year. 14/

14/ Stanford University, "Variations in Wheat Prices," Wheat Studies of the Food Research Institute, Vol. V, No. 7, California, June, 1929.

Figure 15

The Price of Spring Wheat on the Minneapolis Market as Compared to the Receipts of Wheat at Minneapolis for the Years 1941-1951

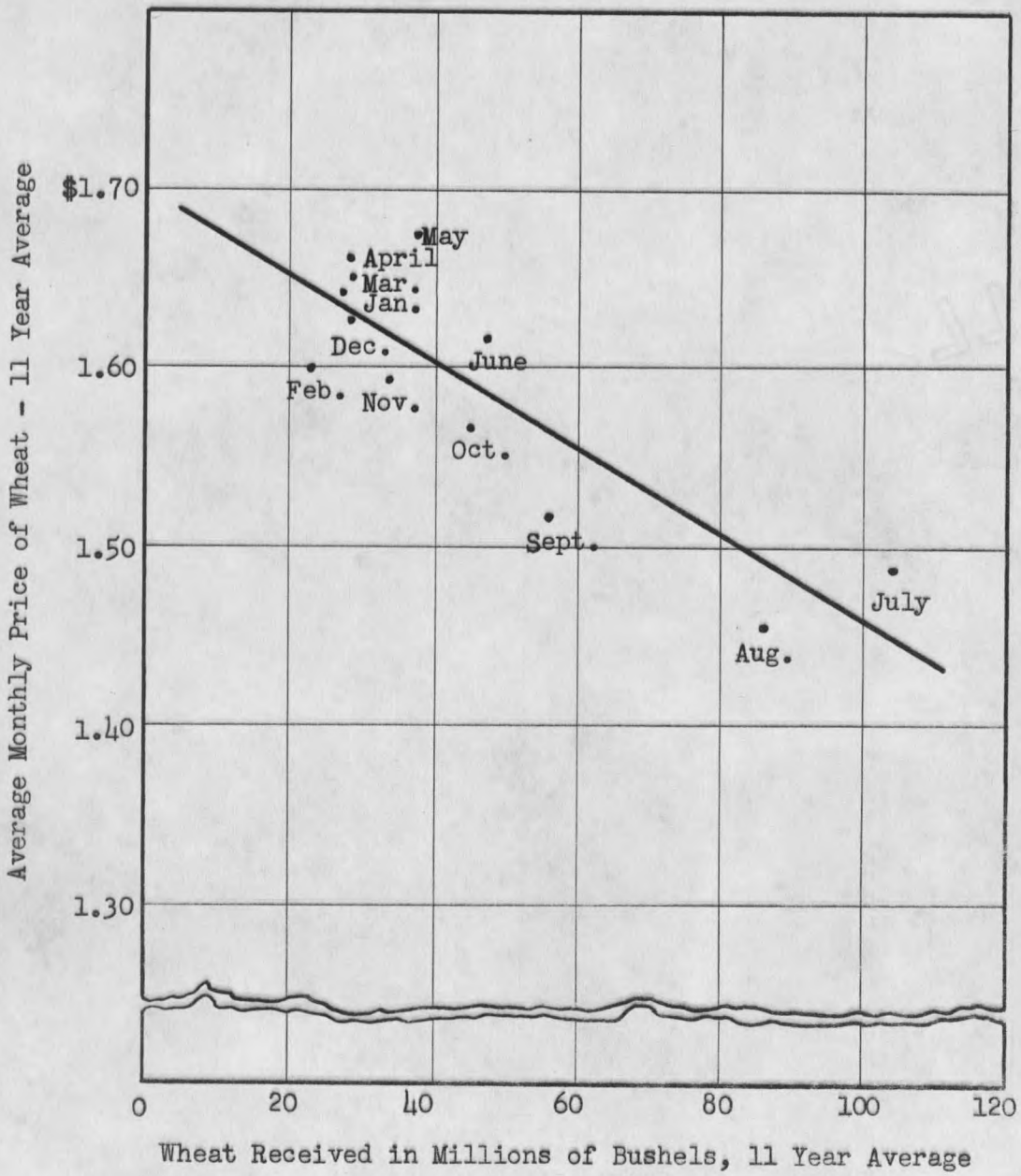


a/ Commodity Research Bureau, Commodity Yearbook, New York, 1952.

b/ Annual Reports, Minneapolis Board of Trade, Minneapolis, 1941-1951.

Figure 16

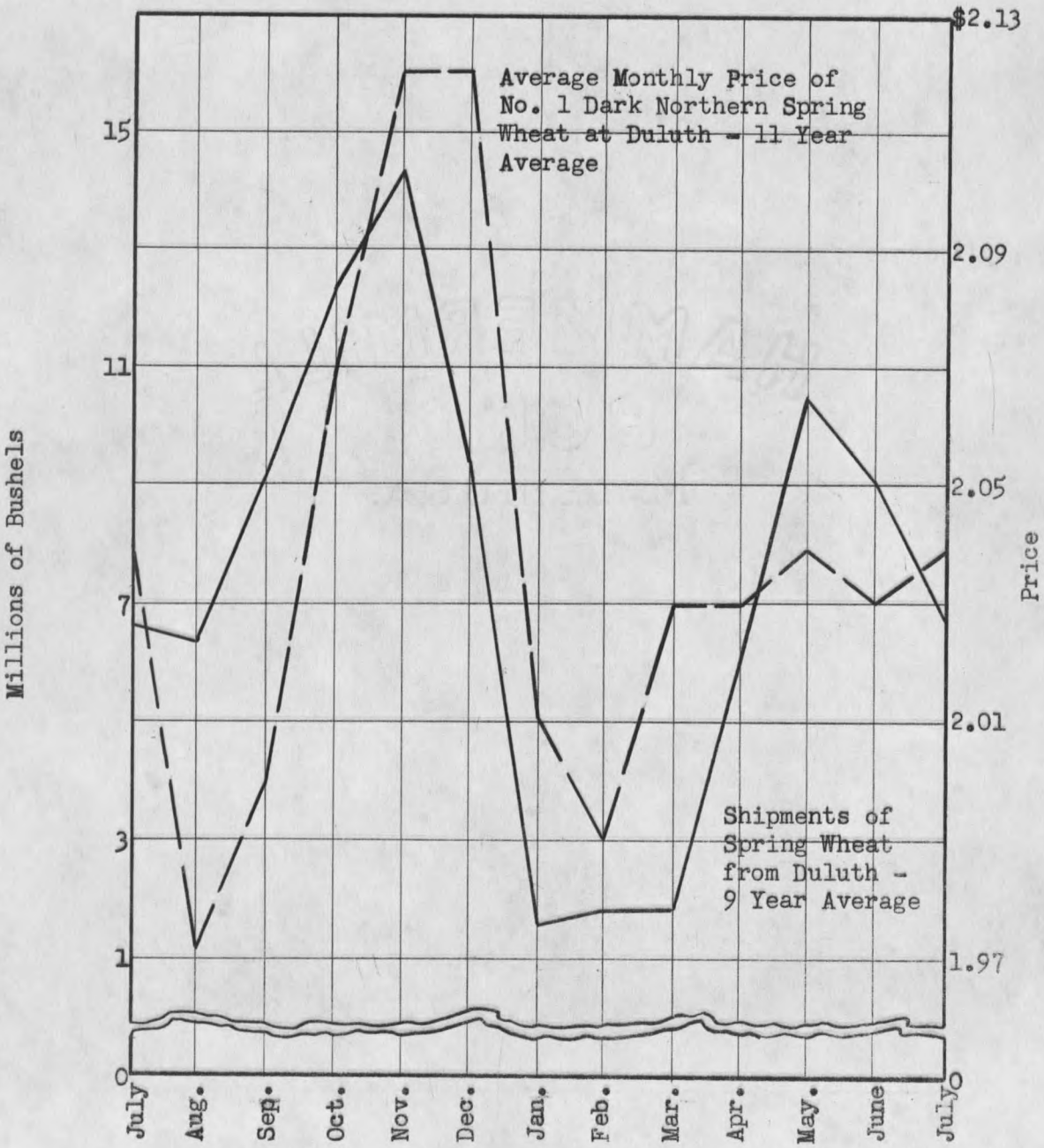
The Price of Wheat Paid to U.S. Farmers; as Compared to the Receipts of Wheat at 12 Principal Markets for the Years 1941 - 1951 a/



a/ Commodity Research Bureau, Commodity Yearbook, New York, 1952.

