Agricultural Economics Report No. 410 **January 1999**

Economic Analysis of the Proposed North Dakota Wheat Pool

Prepared for
North Dakota Industrial Commission

By
Won W. Koo
William Nganje
D. Demcey Johnson
Joon Park
Richard D. Taylor

Department of Agricultural Economics
Northern Plains Trade and Policy Research Center
North Dakota State University
Fargo, North Dakota 58105

Acknowledgments

The authors extend appreciation to professors David Lambert, David Saxowsky, and Andrew Swenson for their constructive comments and suggestions. Special thanks go to Ms. Carol Jensen, who helped to prepare the manuscript.

The research was commissioned by the North Dakota Industrial Commission. Financial support was provided by the North Dakota Mill and North Dakota Farmers Union.

NOTICE:

The analyses and views reported in this paper are those of the author. They are not necessarily endorsed by the Department of Agricultural Economics or by North Dakota State University.

North Dakota State University is committed to the policy that all persons shall have equal access to its programs, and employment without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status, or sexual orientation.

Information on other titles in this series may be obtained from: Department of Agricultural Economics, North Dakota State University, P.O. Box 5636, Fargo, ND 58105. Telephone: 701-231-7441, Fax: 701-231-7400, or e-mail: cjensen@ndsuext.nodak.edu.

Copyright © 1999 by Won W. Koo. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

Table of Contents

Page

List of Tables iv

List of Figures v

Executive Summary vi

1. Introduction 1

2. North American and World Durum and Hard Red Spring Wheat Industries 2
    - Basic Characteristics of Wheat 2
    - The U.S. and World Hard Wheat Industry 2
    - The U.S. and World Durum Wheat Industry 13
    - Changes in Durum and Hard Red Spring Wheat Production 19
        - Production and Production Potential 19

3. A Brief Review of the Existing Pools for Agricultural Commodities and Operation of the CWB 27
    - Market Pool and Operation 27
        - Types of Pools 27
        - Advantages and Disadvantages of Seasonal Pooling 28
            1. Advantages of Seasonal Pooling 28
            2. Disadvantages of Seasonal Pooling 29
    - Voluntary and Mandatory Pools 30
        - Other Examples of Marketing Pools 31
    - The Canadian Wheat Board (CWB) 32
        - Objectives of the CWB 32
        - Operation of the CWB 32
        - Previous Studies of the CWB 33
        - Enumeration of CWB Benefits and Costs 34

4. The Theory of Pooling and Development of an Empirical Model 37
    - The Theory of a Market Pool 37
    - Development of an Empirical Model 41
        - ND Wheat Pool Model 41
        - Joint U.S./Canada Wheat Pool Model 42
        - Data for the Market Power Model and Alternative Scenarios 43

Table of Contents (Cont.)

Page

5. Market Power and Implications for Farm Revenue 45
    Durum Wheat Pool 45
        North Dakota Durum Wheat Pool 45
        Joint U.S./Canada Durum Wheat Pool 47
        Benefits for the Canadian Durum Wheat Producers 50
    Hard Red Spring Wheat Pool 53
        North Dakota Hard Red Spring Wheat Pool 53
        Joint U.S./Canada Pool 56
        Benefits for Canadian Spring Wheat Producers 56
    The Long-Run Effects of the Pool 60
        The Durum Wheat Industry 60
        The Hard Red Spring Wheat Industry 60

6. Management and Operational Efficiency 64
    A Brief Description of A Game Theory Model for Market Efficiency 65
        Baby Version of the Folk Theorem 65
        The Rubinstein Bargaining Framework 66
    The North Dakota Wheat Pool Game 66
    Estimation of Efficiency Gains and Sustainability 68
        Efficiency Gains 68
        Conditions for Sustainability 71

7. Market Strategies and Payment Schedule 73
    Marketing Strategies 73
    Payment Schedule 75
        Incentive and Scheduled Payments 75
        Payment Examples for the Pool Members 75
        Sensitivity of Payments 77

8. Organizational Structure and Handling Mechanism 80
        Organizational Structure for the North Dakota Wheat Pool 80
        Estimated Operating Expenses for the North Dakota Durum Wheat Pool 80
        Estimated Operating Expenses for the North Dakota Hard Red
            Spring Wheat Pool 82
        Components in the Pooling Agreement 83
            1. Producer Commitment 83
            2. Cooperative Commitment 84
            3. Duration of the Agreement 84
            4. Qualifications for Membership 84
            5. Payments to Producers 84
            6. Financing the Pool 84
            7. Other Provisions 84

Table of Contents (Cont.)

Page

9. Summary and Conclusions 85

10. Major Issues and Concerns 87
    - Incentive Payments and Contracts 87
    - Payments to Producers 87
    - Supply Response 87
    - Cooperation with the Canadian Wheat Board 88
    - On-farm Storage 88

References 89

Appendix: Economic Impacts of Pooling Alternatives 91
    - Table A 93
    - Table B 94

List of Tables

Table		Page
2.1	Hard Red Spring Wheat Supply and Demand in the United States	8
2.2	Hard Red Spring Wheat Supply and Demand in Canada	13
2.3	Hard Red Winter Wheat Supply and Demand in the United States	13
2.4	Durum Wheat Supply and Demand in the United States	17
2.5	Durum Wheat Supply and Demand in Canada	17
2.6	Shifts in Durum and Spring Wheat Production Between 1985 and 1996	24
2.7	Durum Production in Arizona and California Between 1985 and 1996	26
3.1	The Return to the Member From the Cooperative's Marketing Operation	31
3.2	Summary of CWB Benefits and Costs for the Wheat Pool Account (1980/81 - 1993/94)	35
5.1	The Quantities and Prices of Durum Wheat Under Competitive Market and Alternative North Dakota Pool Options	46
5.2	The Quantities and Prices of Durum Wheat Under Competitive Market and Joint U.S./Canada Pool Options	49
5.3	Increases in Canadian Revenue from the Durum Wheat Pool	52
5.4	The Quantities and Prices of Spring Wheat Under Competitive Market and North Dakota Pool Options	54
5.5	The Quantities and Prices of Spring Wheat Under Competitive Market and Joint U.S./Canada Pool Options	57
5.6	Increases in Canadian Revenue From the Hard Red Spring Wheat Pool	59
5.7	Ten Years Simulation for the U.S. Durum Wheat Industry	62
5.8	Ten Years Simulation for the U.S. Hard Red Spring Wheat Industry	63
6.1	Strategies and Payoffs of Pool and Non-pool Members and Free Riders	67
6.2	Efficiency Gains for the Durum Wheat Pool	69
6.3	Efficiency Gains for the Hard Red Spring Wheat Pool	70
6.4	Strategies and Payoffs ($/bu) of Pool and Non-pool Members and Free Riders (50% Share)	71
6.5	Forecast of Durum Supply for the U.S. from 1998-2002 and Revenue for Joining the Pool	72
7.1	Payment Examples for Durum Wheat Under the Joint Pool	76
7.2	Payment Examples for Spring Wheat Under the Joint Pool	78
7.3	Sensitivity of Producer Member's Return to Contract Length, Ratio of Domestic Sales to Foreign Sales, and Pay-back Schedule of Incentive Payment	79
8.1	Operating Expenses for the North Dakota Durum Wheat Pool	82
8.2	Operating Expenses for the North Dakota Hard Red Spring Wheat Pool	83

List of Figures

Figure Page

2.1 Protein Range and Flour Uses of Major Wheat Classes 3
2.2 Wheat Production of Major Wheat Exporting Countries/regions 4
2.3 Wheat Exports of Major Wheat Exporting Countries/regions 5
2.4 Export Prices for Various Hard Wheat 6
2.5 Wheat Imports of Major Wheat Importing Countries 7
2.6 U.S. Production of Wheat by Classes 9
2.7 Market Prices for Various Classes of Wheat 10
2.8 Production Share for North Dakota in the United States Market, Hard Red Spring Wheat 11
2.9 Production Share for North Dakota in the North American Market, Hard Red Spring Wheat 12
2.10 Durum Wheat Production of Major Durum Wheat Producing Countries/regions 14
2.11 Exports of Durum Wheat of Major Durum Wheat Exporting Countries/regions 15
2.12 Export Prices for Various Durum Wheat 16
2.13 Imports of Durum Wheat of Major Durum Wheat Importing Countries 18
2.14 Production Share for North Dakota in the United States Market, Durum Wheat 20
2.15 Production Share for North Dakota in the North American Market, Durum Wheat 21
2.16 Production Share for North Dakota in the World Market, Durum Wheat 22
2.17 Shift in Durum Wheat Acres From 1985 to 1996, 1000 Acres 23
2.18 Percent of Durum Wheat Planted Acres to Total Wheat Acres in North Dakota and Montana, 1996 25
4.1 Relationship Between Pool Supplier and Competitive Fringe 38
5.1 Changes in Total Revenue for Durum Wheat Under Alternative North Dakota Pool Options 48
5.2 Changes in Total Revenue for Durum Wheat Under Alternative Joint U.S./Canada Pool Options 51
5.3 Changes in Total Revenue for Spring Wheat Under Alternative North Dakota Pool Options 55
5.4 Changes in Total Revenue for Spring Wheat Under Alternative Joint U.S./Canada Pool Options 58
7.1 Strategies/Marketing Structure of the North Dakota Wheat Pool 74
8.1 Organizational Structure for the North Dakota Wheat Pool 81

Executive Summary

North Dakota Farmers Union has proposed marketing pools for durum and hard red spring wheat. The main purpose of the pools would be to enhance net farm income for wheat producers in North Dakota. In principle, pools could accomplish this through improved marketing efficiency and/or by exerting market power. The overall objective of this study is to evaluate the economic feasibility of proposed pools for durum and hard red spring wheat produced in this region. Findings of this study are as follows:

1. The total benefits of the Canadian Wheat Board, including single-desk selling (SDS), pool account deficit transfers, guaranteed borrowing and risk management, averaged C$23.23/tonne for the 1980/81 to 1993/94 period. This amount is based on conservative estimates for each source of benefit. The total costs are C$13.59/tonne. Subtracting the costs from the benefits leaves a net benefit of C$9.64/tonne (or C$0.26 per bushel). These benefits are largely attributed to the mandatory nature of pooling in the CWB operation.