Figure 17

The Monthly Price of Spring Wheat on the Duluth Market as Compared to the Monthly Shipments of Spring Wheat from Duluth for an Average Year.



Minneapolis prices show a similar movement, although it is not so pronounced. The small rise in January, the very sharp drop in February, and the fluctuation of prices in the spring months suggest some influence not present in the U.S. prices. The U.S. price is greatly determined by the price of winter wheat in the Kansas City market since hard winter wheat represents the largest proportion of the total wheat crop. This different movement of U.S. prices is also shown by Green in a study on the seasonal variation of U.S. wheat prices in 1925. 15/ His findings included to a large extent the effect of foreign wheat on the domestic market. However, this relationship no longer exists because of the high support price on domestic wheat. Green pointed out three potential weak spots in the U.S. wheat prices: (1) June, July, and August, which are affected by prospective and actual movement of the winter wheat crop of the United States; (2) November, when the new spring wheat (pre-combine) and Canadian crops move; and (3) February and March, when wheat from Australia and Argentina arrive. He also points out three potential strong spots: (1) September and October, when the movement of winter wheat has decreased and the spring wheat crop has not yet begun to move; (2) January, when the Great Lakes are closed and the Canadian wheat is shut off and it is too early for foreign wheat; and (3) April, when the foreign wheat has passed its peak and the Great Lakes have not yet opened. The high spot he mentions for January, which is in contrast to the January drop on the Duluth market, is largely due to his emphasis on foreign

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15/ R. M. Green, Seasonal Fluctuations of Wheat Prices, Kansas Agricultural Experiment Station, Manhattan, Circular 121, 1925.

wheat (Canadian, Australian, and Argentina) and its effect on the U.S. price of wheat.

Further statistical analysis indicates that any correlation between Duluth prices and the quantity of shipments is not significant. Price indexes were calculated for Duluth, Minneapolis, and the United States. An 11 and 12-month average of U.S. Farm price indexes and the Duluth price indexes is shown in Figure 18. A difference in the index pattern can be seen. The U.S. farm index tends to rise from the summer low to January with a deep drop in February, which apparently is a normal phenomenon that is yet to be explained, and a recovery in March and April. The Duluth index rises to November and drops off in December, January, and February. It rises again in March, just prior to the Great Lakes opening, and then levels off again in April, May, and June.

From these indexes a correlation was made between the differential between Duluth and Minneapolis deviations from the trend (Duluth deviations were subtracted from Minneapolis deviations) and the quantity of wheat shipped over the Great Lakes. The result was that again there is a positive relation between the quantity of shipments and the differential between Duluth and Minneapolis indexes. In other words, the larger the shipments the larger the differential between Duluth and Minneapolis prices with Duluth being above Minneapolis. This conforms to the logic that during the heavy shipping season the Buffalo millers will pay more for spring wheat than the Minneapolis millers. At the time of peak shipments the differential between Duluth and Minneapolis is the greatest. When the lakes close, the Duluth price drops down close to the Minneapolis, and may even go below it. Figure 19 shows the relationship.

Figure 18

Comparison of U.S. Farm Price Index and Duluth
Price Index for Wheat by Months

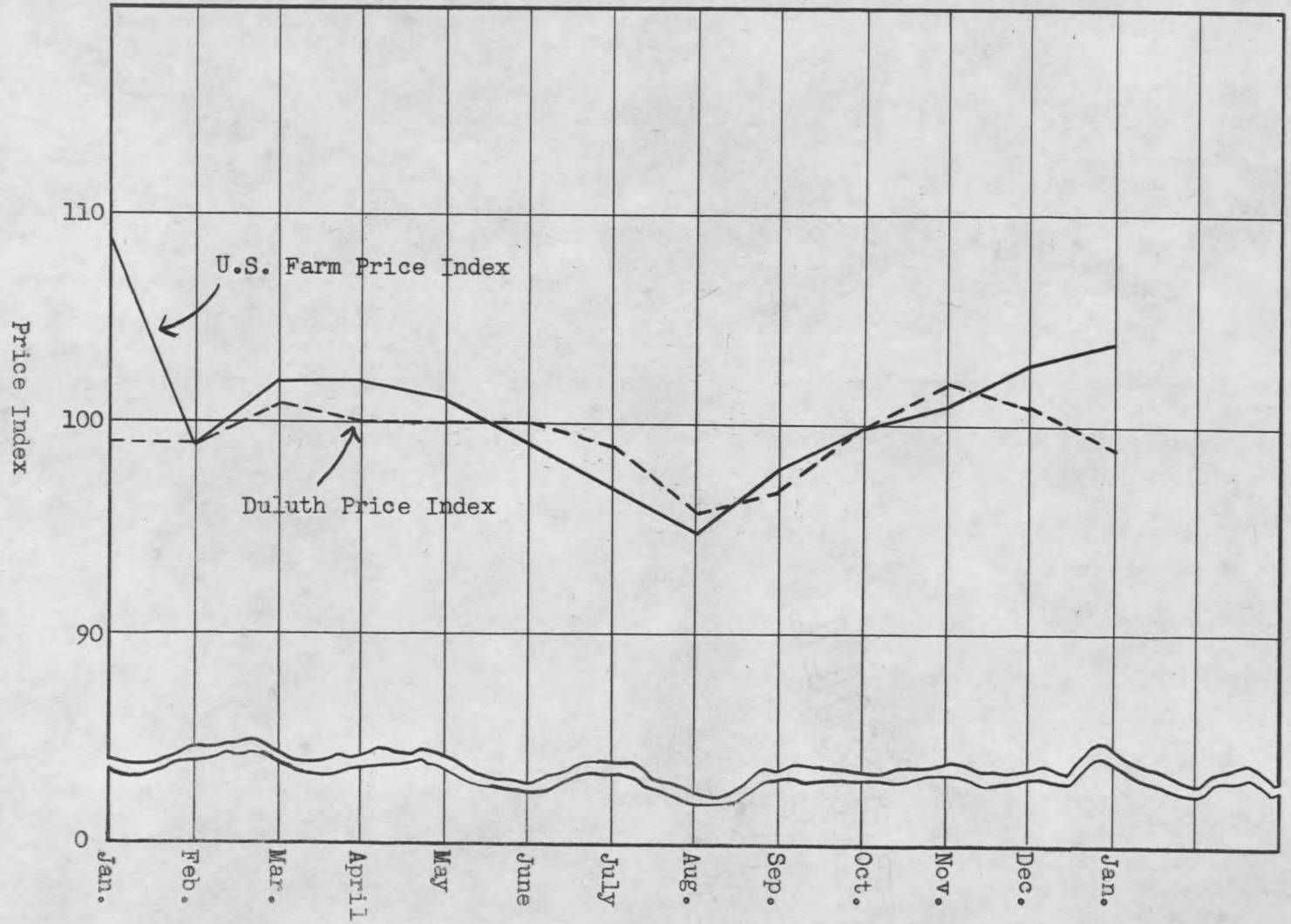
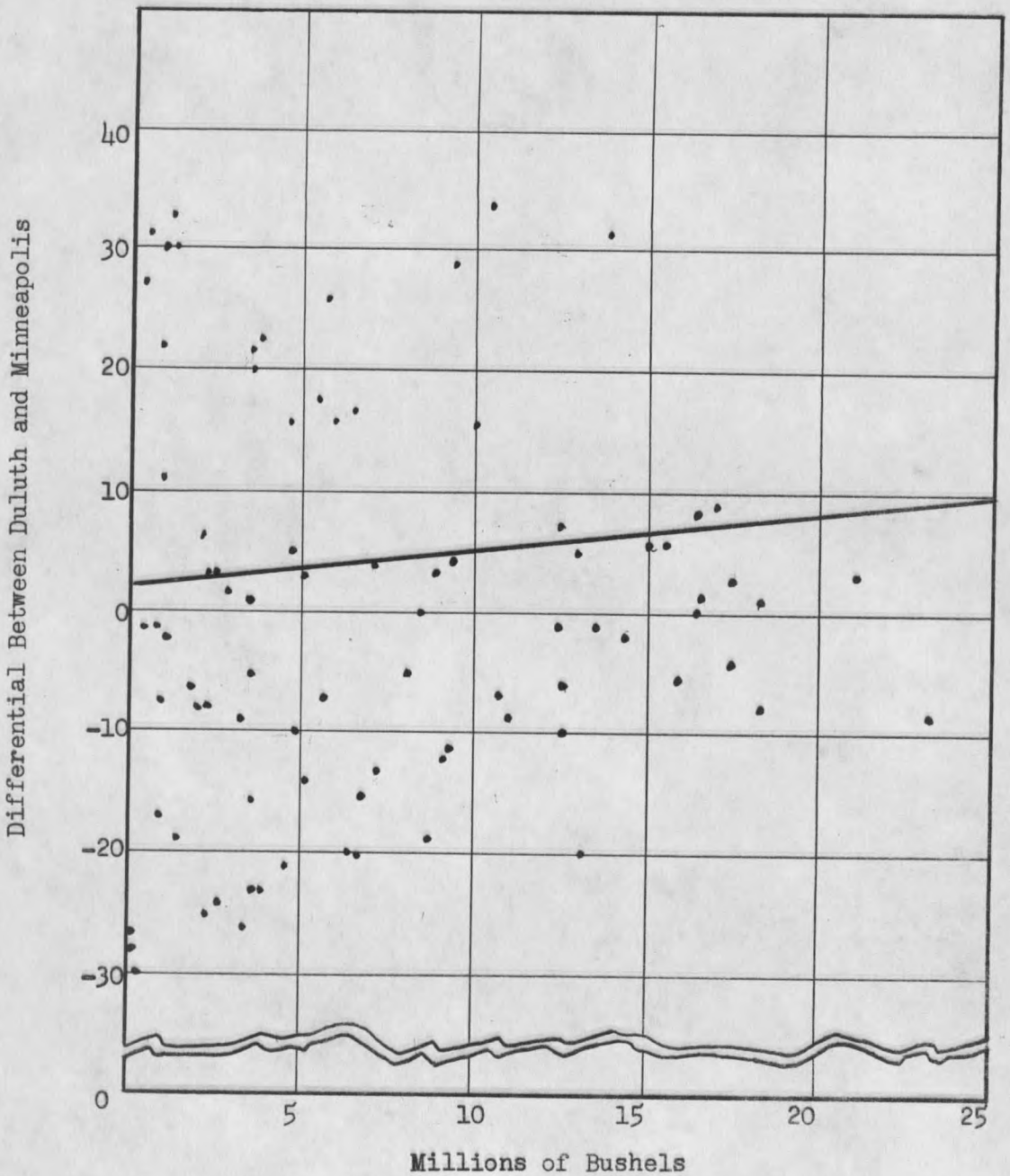