2. The proposed pools would be based on voluntary participation. Previous studies have pointed to problems with voluntary pooling. While a voluntary pool can offer improved marketing efficiency (relative to independent selling by producers), its ability to raise domestic prices by exercising its market power is limited. Under a voluntary pool, non-members become 'free-riders' and weaken its market power. A feasible option is to have a multi-year contract with pool participants. The study indicates that the optimal contract period may be 4 - 5 years.

3. The success of the pool depends upon its market share in the United States and the extent of potential cooperation with the CWB. Without full cooperation from the CWB, the proposed ND wheat pools would have extremely limited market power and would have limited potential to increase its revenue. Since Canada can increase its exports to the United States in response to a price increase, the pool's market share could shrink in absence of some form of cooperation with Canada.

4. The ND Durum Wheat Pool may provide additional revenue to durum wheat producers by raising the domestic price jointly with the CWB in the North American market. If such cooperation with the CWB were feasible, the domestic (North American) price could be driven higher than the world equilibrium price, which would work to the mutual benefit of U.S. and Canadian producers. However, in absence of the cooperation, the pool price could not exceed the price offered by overseas suppliers (adjusted for shipping and handling costs).

5. The ND Spring Wheat Pool would have less capacity to raise the price of HRS wheat. That is because (1) hard red spring and hard red winter wheats are highly substitutable; and (2) the pool's market share in the U.S. hard wheat market is too small to provide effective market power. Because of these characteristics, potential increases in total revenue would be quite small, even if the pool could secure full cooperation from the CWB.

6. The ND pools for durum wheat and hard red spring wheat could seek to raise producer returns through improved marketing efficiency, marketing strategies (e.g., contract sales), and risk management. The efficiency gains associated with the pool operation are difficult to estimate. However this study indicates that an efficiency gain ranging 16-28 cents/bushel for durum wheat and 7-9 cents/bushel seems plausible based on potential returns from blending and logistical advantages. In addition, the pool would fulfill a risk management function for producers, lowering their exposure to price risk.

7. The pool should adopt the following marketing strategies to maximize efficiency gains: (a) the pool should become identified as a reliable supplier of consistent quality wheat to domestic and foreign buyers; (b) producers should be rewarded with premiums for consistent quality wheat delivered to the pool; (c) quantity premiums should also be provided to attract more volume and enhance the pool's market position; (d) the pool should pursue opportunities for long-term contract sales with domestic and foreign buyers; and (e) the pool should use hedging and other risk management tools to protect producers' returns.

8. Annual operating costs are $1.18 million for the durum wheat pool, which handles about 50 million bushels of durum wheat annually. This is equivalent to $0.024 per bushel. Operating costs for the HRS wheat pool are $2.48 million with annual volume of 136 million bushels, which is equivalent to $0.018 per bushel.

9. A study by Leistritz indicates that the total economic impact of the durum wheat pool would be $71.7 million for the North Dakota pool (without cooperation from Canada), and $331 million for the joint pool (with cooperation from Canada). The gross business volume generated in the various sectors of the state economy would support 911 jobs in the North Dakota pool scenario, and 3,308 jobs in the joint pool scenario. Increases in the state tax revenue range between $1.4 million in the North Dakota pool scenario, and $6.3 million in the joint pool scenario. For the hard red spring wheat pool, the total economic impacts are much smaller: $43.2 million in the North Dakota pool scenario, and $67.4 million in the joint pool scenario. Detailed state-wide economic impact analysis is reported in the Appendix.

10. Major issues and concerns in operating the pool included the following.

Incentive payments and contracts: The incentive payment could come from either the state government as a subsidy or from the state bank or commercial banks as a loan. A state government subsidy might violate the WTO agreement, and would require approval of the North Dakota legislature. If the incentive payment is subsidy-neutral, it must be financed by a bank and the pool would be responsible for the repayment of the loan. In this case, the pool would have to arrange multi-year contracts with its members; otherwise, members would exit after receiving the incentive payment. The magnitude of the incentive payment, therefore, should depend upon the contract period and expected additional revenue from the pool operation.

Payments to Producers: The total payment to producers would be the average price plus efficiency gains for the pool members minus the pool's operating cost. In absence of efficiency gains, the total payment to the member, therefore, may be lower than the domestic price. Because of this difference, members could seek to exit the pool in order to receive the higher domestic price. These free riders would weaken the market power of the pool.

Free Riders: The supply of durum wheat is elastic in some regions in the United States--0.98 in the United States and 0.86 in North Dakota. This implies that a 10 percent increase in the price of durum wheat would induce about the same percentage increase in supply. If the pool were to raise the domestic price of durum by 30 percent (e.g., from $4.00/bushel to $5.20/bushel), the domestic supply of durum wheat would increase by 30 percent. To the extent that additional production is supplied by free riders, this will weaken the market power of the pool. An alternative would be to form a U.S. durum wheat pool by including producers in other durum wheat producing states, specifically Montana, Minnesota, California, and Arizona. A mandatory pool may overcome the free rider problem. However, it may be difficult to implement a mandatory pool in the current legal and political environment.

Cooperation with the Canadian Wheat Board: The durum wheat pool can be successful if it obtains cooperation from the Canadian Wheat Board (CWB). If the ND pool and the CWB cooperate with each other, the two parties can jointly determine a minimum price of durum wheat, which would be higher than the competitive price in the North American market. This cooperation would entail the CWB restricting its durum wheat exports to the United States to an agreed level. As long as the ND pool and the CWB continue to honor the agreement, producers in the two countries could earn additional revenue. However, the legality of such cooperation (if based on an explicit agreement) would have to be determined. In absence of an explicit market-sharing and pricing agreement, cooperation would have to be implicit, based on recognition of mutual interests.

On-farm Storage: The carry-over stock at the end of the 1997-98 marketing year was about 23 million bushels for durum wheat and 228 million bushels for hard red spring wheat. The pool may have to absorb a major portion of these stocks to effectively exercise its market power, and some of the remaining stocks could be supplied to the domestic market by non-members. Large current carry-over stocks, therefore, may reduce the pool's effective market share and weaken its market power.

Economic Analysis of the Proposed North Dakota Wheat Pool

Won W. Koo, William Nganje, D. Demcey Johnson,
Joon Park, and Richard D. Taylor*

1. Introduction

North Dakota Farmers Union has proposed marketing durum and hard red spring (HRS) wheat produced in the state through a wheat pool. The primary objective of the ND Wheat Pool would be to enhance net farm income. However, there are several concerns about the proposed wheat pool. These include the effectiveness of the pool in marketing HRS and durum wheat, the quantities of HRS and durum wheat that would be handled by the pool, needed incentive payments under alternative marketing conditions, how to finance the proposed incentive payments, and the structural mechanism necessary to implement the ND Wheat Pool.

Contracts with growers would play an important role in the operation of a pool. Ultimately, producers who want to participate in the pool may be required to plant specific varieties of wheat that possess specific quality attributes. This wheat could be identity-preserved through the marketing and transportation system, and eventually sold to processors who are willing to pay a price premium. In this way, the proposed ND Wheat Pool could implement a vertically integrated marketing strategy. However, its success would depend on the additional costs associated with this type of production and marketing, and the premiums that processors are willing to pay for specified quality attributes. Because wheat quality depends not only on variety but on other factors (weather conditions during the growing season, input applications, harvesting methods, etc.), quality assurance would present a major challenge. Producers would also have to relinquish some control over production and marketing decisions.

The overall objective of this study is to evaluate the economic feasibility of pools for durum wheat and HRS wheat produced in this region. Specific objectives are:

1. to review the current wheat marketing systems in the United States and Canada, including the Canadian Wheat Board (CWB), and analyze factors affecting wheat prices received by producers;

2. to estimate possible impacts of the proposed ND Wheat Pool on market prices and farm income under alternative scenarios, including joint marketing with the CWB;

3. to evaluate alternative marketing strategies for ND wheat (e.g., contracting, product differentiation, etc.) from an economic perspective;

4. to analyze possible efficiency gains using delivery and handling mechanisms for pooled wheat; and

5. to determine the possible impact of a ND Wheat Pool on the state economy.

This report is focused on objectives 1 through 4. Objective 5 will be addressed in the Appendix .

---

*Koo is professor of Agricultural Economics and Director of Northern Plains Trade and Policy Research Center, Nganje is assistant professor and Johnson is associate professor of Agricultural Economics, Park is post-doctoral research associate, and Taylor is research associate in the Department of Agricultural Economics, North Dakota State University, Fargo.