Figure 19

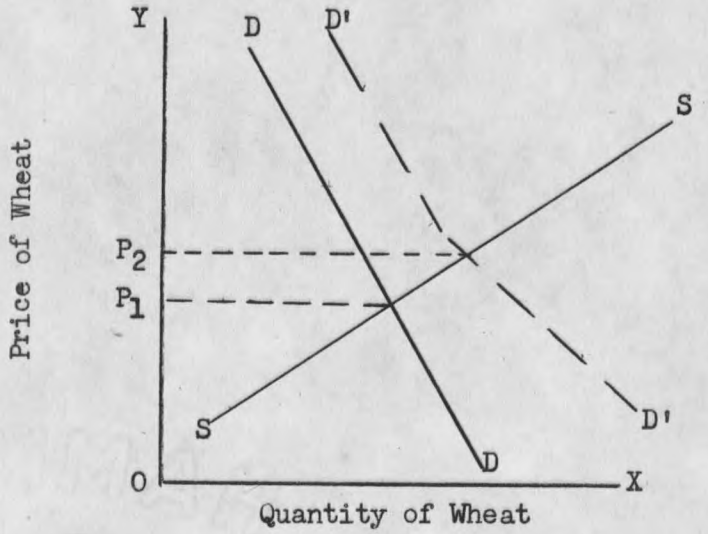
Comparison of the Differential between Duluth and Minneapolis, Price Indexes for Wheat and the Quantity of Shipments over the Great Lakes, Monthly Figures for 11 Years, 1941 - 1951



The correlation analysis indicates that the relationship between differential and quantity of shipments is not significant at all. It indicates that at best only one per cent of the variations in differentials could be explained by the quantity of shipments. There apparently must be other factors which enter the picture that have a more direct effect on the price movement at Duluth and causes the seeming relationship between price and shipments. However, it can be said that the seasonality of shipments on the Great Lakes does have a seasonal effect on the demand for high protein spring wheat. In the fall when the quantity demanded is great and shipping at its peak, the demand curve may be considered to have shifted to the right and become more elastic below a certain price. This price is the point where it no longer benefits the Buffalo millers to obtain wheat over the Great Lakes. Above that price it will cost them just as much as it would if they shipped over land routes and therefore, they probably would be reluctant to purchase any more than immediate requirements. Below this price, however, the curve will be more elastic than before. This is shown in Figure 20. Here, $P_2 - P_1$ will represent the differential over the Minneapolis price, assuming Minneapolis and Duluth were about the same before the fall shipping season started. The Minneapolis price will rise some due to the influence from Duluth, however, the Duluth price will remain above it under normal circumstances. As soon as the Great Lakes close the great demand at Duluth will no longer exist and the demand curve will tend to return to its former position. Although, this has not proven out statistically, the relationship still appears to exist and probably is the result of other factors which cannot be located at this time.

Figure 20

Theoretical Demand Curves for High Protein Spring Wheat



E. Blending of Protein

I. Variations in Supply of Protein

The production of wheat is a somewhat precarious business because no two crops are ever exactly alike. The wheat raised every year varies in physical and chemical characteristics. High protein wheat varies both in the quantity and the quality of the protein. In the state of Montana the protein content for the years 1951 and 1952 varied as follows: 16/

	Per cent of Total Crop	
Protein	1951	1952
Under 13.0%	21	18
13.0 - 13.9	18	20
14.0 - 14.9	17	26
15.0 and over	44	36
	100	100
Total Crop (Bushels)	95,033,000	83,548,000

16/ Montana Department of Agriculture and U. S. Department of Agriculture, Protein Content of Montana Wheat, 1951 and 1952 Crops, Helena, 1952.

These figures show the great variation that took place in Montana alone in just one year. The amount of wheat testing over 15.0 per cent protein dropped 11,076,200 bushels in this one year. Similar variations can be found throughout the spring wheat area.

II. Objectives of Millers and Bakers

The sole objective of the baker is to make a profit selling good bread. The baker, if he could be completely certain that all the flour he received would make the best loaf possible, would not care what kind of flour he used. The baker wants a quality loaf and all the specifications he gives to the miller are merely what he believes are the criteria for a good baking flour.

The baker realizes that the wheat produced fluctuates every year in quality. Both the quantity and quality of protein fluctuate yearly. Therefore, in attempting to maintain what he feels is a quality bread loaf, the baker alters his flour specifications from year to year to meet the changes in the wheat. The bakers interviewed all agreed that production of the best bread loaf is what they are interested in. Most of these bakers altered their specifications from year to year. However, some merely set minimum and maximum values for ash and protein content and left the rest up to the miller. One baker stated that he tries not to hinder the miller with too many rigid specifications. All he wants is a good loaf of bread and if the flour the miller delivers will produce satisfactorily, then he is satisfied and doesn't care about the particular properties.