2. North American and World Durum and Hard Red Spring Wheat Industries

Basic Characteristics of Wheat

Wheat can be divided into common and durum wheat. Common wheat is used for bread, rolls, muffins, cakes, and crackers. Durum wheat is used for pasta. In the United States, common wheat is divided into four classes: hard red winter (HRW), hard red spring (HRS), soft red winter (SRW), and white wheat. HRS wheat is grown in the northern plains states, HRW wheat is grown in the southern plains states, SRW wheat is grown in the Ohio River Valley area, and white wheat is grown in the northwest. U.S. durum wheat is grown primarily in North Dakota.

Canada is a major competitor in HRS and durum wheat markets. Canadian western spring (CWS) wheat, which is comparable to HRS, and durum wheat are grown in the western provinces and marketed by the Canadian Wheat Board. Other world competitors include the European Union (EU), which produces soft and durum wheat, Argentina (HRW wheat), and Australia (soft wheat).

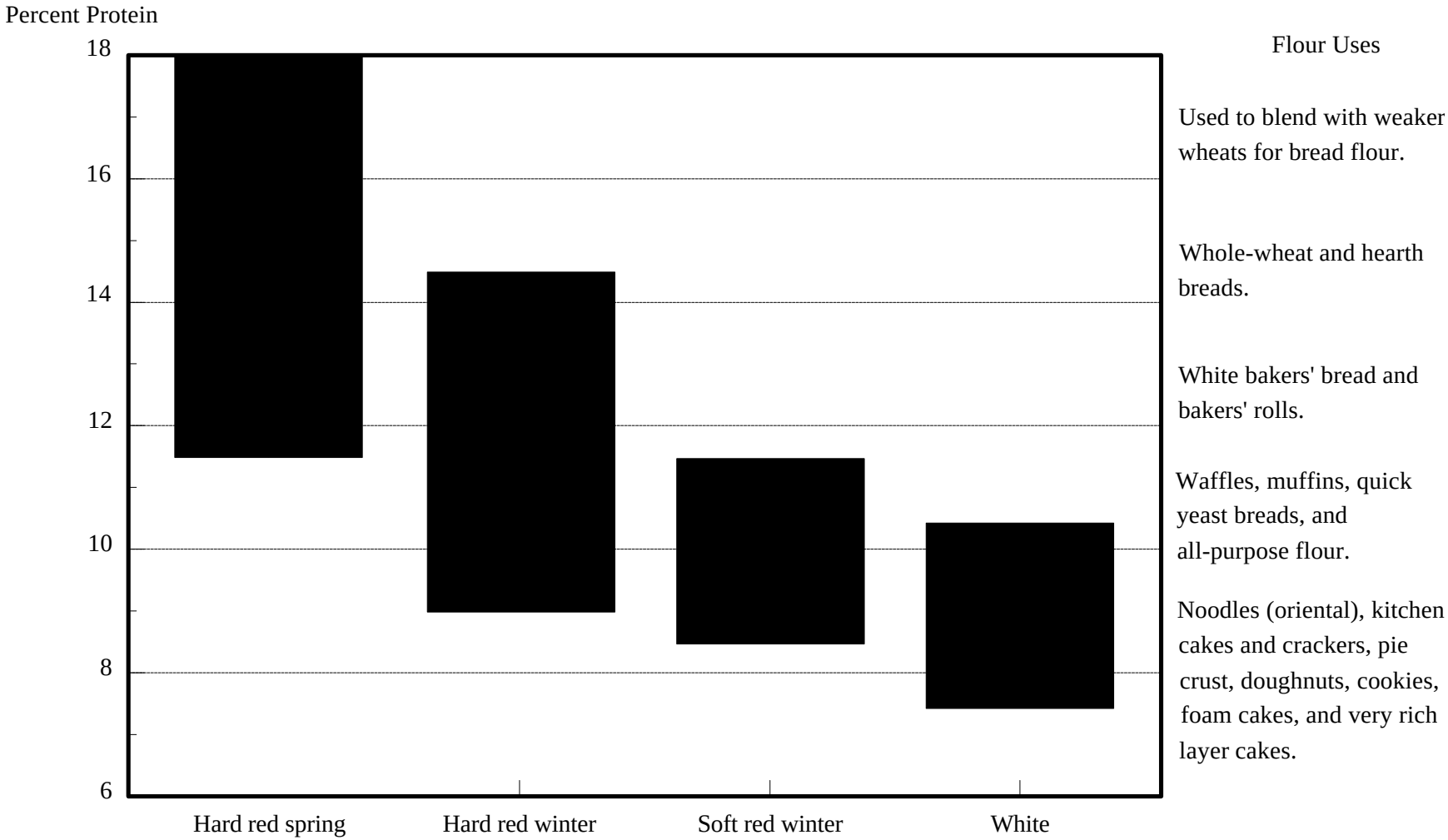
Figure 2.1 shows the protein range and flour uses for major wheat classes. For protein ranging between 11.5 percent and 14.5 percent, there is substantial substitution between HRS wheat and HRW wheat. Both classes of wheat can be used for white bakers' bread and rolls. Higher protein HRS wheat is used to blend with weaker wheats to make bread flour. Lower protein HRW wheat and SRW wheat are used for waffles, muffins, and all-purpose flour. White wheat is used for noodles, cakes and crackers.

The U.S. and World Hard Wheat Industry

World common wheat production is dominated by five producing regions: the EU, the United States, Canada, Australia, and Argentina. Figure 2.2 shows the production of common wheat over the past seven years. The EU ranks as the largest wheat producing region in the world, with production ranging between 2,729 and 3,367 million bushels per year for the 1991-1997 period. U.S. production of hard wheat ranged between 1,875 and 2,432 million bushels during the same period.

The United States is the largest wheat exporting country, with export volumes ranging between 962 and 1,305 million bushels per year (Figure 2.3). Canadian exports ranged between 476 and 818 million bushels per year during this period and EU exports ranged between 436 and 712 million bushels. Australian exports have been comparable in magnitude to those of the EU in the last several years. Figure 2.4 shows the price trends for hard wheat at various port elevators. Australian Prime Hard wheat shows a fairly consistent premium, followed by Canadian Western Spring and U.S. HRS wheat.

Figure 2.5 shows the major common wheat importing regions/countries of the world. China is the largest importer of common wheat. Its imports ranged between 106 and 583 million bushels per year over the past 7 years. Egypt has imported between 213 and 253 million bushels during the same time period, and Japan has imported between 208 and 219 million bushels.



Note: Flour uses are approximate levels of protein required for specified wheat products.
Source: USDA