The millers are anxious to satisfy the bakers' desire for flour that will produce the same quality bread loaf year after year. The millers try

to produce a flour that has the same quantity and quality of protein every year. Since the quantity and quality of protein in wheat is never the same the millers resort to blending of wheats. One wheat may be deficient in the quantity of protein and another with sufficient quantity may be deficient in protein or gluten quality. A blend of the two will strengthen the resulting flour and make it a better product.

III. Blending Practices

Every one of the millers interviewed stated that they purchased all of their wheat on the basis of protein and blended the wheat after purchasing. As mentioned, the millers' objective in blending is to produce a high quality uniform flour. However, the relative prices and supplies of the various proteins determine exactly what will be blended. The demand for a protein wheat will fluctuate from season to season and year to year depending upon a multitude of factors which probably never can be tested empirically. These factors include the supplies of various proteins in the hard red spring wheat area, the supplies of various proteins in the hard red winter wheat area, and the relative price levels of the two markets.

The high gluten flour which is used to make specialty products is made from spring wheat testing 15.5 - 16.0 per cent protein. The miller requires a certain amount of this extra high protein wheat every year and the demand for it can be considered more inelastic than for other proteins because it has no substitute. Specialty products can not be made out of lower protein spring wheat flour nor out of high protein winter wheat flour. This extra high protein spring wheat is necessary to the production of the specialty

products. Table 8 indicates this by showing that only very high protein spring wheat is used for these products. This specific demand causes the price of 15.5 - 16.0 per cent protein spring wheat to remain relatively high every year.

Table 8 indicates that this extra high protein wheat is used to blend with lower proteins to produce bakery flour. The relative proportion of this extra-high protein wheat that is used for blending is not known. However, it is suspected that only a small proportion of the 15.5 - 16.0 per cent spring wheat milled is used to blend with lower proteins. One miller commented that under the present premiums only a small amount of extra high protein would be blended down.

It is the spring wheat between 12.0 per cent and 15.5 per cent protein that is generally used for blending purposes. The demand for the various proteins is a function of relative supplies of various protein categories and the ratio of substitution between them. If, for example, the miller desired a milling wheat of 13.5 per cent protein, this could be satisfied by mixing in equal proportions 13.0 per cent and 14.0 per cent protein. Or 12.5 per cent and 14.5 per cent protein could be mixed in equal proportions. Or one-half could be 13.5 per cent protein, one-fourth 12.5 per cent protein, and one-fourth 14.5 per cent protein. There are countless mixes that could be used to produce a milling wheat of 13.5 per cent protein. The particular mix will depend to a large extent on the relative supplies and prices of the various spring wheat proteins as well as those in the hard winter wheat area. A large supply of one protein in relation to others might cause this protein to be used more in the mix because of

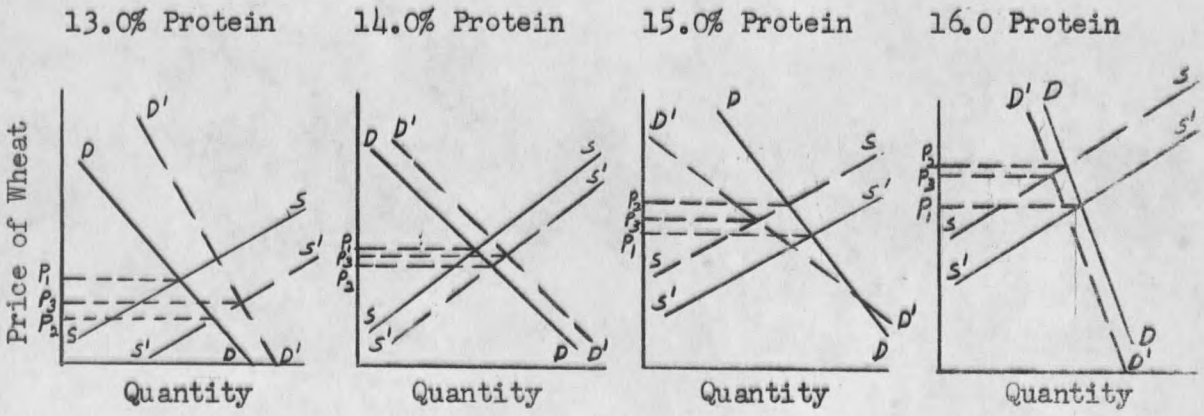
the price advantage. At the same time, the increased demand for this protein would tend to maintain a higher price for this protein than would otherwise be warranted.

IV. The Effect on Demand

To obtain a better picture of the effect the changes in protein supply have on demand, some theoretical models have been set up. In Figure 21, DD and SS are the demand and supply curves for each protein in the inital position. Now suppose there is either an actual or expected shift in the relative supplies. There is a large increase in the supply of 13.0 per cent protein, a small increase in the supply of 14.0 per cent protein, and a decrease in the supplies of 15.0 and 16.0 per cent protein. Because of the increased supplies of 13.0 and 14.0 per cent protein the price will drop from P_1 to P_2. Similarly, the prices of 15.0 and 16.0 per cent protein will increase. Immediately, buyers will begin to purchase 13.0 and 14.0 per cent protein and decrease their purchases of 15.0 and 16.0 per

Figure 21

Theoretical Demand and Supply Curves for High Protein Spring Wheat

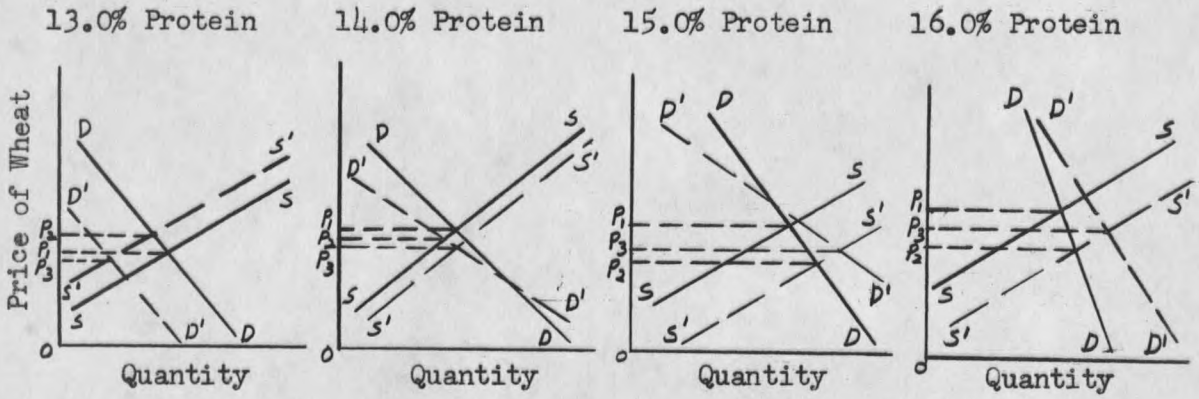


cent protein. This will change the demand curves. The demand for 13.0 per cent protein shifts to the right because it is an increased demand schedule and it will tend to become more inelastic because there is a limit to the amount of this protein the millers want regardless of the price. This shift in demand raises the price but only to some point P_3 between the initial price P_1 and price P_2 which was the result of an increased supply. The demand for 14.0 per cent protein will shift to the right and raise the price here also. Since there is a price rise for 15.0 per cent protein, millers will curtail their purchases and substitute other wheat which will cause the demand curve to shift to the left and become more elastic. It becomes more elastic because the millers still would like to have more of this protein than they can get at the market price so any drop in price would bring about a correspondingly greater increase in the quantity demanded. Any increase in price will have a correspondingly greater decrease in the quantity demanded. The price for 16.0 per cent protein rises also and so buying is curtailed and the demand curve shifts to the left. Since the demand for this protein is generally more inelastic than the others the shift in the demand curve is much smaller than the others and it retains the same elasticity. This shifting decreases the price from P_2 to P_3 but it still is above the initial price. The change in quantity demanded is very small.