Figure 2.1. Protein Range and Flour Uses of Major Wheat Classes

3

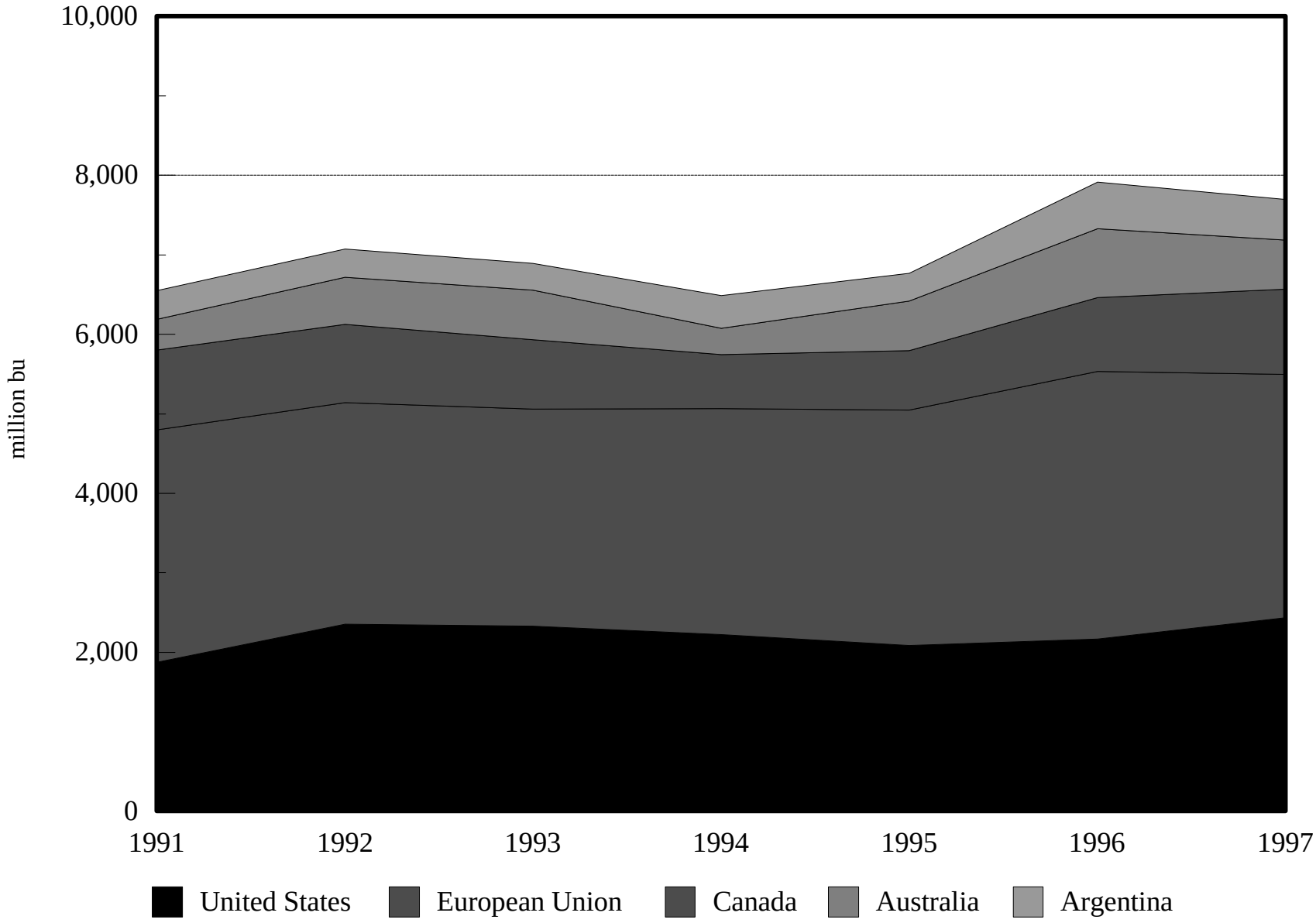


Figure 2.2. Wheat Production of Major Wheat Exporting Countries/regions

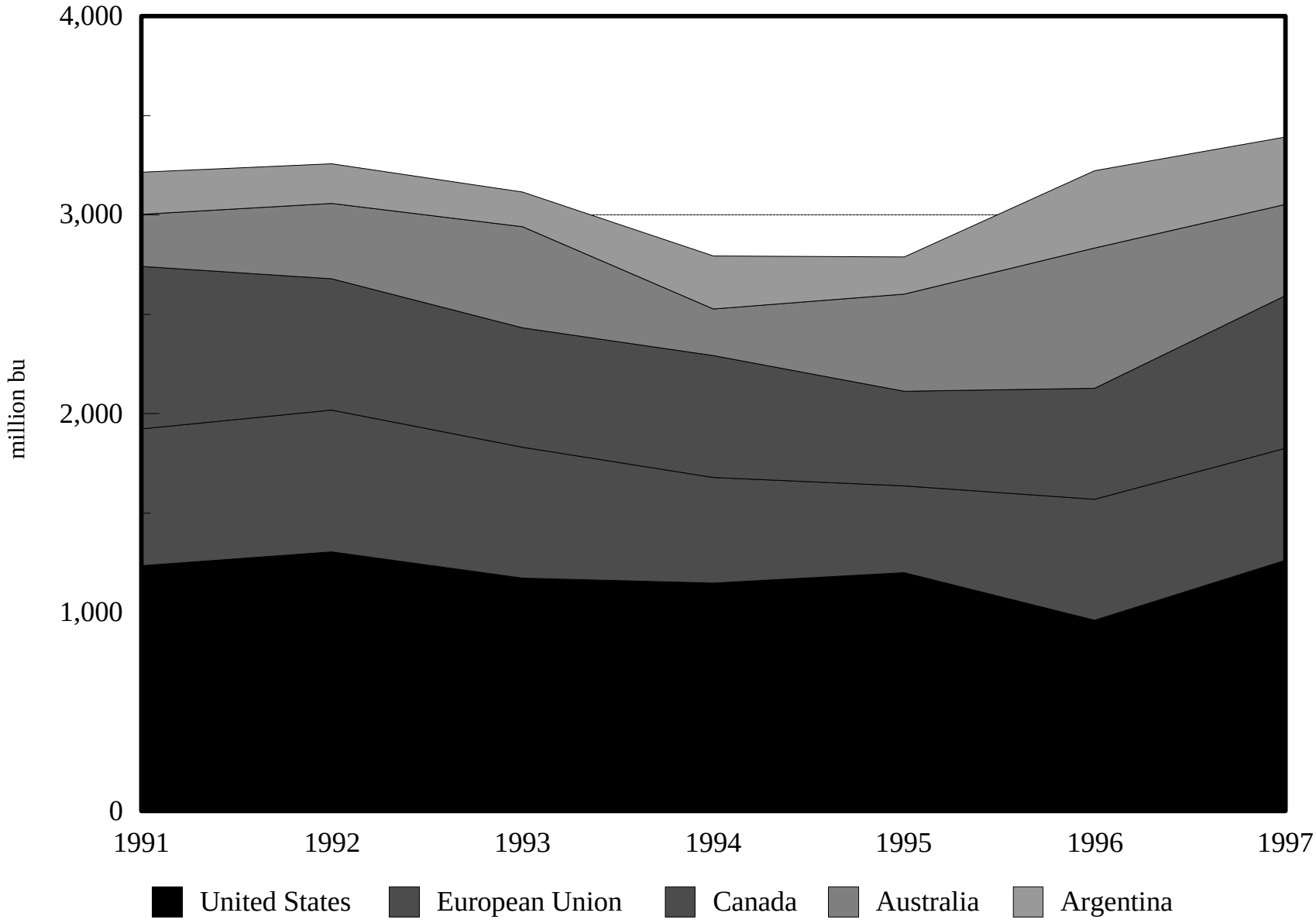


Figure 2.3. Wheat Exports of Major Wheat Exporting Countries/regions

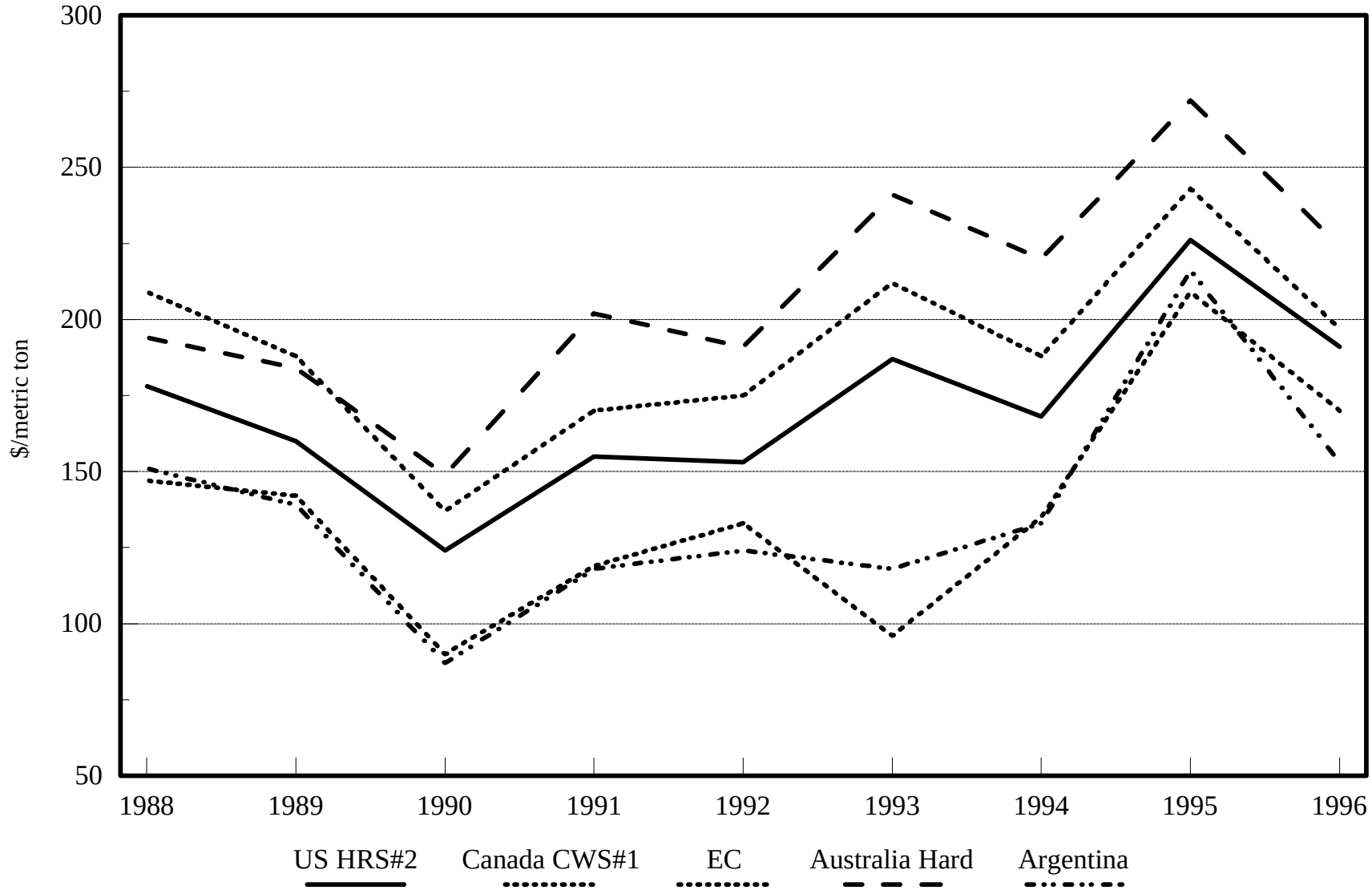


Figure 2.4. Export Prices for Various Hard Wheat

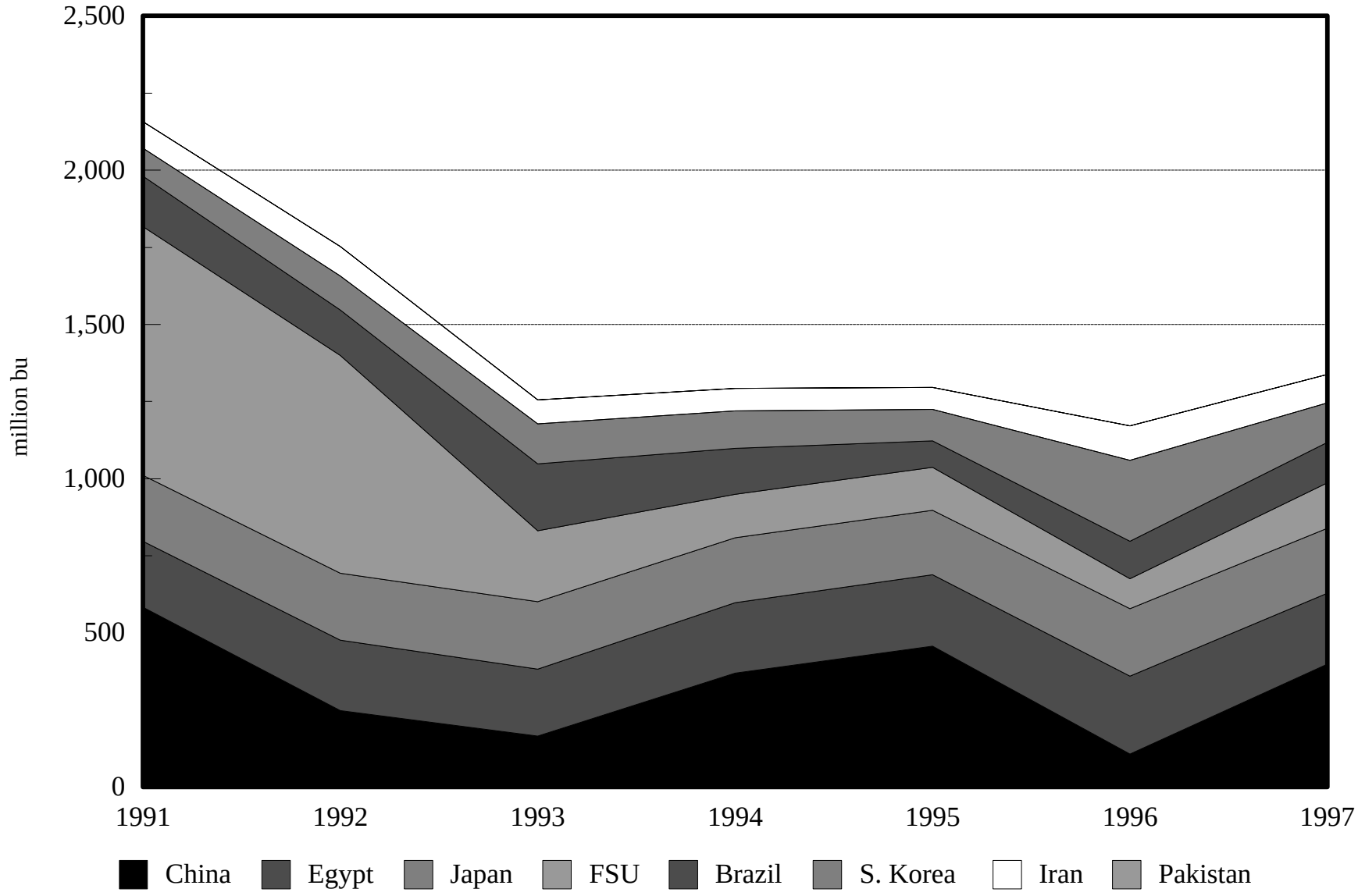


Figure 2.5. Wheat Imports of Major Wheat Importing Countries

China is the largest wheat consuming region, averaging between 3,936 and 4,477 million bushels of consumption per year, followed by the Former Soviet Union (FSU) with between 2,342 and 4,004 million bushels per year. The EU consumes between 2,037 and 2,761 million bushels per year.

Figure 2.6 shows the production of wheat in the United States by class. HRW wheat has the largest share of production, followed by HRS wheat. Over the past 10 years, U.S. production of HRW wheat ranged between 825 and 1,196 million bushels, while that of HRS wheat ranged between 181 and 707 million bushels per year. Production of SRW wheat ranged between 325 and 559 million bushels per year, and white wheat production ranged between 219 and 355 million bushels.

Figure 2.7 shows average market prices for U.S. wheat by class. HRW and DNS (Dark Northern Spring, a sub-class of HRS) have followed similar price patterns. SRW and white wheat generally sell at a discount relative to hard wheats.