Similar action is shown in Figure 22. Only here, the opposite is happening. In this case, the price of 16.0 per cent protein drops and there is an immediate rush to buy it up thus raising the price because of a shifting of the demand curve. In this situation the curve would become

Figure 22

Theoretical Demand and Supply Curves for High Protein Spring Wheat



more elastic because the buyers would be eager to buy this protein, as much as possible, if the price dropped. However, a price rise would have a reverse effect. This example would not hold as true for 16.0 per cent protein if the increased supply was real and due to an abundant production of it during the crop year. In that case, the millers would not be so anxious to buy it up immediately and the price would remain at or near P_2. Eventually, they would begin to buy it up and cause the demand to shift to the left to some point D'D'.

The actual demand for each protein is highly intangible and subject to many factors. Expectations play a large part in the shifting of demand for the various proteins. Therefore, an exact determination of these protein demands and the effect they have on the demand for high protein wheat in general probably cannot be made.

F. Blending With Durum Wheat

I. The Use of Durum Wheat

Durum wheat is used to make semolina flour which is used to make the

various macaroni products. Durum wheat is used because flour made from it has strength to hold together and not become soggy when cooked. Macaroni made out of ordinary wheats becomes slimy and mushy after cooking. Durum flour, however, does not have the rising properties found in bread flours. The ability of a flour to rise is an asset for bread making but a detriment to macaroni production. Durum wheat also gives a tough "bend but not break" quality to the dried macaroni st cks. 17/

II. The Substitution of Spring Wheat for Durum

In most years some spring wheat is used in making semolina. In the last two years large amounts of spring wheat have been used because of the shortage of durum. Normally, hard spring wheat can be substituted for durum up to 50 per cent of the total flour. Beyond that point, the flour takes on more of the spring wheat characteristics and less of durum. The proportion of spring wheat used with durum will depend upon the relative supplies and prices of both wheats. In a year such as 1953 when the durum crop was very poor and the prices very high, it is advantageous for the durum millers to use as much spring wheat as possible.

The consumption of macaroni products has been on a steady increase for the last thirty years. In 1920 the per capita consumption was approximately 3.7 pounds. By 1952, the per capita consumption reached 6.8 pounds, which requires 25 million bushels of durum to meet the consumer demand. 18/

17/ John S. Cooper, "Spaghetti and 15-B," The Wall Street Journal, Vol. XXXIV, No. 219, Dow Jones and Company, Inc., Chicago, August 25, 1954, p.1.

18/ Northwest Crop Improvement Association, More Durum is Needed, Minneapolis, 1953.

Since the war there has been a 60 per cent increase in macaroni consumption while the consumption of other bakery products made of flour has decreased 15 per cent. 19/

The production of durum wheat in the last three years has lagged considerably behind the demand for it. In 1952, the production was 23,097,000 bushels while the total disappearance was 31,427,000 bushels. Complete figures for the past few years are as follows: 20/

Year	Carry-over July 1	Production	Imports	Total Supply	Used For Seed	Milled	Grain Only Exports	Other Uses	Total Disappearance
				1,000 Bu.					
1948	10,299	45,829		56,128	5,265	21,684	2,537	8,606	38,092
1949	18,036	39,503		57,539	4,085	21,630	1,125	5,741	32,581
1950	24,958	37,948	214	63,120	3,610	23,337	9,620	2,929	39,496
1951	23,624	35,492	398	59,514	3,218	25,533	14,536	1,213	44,500
1952	15,014	23,097	158	38,269	2,997	23,668	3,075	1,687	31,427
1953	6,842	13,883							

The current estimates for the 1954 crop are approximately 12,000,000 bushels. However, there is indication that it might be somewhere around 8,000,000 bushels. This year will probably be the smallest crop since 1936 when the production was only 8,871,000 bushels. 21/ It is estimated that between 35 and 40 million bushels will be needed in 1954 to meet the immediate requirements for macaroni products, seed, feed, and provide a small

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19/ John S. Cooper, op. cit.

20/ Agricultural Marketing Service, The Wheat Situation, WS-138, United States Department of Agriculture, Washington D.C., April 26, 1954, p. 23.

21/ Ibid.

carry-over. 22/ The need then will definitely fall somewhere between the 25 million needed for milling and the total estimated needs of 35 million. Assuming a production of 8 million, a demand for 35 million, the quantity of hard red spring wheat that will be needed to substitute for durum will be 27 million less 7 million of carry-over or a total of 20 million bushels. The October 1, 1954 government crop estimate for spring wheat is 183,358,000 bushels. 23/ On this basis, about 10 per cent of this year's crop would be used in the manufacture of semolina. Undoubtedly, some winter wheat will also be substituted for durum but the amount probably does not match that for spring wheat. Since there is such a shortage of durum wheat this year, the macaroni trade expects to use a blend of 25% durum and 75% spring wheat some time after January. 24/ At the present, this is an optional blend for durum millers but if the present crop estimates prove to be too high this blend may become mandatory. Using a milling figure of 25 million bushels, this would mean that 19 million bushels of spring wheat will be used if the 25 - 75% ratio is used throughout the year. Sales in the first six months of this year are running about 6 per cent higher than they were for the same period last year. So, it is likely that more than 25 million bushels will be ground into semolina. This will cause more than 19 million bushels of spring wheat to be used. In general, however, it can be

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22/ Northwest Crop Improvement Association, op. cit.

23/ Daily Market Record, Government Crop Estimate, No. 195, Minneapolis, October 11, 1954, p. 7.

24/ John S. Cooper, op. cit., p. 5.

expected that about 10 per cent of this year's spring wheat crop will be substituted for durum wheat.

It can be seen from these figures that the use of spring wheat as a substitute for durum wheat is not nearly as important a factor affecting demand as some of the others like flour sales. Also, most of the spring wheat used will be lower in protein than wheats used for making bread flour. However, it does represent an alternative use for high protein spring wheat and will tend to make the demand more elastic.

III. Substitution Elasticities

Kaldor's study indicates that there was a substantial change in the relationship between durum and spring wheat during the period 1929-1938. He states that, "In 1931 the crop of durum wheat was only 32 per cent as large as in the preceding five-year period. The 1934 crop was only 7 million bushels or 10 per cent as large as production during the 1926 to 1930 period. At no time since 1930 has the crop of durum been equal to production during this period." 25/ He obtained two sets of supply and production ratios indicating a shift in the relationship between durum and spring wheat. The elasticity of the price and production ratios was less than -2.0 in each case. However, if the shift in the relationship is disregarded then the price and production ratios have an elasticity of -5.0. Kaldor further states that, "It would seem that either there has been a decline in the demand for the products prepared from durum or there has

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25/ D. R. Kaldor, op. cit., p. 29.

occurred substitution on a large scale between durum and the common wheats." 26/ Kaldor's latter opinion has proved correct in the last few years. As indicated above, there has been a substantial increase in the demand for durum products and an increase in the amount of substitution between spring and durum wheat.

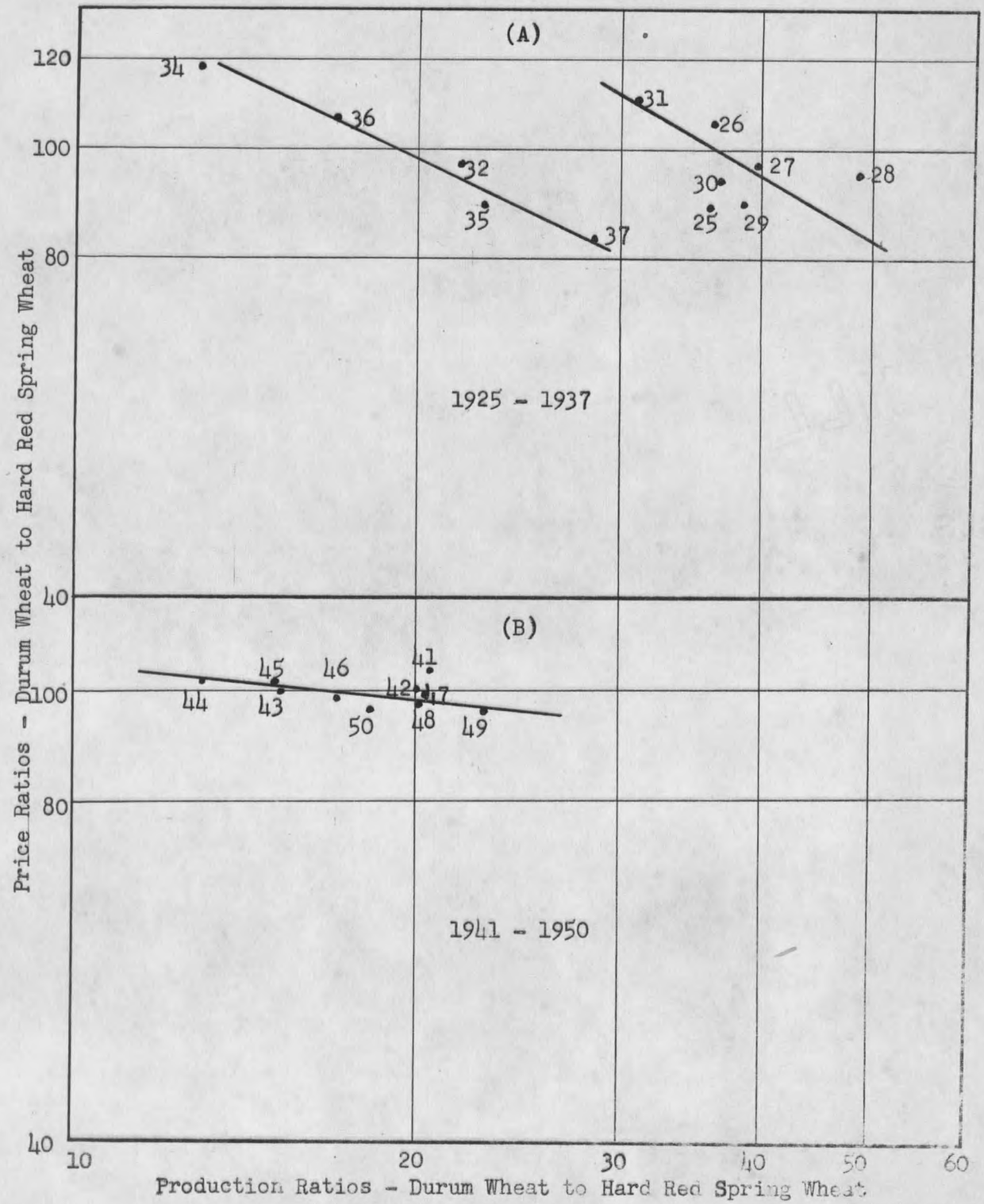
To compare up-to-date figures with Kaldor's, production and price ratios were computed for each year of the period 1941-1950. Figures were also computed from the same source for the years included in Kaldor's study. The results of these are shown in Figure 23. The period 1941-1950 is plotted on one set of axes, and 1921-1937 on another. As Kaldor mentioned, there was a definite shift in the relationship for the two periods he covered. The figures for 1941-1950 show a further shift in the elasticity of substitution between spring and durum wheat. The 1941-1950 ratios would indicate a possibility for large scale substitution. In the early 40's a large carry-over was built up. However, this was practically used up by 1946. The carry-over was then built back by 1950 but not to the extent to which it was done in the early 40's. 27/ In those years there probably was substitution between spring and durum wheat. In the last three years, the amount of substitution has increased substantially through necessity. This increased substitution over the years substantiates the results obtained by using the price and production ratios as in Figure 23. The ratios indicate an increase in the elasticity of substitution and in actual practice there has been more substitution.

26/ Ibid.

27/ For complete figures on durum wheat see Table III in the Appendix.

Figure 23

The Elasticity of Substitution between Durum Wheat and Hard Red Spring Wheat

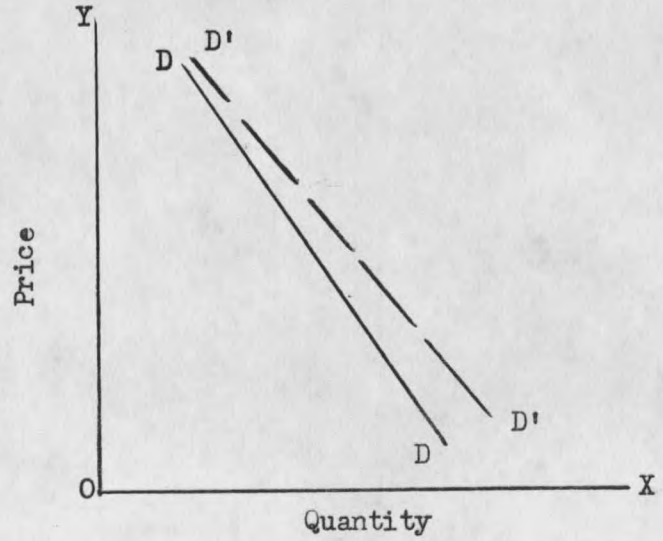


IV. The Effect on Demand

Since the use of high protein spring wheat in making semolina represents an alternative use for spring wheat it will tend to make the demand curve more elastic. The effect will not be great because of the relatively small amount being used. In the last two years, price has not been a major factor in determining the amount of spring wheat used. Therefore, the demand curve as a whole will tend to be more elastic. The demand curve will also move to the right because of an increase in the quantity demanded at all given prices. Figure 24 illustrates the movement. In years when the durum crop is of sufficient size to meet demand, some spring wheat may be used if the price relationship is such that it would be beneficial to do so. In this case, the quantity demands will increase some but only below a certain price. Even then the shift in the demand curve will only be slight.

Figure 24

Theoretical Demand Curves for High Protein Spring Wheat



The substitution for durum even in years such as 1954 is not a great factor affecting the demand. But in a year like 1954, if the poor durum crop is coupled with a similarly poor spring wheat crop, the substitution factor might have considerable effect.

G. Changing Technology in the Baking and Milling Industries

1. Changes in the Baking Industry

The baking industry has made many advances in baking techniques during the last fifteen years. Automatic machines, high speed production, and increasing size of operation are the primary changes that the industry has undergone. The industry is becoming more highly concentrated every year. One miller stated that approximately 14 per cent of the bakers in the United States buy 75 per cent of the flour. Because of these industrial changes and those of consumer desire, the bakers are using lower protein flour together with more sugar, milk and shortening.

High protein flour has a much higher tolerance for temperature and mixing than does low protein flour. This enables the baker to have fewer worries over the effects of temperature and varied mixing times. This is very important in the smaller shops where dough is made and then set aside to await baking, and where the temperature cannot be rigidly controlled. In large mechanized bakeries, however, this tolerance is not so necessary. With rising costs, particularly labor, it has become important for the large baker to make the most efficient use of that labor and limit the number of working hours. This has caused a shift to a more rapid baking process and this in turn necessitates a shorter mixing time for the dough.

Mixing time depends mainly on the quality of the protein. However, varietal characteristics also can influence the mixing time. There have been instances of low protein with long mixing times but, in general, the higher proteins have a longer mixing time.

With shorter mixing time needed, the bakers no longer have to have as high a protein flour as they once did. Fifteen years ago the average protein content of the flour used by the nine bakers interviewed was 12.3 per cent. Ten years ago the average protein content was 11.9 per cent. Today the average protein content is 11.4 per cent. This is a drop of .9 per cent in fifteen years. This drop has not been true of all areas. For instance, in the South where the bakers over the past fifteen years have been using more hard wheats in place of native soft wheats for bread making, the protein content has gone up. However, generally in those areas where hard wheats have been predominate the protein content of the flour used has decreased. This also means that the protein content of the wheat milled has declined by a similar amount.