During the past five years, North Dakota has accounted for about 50 percent of the HRS wheat produced in the United States (Figure 2.8). State production of HRS wheat averaged 267 million bushels during 1993 to 1997. When CWS wheat production is included, the production share for North Dakota (relative to total HRS and CWS produced in North America) drops to about 20 percent (Figure 2.9). Canada has averaged 802 million bushels of spring wheat during this period.

United States spring wheat supply and usage are shown in Table 2.1. Domestic use of spring wheat has averaged 282 million bushels during 1993-97, or 54 percent of production. Exports have averaged 284 million bushels during the same time period. The United States imports 6.7 percent of its total supply of spring wheat, mainly from Canada.

Table 2.1. Hard Red Spring Wheat Supply and Demand in the United States

	Beginning Stocks	Production	Imports	Total Supply	Domestic Use	Exports	Ending Stocks
	----------million bu----------						
1993	171	512	66	749	282	266	201
1994	201	515	51	767	282	292	193
1995	193	475	30	698	262	330	106
1996	106	631	53	790	324	300	166
1997	166	501	49	716	258	230	228

Source: USDA

Canadian spring wheat supply and usage are shown in Table 2.2. Domestic use of spring wheat has averaged 202 million bushels during 1993-97. Exports have averaged 427 million bushels during the same time period. On average, Canada exports 71 percent of its production.