Assume for a moment that the millers did no blending of wheat by protein content and they milled the various proteins as they purchased them. This would mean that fifteen years ago the millers were purchasing and milling wheat .9 per cent higher than they are today. This drop of .9 per cent protein if put into dollar terms would cause a loss to the producer of approximately 3 cents per bushel for every bushel sold. 28/ Of course, the

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28/ Based on a 20-year average price of No. 1 Dark Northern Spring Wheat at Great Falls, Montana. Average of differentials between various protein premiums.

assumption is not realistic but it illustrates that the decline in protein used by the bakers has a tendency to reduce farmers' income. In addition, if the decline in demand for high protein flour lowers the premiums as well, it causes an additional loss in revenue to the farmer.

Since the bakers no longer require flour as high in protein as previously, they may not be willing to pay high prices for high protein flour. Not only are the bakers using a lower protein flour but they are using more winter wheat flour in their flour mixes because it produces a "mellower" flour and a softer dough which they like for present day baking processes. This has a dual effect on the demand for high protein spring wheat. The quantity of high protein spring wheat demanded will be less in both cases.

II. Changes in Milling Industry

There is an indication that flour millers are finding ways in which to treat soft wheat flours in order to improve their bread-making qualities. If soft wheat flours can be treated so that they will produce good bread loaves, they will become a substitute for hard wheat. Soft wheat prices are now below those of hard spring wheat. If soft wheat became a substitute for hard spring wheat it would probably cause the price of hard spring wheat to drop until there was some sort of equalization between the two prices.

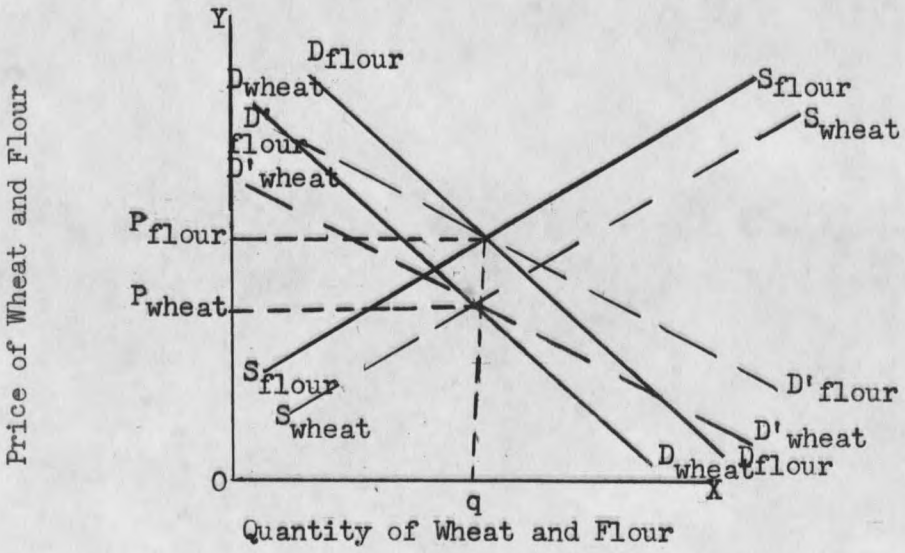
III. Effects on Demand

In Section A it was shown how the demand curve for high protein wheat could be derived from the demand curve for flour. If the bakers do not need high protein wheat like they previously did and they purchase it only when

the price is right, the demand for flour will become more elastic. (Figure 25) In other words, any increase in the price of the high protein flour and there would be a larger corresponding drop in the consumption of this flour and a greater consumption of lower protein flour. This causes the same reaction on the demand for high protein wheat. Due to a rise in price, less of the higher protein wheat will be purchased.

Figure 25

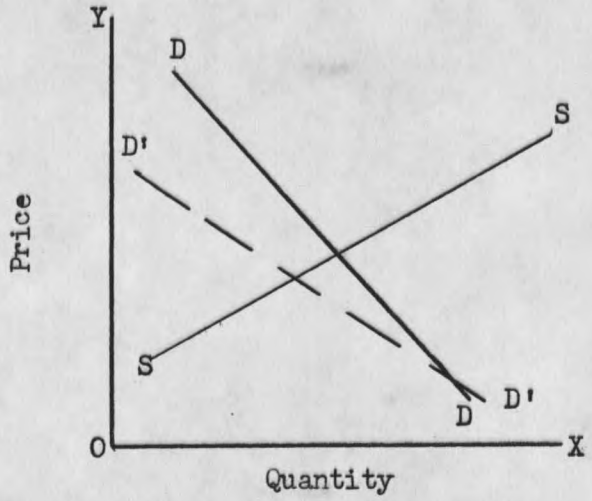
Theoretical Demand and Supply Curves for
High Protein Spring Wheat and Flour



Similarly, if soft wheat flours can be treated so that they can compete with hard wheat flours for bread making, then soft wheat flours will be a substitute for hard spring wheat flour. Soft wheat will then become a substitute for high protein spring wheat. As a substitute, it will make the demand for high protein spring wheat more elastic and may shift to the left until the price of spring wheat drops to a level that is competitive with soft wheat. The demand curve for high protein would move from DD to D'D' as in Figure 26.

Figure 26

Theoretical Demand and Supply Curves for High Protein Spring Wheat



The principal effect of these technological changes is to make the demand for high protein hard red spring wheat more elastic. This may lower the price the farmer receives for his wheat but at the same time it will lessen the amplitude of price movements and tend to stabilize price to a greater extent than previously.

Part IV

CONCLUSION

A. Summary

The analysis has shown that the demand for high protein hard red spring wheat is largely dependent on and determined by the demand for flour. If the demand for flour shifts and becomes more elastic the demand for high protein spring wheat will also. The flour orders received by the flour millers is the largest and most important factor affecting the demand for high protein spring wheat. While the demand for flour is the largest determinant of the demand for high protein spring wheat, the other factors included in the investigation add to the constant fluctuation in demand and wheat prices.

When buyers from other market areas enter the spring wheat market they provide an alternative use for high protein spring wheat. When buyers from the spring wheat areas go into other markets to purchase wheat they create a substitute for high protein spring wheat. The results of these actions is to cause the demand for high protein wheat to become more elastic than it would if the other markets were not available. It was indicated that the substitution elasticity between spring and winter wheat is relatively high and that a great deal of substitution does exist.

A cursory glance at the relationship between Duluth prices and the quantity of shipments over the Great Lakes seems to show that the Duluth price is greatly affected by the shipments. There is a definite positive

relationship between the two. There is also a positive relationship between the Duluth-Minneapolis differential and the quantity of shipments. However, these relationships do not prove to be statistically significant. There apparently are other factors which are present and help provide the positive relationships.

In order to produce the required flours, millers must resort to blending proteins. The demand for each individual protein will depend to a large extent on the relative supplies of each protein. Other factors include the supplies of various proteins in the hard winter wheat area, and the relative price levels of the two markets. Sixteen per cent protein has a more limited use than the other proteins and its price remains relatively high every year. The demand curve for each protein will shift and change in elasticity according to its relative supply and price.

Every year some spring wheat is used as a substitute for durum wheat in the making of semolina flour. In the last two years the substitution has been very substantial. The substitution elasticities computed for the years 1921-1950 indicate a shift in the relationship toward more substitution. This substitution will cause the demand for high protein spring wheat to become more elastic. As mentioned, this substitution holds a minor role in altering the demand curve, but under the proper circumstance it could grow to considerably more importance.

The change in technology that has taken place in the last fifteen years has caused a decline in the protein content of the flour used by the bakers.

The bakers, therefore, do not need to purchase as high a protein flour as previously. Thus, they are not willing to pay high prices for the higher

protein flour and will be more price conscious than before. The demand for high protein spring wheat will be less for this reason. There is also indication that soft wheat flour can be treated and used as a substitute for hard wheat flours. If this is true, it will tend to make the demand for spring wheat more elastic and may cause a drop in spring wheat prices.

B. Conclusions

The definite conclusions that can be drawn from this study are rather general in nature. The demand for high protein hard red spring wheat is a function of the demand for flour. The demand for flour is the largest factor affecting the demand for high protein spring wheat. However, the demand for flour is subject to many influences that are not easily determined.

The other factors considered in this study affect demand but again the result is indeterminant. This study considered each factor separately in order to facilitate the analysis. But, when any conclusion is to be derived from these factors, their effect on demand must be considered jointly. A change in one factor has an effect on all the other factors. Since the demand for high protein spring wheat is a result of market conditions, it is subject to the effects of expectations. The bakers, millers, elevator operators, merchandising firms, and others in the grain trade are all attempting to perform their particular business operations in connection with the wheat market. Each one attempts to keep himself in the best possible position in relation to the market. Each has his own idea of what is going to happen next on the market. These ideas collectively influence the market and may at times offset the normal effect of the factors mentioned.

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The hypothesis stated at the beginning of this study are in general correct with the exception of the effect of the Great Lakes shipping on the Duluth price. Statistically, there is no evidence that this relationship exists. The factors considered, other than flour orders, tend to increase the elasticity of demand. However, their effect fluctuates and is not readily determinable in a precise manner.

It must be concluded then that the demand for high protein hard red spring wheat is a function of the demand for flour and is largely affected by expectations and circumstances. The other factors considered enter the picture as factors altering the basic demand curve in the manner described previously.

C. Implications of the Study

The purpose of this study is to give the producer a better understanding of the marketing structure and the factors behind the price he receives for his high protein hard red spring wheat. It is felt that this study has given the producer a picture of the uses for his wheat, what happens to his wheat when it is sold, the major factors behind the price he receives for his wheat, and has contributed to a better understanding of the functioning of the flour milling and baking industries. The study has indicated the factors that contribute to the demand for high protein spring wheat and the general way in which they affect demand. It is hoped that the producer will have a better understanding of some of the reasons why demand and price fluctuate so greatly. With these ideas in mind, the producer can apply them to his specific operation in order to market his product better

and obtain the best possible price.

D. Areas for Further Study

Any analysis of market demand is a tremendous undertaking. Market demand is highly variable and subject to all kinds of tangible and intangible influences. It is felt that further study on all phases of the demand factors would be rewarding. Since the demand for high protein spring wheat is largely determined by the demand for flour, it would be wise to analyze flour demand. Also, it would be helpful to have a multiple correlation of several of the factors considered in this study.

A P P E N D I X

TABLE I

Wheat Flour Production at Principal Centers in the U.S. a/

Year	Minneapolis	Buffalo
1953	13,578,063	26,216,130
1952	14,386,966	24,085,458
1951	13,718,511	24,843,764
1950	13,367,010	25,068,889
1949	13,066,517	26,583,307
1948	13,844,079	26,817,356
1947	18,699,256	27,634,470
1946	16,431,801	25,988,050
1945	16,449,807	26,341,479
1944	14,783,589	24,849,936
1943	14,436,850	23,990,365
1942	11,693,135	20,408,663
1941	11,019,724	19,953,137
1940	10,273,454	19,214,531
1939	10,896,510	19,969,115
1938	12,438,575	19,992,825
1937	11,135,544	20,093,542
1936	12,647,227	20,433,657
1935	13,006,872	18,884,796

a/ Northwestern Miller Almanack, 1954, p. 30, Miller Publishing Co., Minneapolis, Minnesota.

TABLE II

U. S. Wheat Flour Consumption, 1935-52 a/

Wheat Flour--Civilian Consumption, U. S. 1935-52

Consumption year beginning:								
	January				July			
	Commercially produced		Commercially and non-commercially produced		Commercially produced		Commercially and non-commercially produced	
Year	Total 1,000 sacks	Per capita lb.	Total 1,000 sacks	Per capita lb.	Total 1,000 sacks	Per capita lb.	Total 1,000 sacks	Per capita lb.
1935	194,007	150.4	200,795	155.7	197,026	152.1	203,970	157.5
1936	202,687	156.2	209,104	161.1	200,322	153.7	206,212	158.3
1937	198,509	152.0	204,292	156.4	198,716	151.5	204,392	155.8
1938	201,716	153.3	207,481	157.7	202,968	153.5	208,822	158.0
1939	201,755	152.1	207,081	156.1	201,686	151.3	206,444	154.9
1940	199,939	149.2	204,539	152.6	202,616	151.3	207,058	154.6
1941	200,677	150.1	204,834	153.2	195,212	145.6	199,084	148.5
1942	202,365	151.8	205,859	154.4	207,436	157.6	210,552	160.0
1943	207,254	158.7	210,033	160.8	200,136	153.2	202,758	155.3
1944	188,656	144.8	191,038	146.6	196,100	150.3	198,422	152.0
1945	205,190	156.8	207,310	158.4	201,540	147.9	203,458	149.3
1946	214,899	153.2	216,687	154.4	205,457	143.8	207,115	144.9
1947	196,751	136.1	198,443	137.2	203,675	139.4	205,401	140.6
1948	198,467	134.8	200,076	135.9	200,050	134.8	201,542	135.8
1949	198,835	132.9	200,206	133.8	202,175	133.8	203,425	134.6
1950	201,003	132.0	202,240	132.8	201,035	131.6	202,259	132.4
1951	200,608	130.9	201,791	131.7	200,646	130.0	201,788	130.7
1952	201,656	129.7	202,783	130.4	199,894	127.2	201,012	128.0

a/ The Miller Publishing Company, Northwestern Miller Almanack, Minneapolis, 1954, p. 74.

Table III

Durum Wheat: United States supply and distribution, marketing years 1933-53 (Includes both amber and red durum wheat) a/

Year beginning July	Carryover July 1	Production	Imports 1/	Total supply	Used for seed	Milled 2/	Grain only exports 1/	Other uses 3/	Total disappearance
	1,000 bu.	1,000 bu.	1,000 bu.	1,000 bu.	1,000 bu.	1,000 bu.	1,000 bu.	1,000 bu.	1,000 bu.
1933	16,477	17,622	---	34,099	2,684	13,196	---	9,598	25,478
1934	8,621	6,794	5,905	21,320	3,556	12,248	---	457	16,261
1935	5,059	24,641	3,810	33,510	5,202	15,723	---	5,816	26,741
1936	6,769	8,871	9,293	24,933	4,687	12,052	---	4,761	21,500
1937	3,433	28,688	50	32,171	5,538	13,630	---	7,786	26,954
1938	5,217	41,201	---	46,418	4,608	14,821	1,765	7,222	28,416
1939	18,002	33,044	---	51,046	4,951	15,423	510	10,946	31,830
1940	19,216	32,942	---	52,158	3,614	16,499	300	6,805	27,218
1941	24,940	41,403	---	66,343	2,998	18,961	1,049	9,079	32,087
1942	34,256	41,836	469	76,561	2,976	23,880	---	22,774	49,630
1943	26,931	34,265	2,867	64,063	2,931	20,409	---	26,432	49,772
1944	14,291	30,328	4,350	48,969	2,826	26,031	---	11,976	40,833
1945	8,136	33,281	1,537	42,954	3,482	22,242	---	12,307	38,031
1946	4,923	36,308	350	41,581	4,162	21,365	921	6,226	32,674
1947	8,907	44,912	---	53,819	4,581	28,179	8,441	2,319	43,520
1948	10,299	45,829	---	56,128	5,265	21,684	2,537	8,606	38,092
1949	18,036	39,503	---	57,539	4,085	21,630	1,125	5,741	32,581
1950	24,958	37,948	214	63,120	3,610	23,337	9,620	2,929	39,496
1951	23,624	35,492	398	59,514	3,218	25,533	14,536	1,213	44,500
1952	15,014	23,097	158	38,269	2,997	23,668	3,075	1,687	31,427
1953	6,842	13,883							

1/ Imports are based on Canadian shipments to the U. S. and exports on inspections for export.
2/ Quantity of Durum wheat milled compiled from mill reports.
3/ Includes quantity used for feed and cereals. Also includes waste, loss, and statistical errors of estimates.
a/ Agricultural Marketing Service, The Wheat Situation, United States Department of Agriculture, WS-138, Washington D. C., April 26, 1954, p. 23.

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