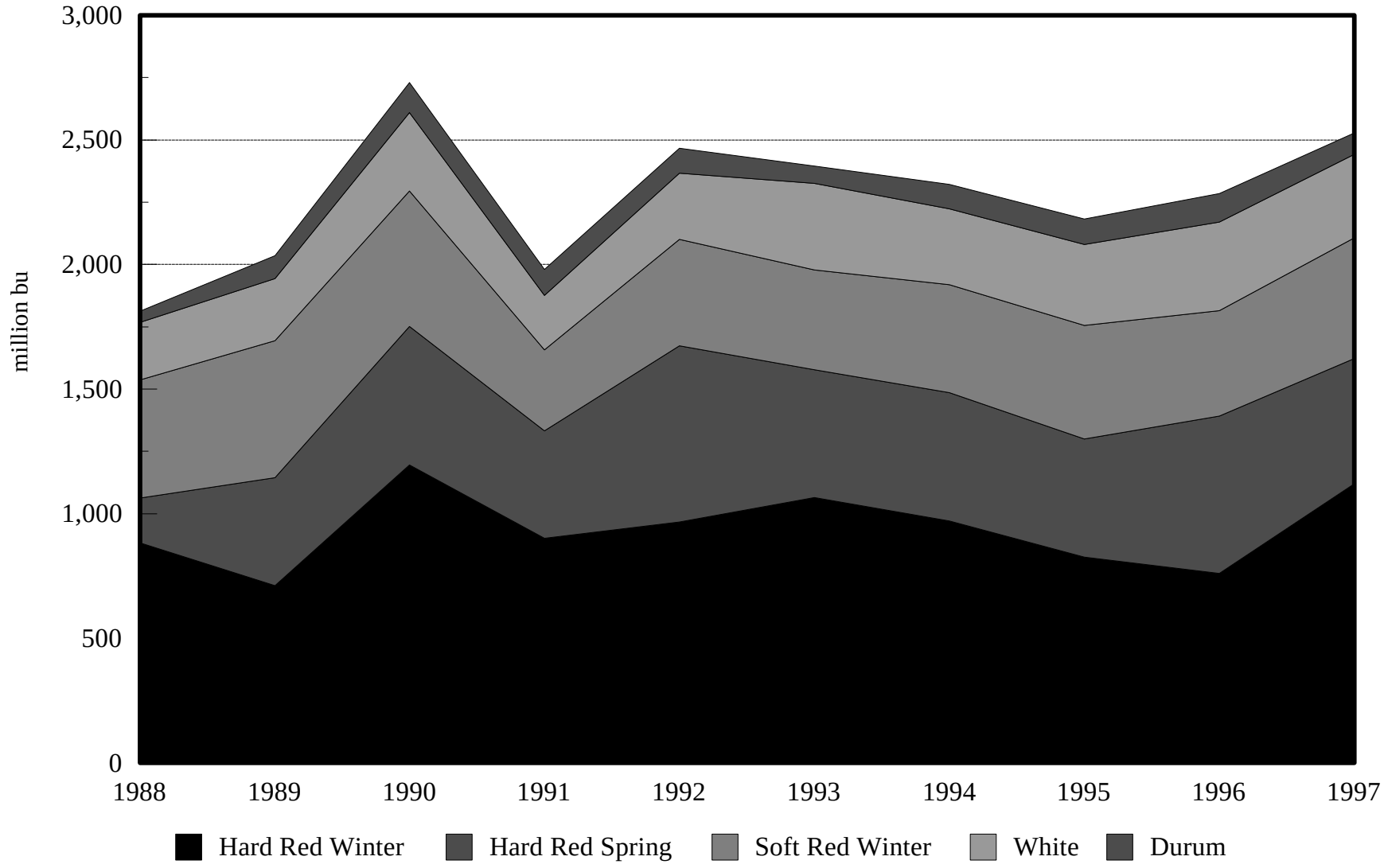


Figure 2.6. U.S. Production of Wheat by Classes

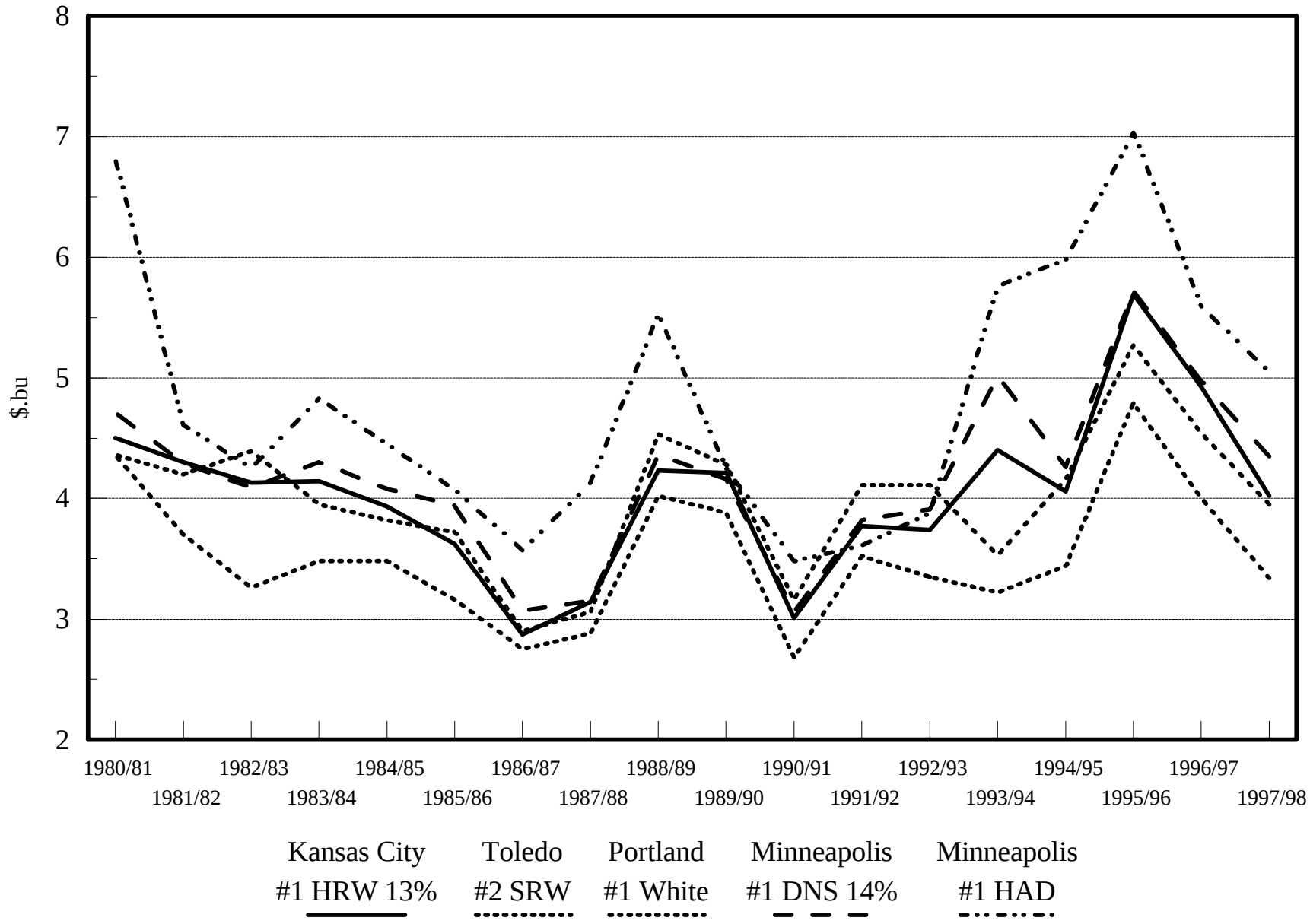


Figure 2.7. Market Prices for Various Classes of Wheat

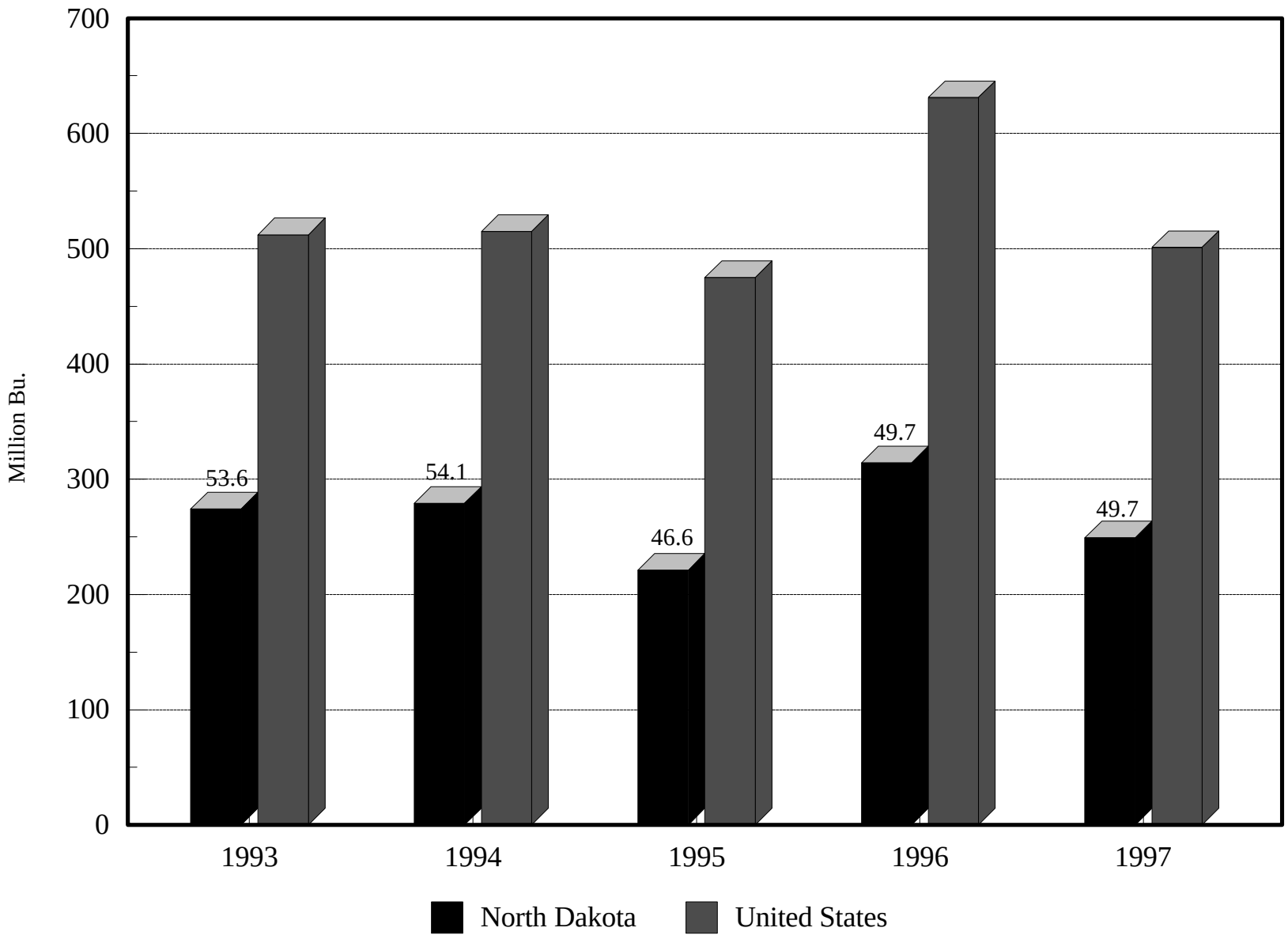


Figure 2.8. Production Share for North Dakota in the United States Market, Hard Red Spring Wheat

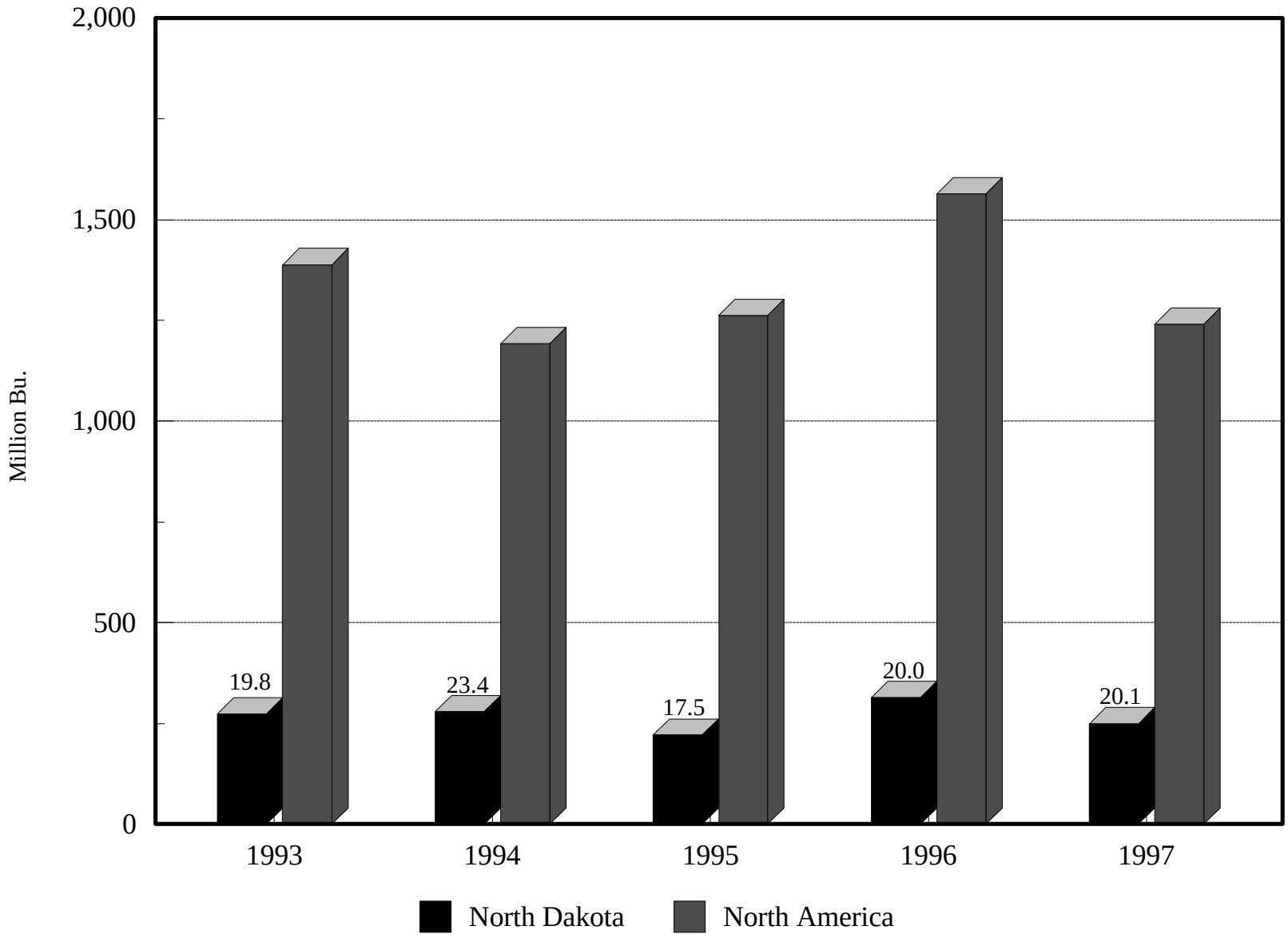


Figure 2.9. Production Share for North Dakota in the North American Market, Hard Red Spring Wheat

Table 2.2. Hard Red Spring Wheat Supply and Demand in Canada

	Beginning Stocks	Production	Imports	Total Supply	Domestic Use	Exports	Ending Stocks
	----------million bu----------						
1993	276	650	0	927	233	446	248
1994	248	502	0	751	191	401	158
1995	158	564	0	722	185	354	183
1996	183	697	0	880	197	496	187
1997	187	604	0	791	206	435	150

Source: Canadian Wheat Board

When HRW wheat production is included, North Dakota's share (of all hard wheats produced in North America) drops still further, to about 15 percent. As discussed below, this has important implications for the ability of a ND Wheat Pool to exert market power in the spring wheat industry.

United States winter wheat supply and usage are shown in Table 2.3. Domestic use of winter wheat has averaged 544 million bushels during the 1993-97 period or 58 percent of production. Exports have averaged 395 million bushels, or 42 percent of production during the same time period.

Table 2.3. Hard Red Winter Wheat Supply and Demand in the United States

	Beginning Stocks	Production	Imports	Total Supply	Domestic Use	Exports	Ending Stocks
	----------million bu----------						
1993	204	1,066	3	1,273	560	486	227
1994	227	971	4	1,202	586	422	194
1995	194	825	0	1,019	481	384	154
1996	154	761	0	915	486	286	143
1997	143	1,121	1	1,265	605	395	265

Source: USDA

The U.S. and World Durum Wheat Industry

World durum wheat production is dominated by three producing regions: the EU, the United States, and Canada. Figure 2.10 shows the production of durum wheat over the past seven years. The EU is the largest durum wheat producing region in the world. Its production ranged between 246 and 305 million bushels between 1991 and 1997. U.S. production of durum wheat ranged between 70 and 116 million bushels, while Canada produced between 115 and 172 million bushels.

Figure 2.11 shows the major durum wheat exporting regions. Canada is the largest exporting country, with exports ranging between 84 and 150 million bushels per year, followed by the United States with exports between 38 and 54 million bushels per year. EU exports have ranged between 11 and 123 million bushels per year. Figure 2.12 shows the price trends for durum wheat at port elevators in the United States and Canada. The observed price spreads largely reflect grade differentials, which have varied through time.

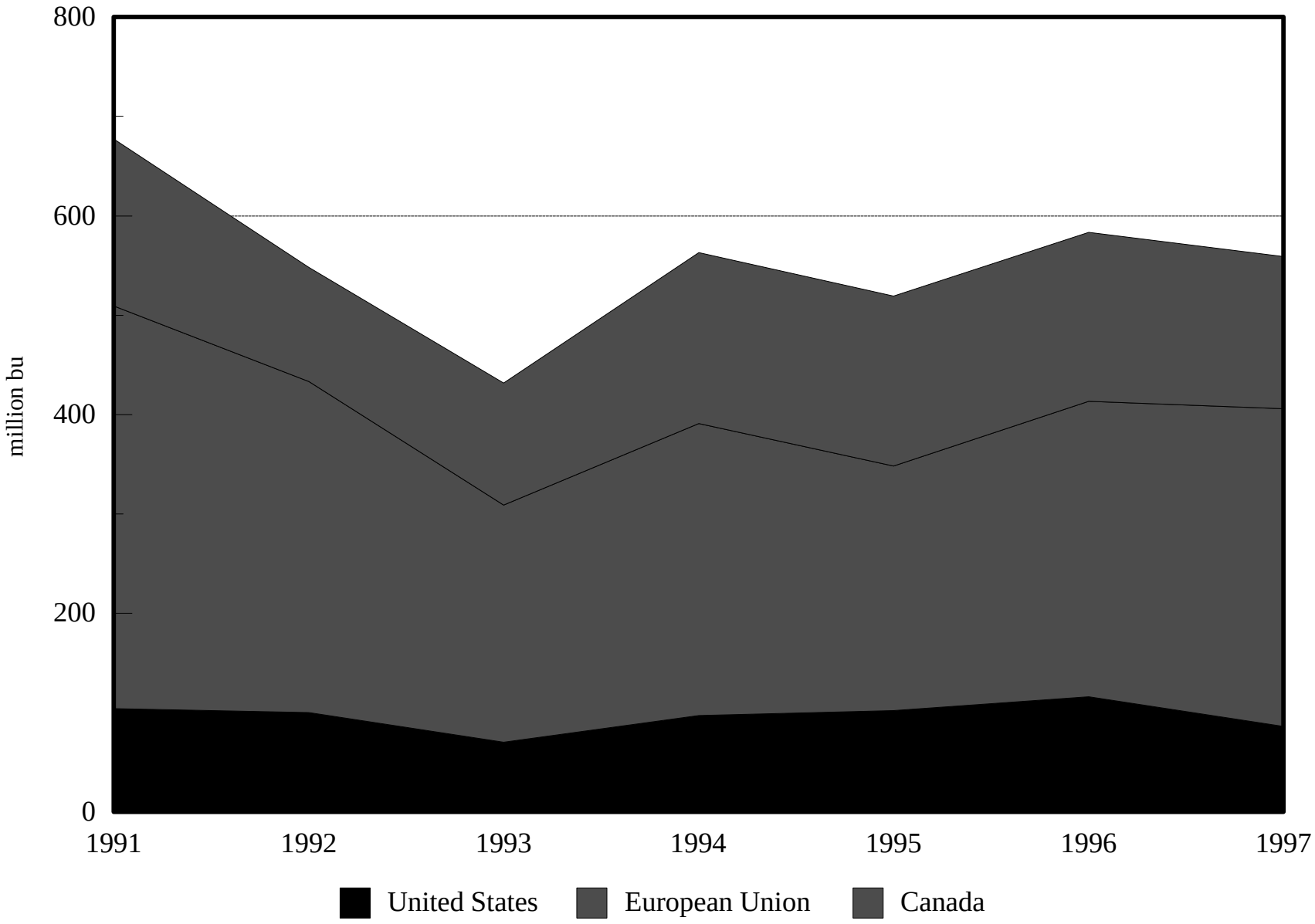


Figure 2.10. Durum Wheat Production of Major Durum Wheat Producing Countries/regions

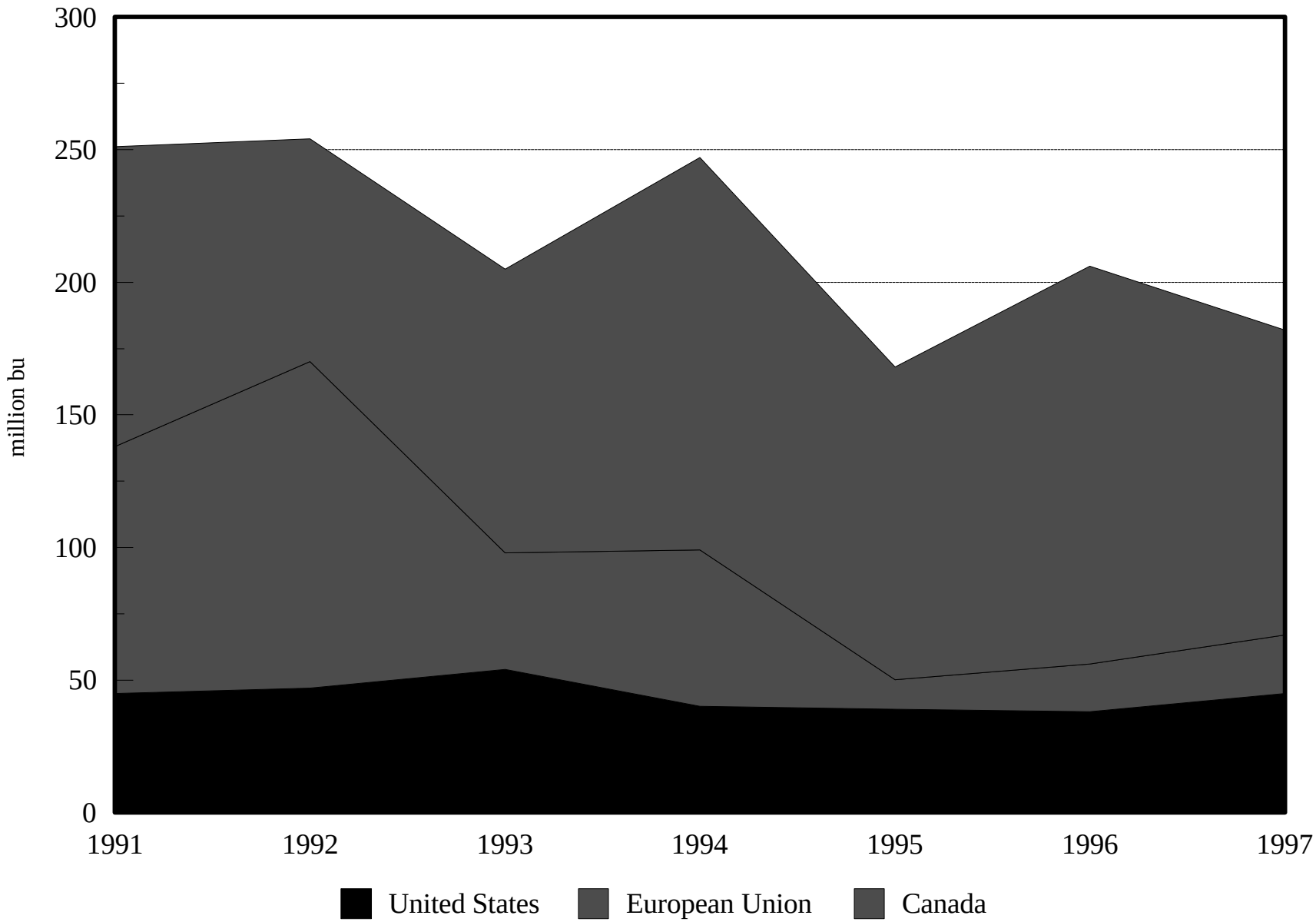


Figure 2.11. Exports of Durum Wheat of Major Durum Wheat Exporting Countries/regions

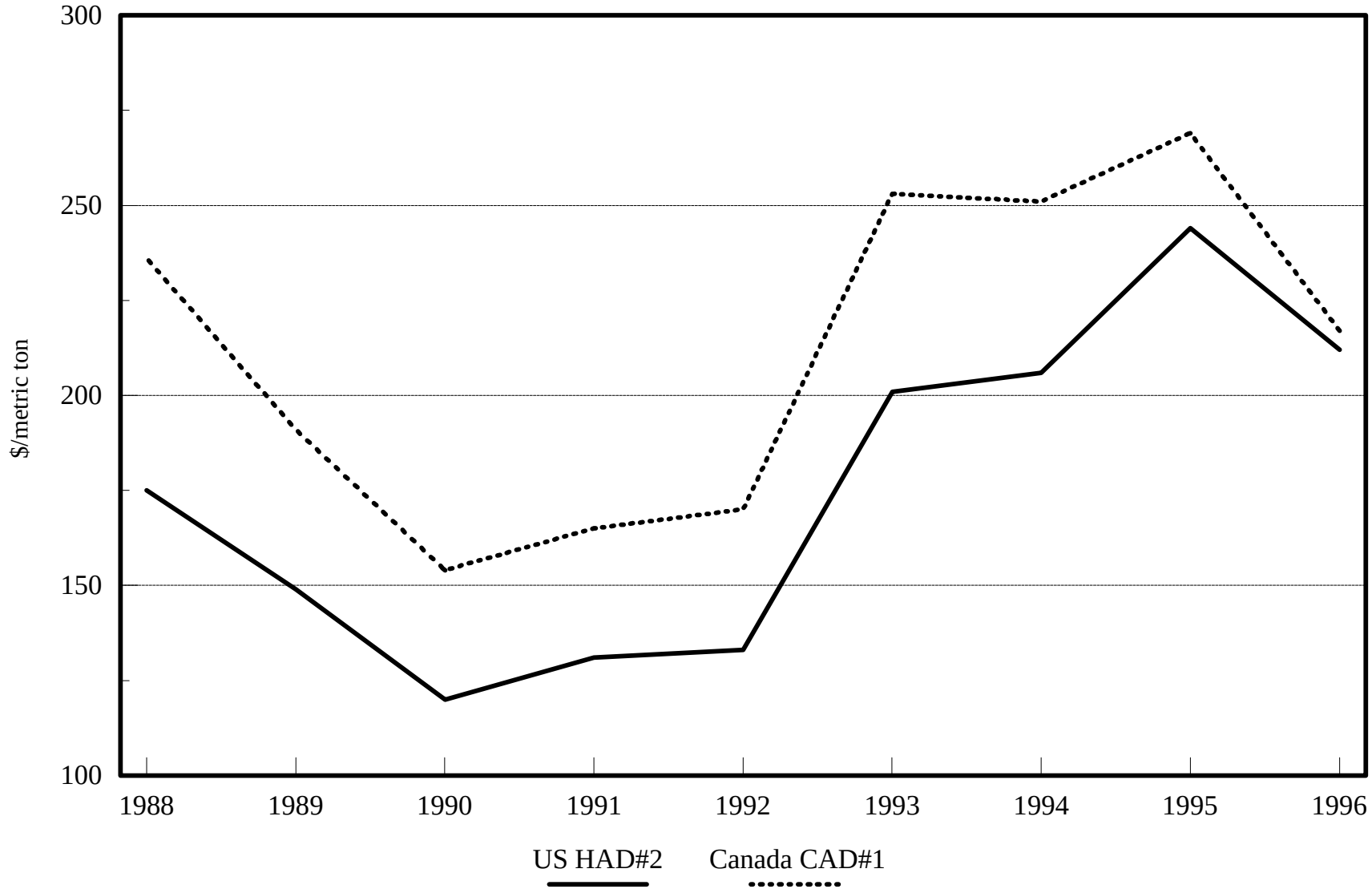


Figure 2.12. Export Prices for Various Durum Wheat

Figure 2.13 shows the major durum wheat importing regions in the world. Algeria is the largest importer of durum wheat, with imports ranging between 53 and 129 million bushels over the past seven years. The EU has imported between 5 and 44 million bushels during the same time period, and the United States imported between 19 and 31 million bushels per year.

The EU is the largest durum wheat consuming region, averaging between 213 and 305 million bushels per year, followed by Turkey ranging between 135 and 185 million bushels per year. Algeria consumes between 99 and 137 million bushels per year.

Figure 2.6 compares U.S. production of durum and other wheat classes. Durum wheat accounts for a very small share of total U.S. wheat production. United States durum wheat supply and usage are shown in Table 2.4. Domestic use of durum wheat averaged 81.2 million bushels during 1993-97. Exports averaged 43.2 million bushels, or 48 percent of production during this period. The United States has imported about 15 percent of its total supply of durum wheat from Canada.

Table 2.4. Durum Wheat Supply and Demand in the United States

	Beginning Stocks	Production	Imports	Total Supply	Domestic Use	Exports	Ending Stocks
	----------million bu----------						
1993	49	70	31	150	68	54	28
1994	28	97	22	147	81	40	26
1995	26	102	18	146	82	39	25
1996	25	116	24	165	97	38	30
1997	30	86	30	146	78	45	23

Source: USDA

Canadian durum wheat supply and usage are shown in Table 2.5. Domestic use of durum wheat has averaged 22.9 million bushels during 1993-97. Exports have averaged 86.9 million bushels, or 77.1 percent of production. The United States has accounted for about 29 percent of Canadian durum wheat exports.

Table 2.5. Durum Wheat Supply and Demand in Canada

	Beginning Stocks	Production	Imports	Total Supply	Domestic Use	Exports	Ending Stocks
	----------million bu----------						
1993	56	91	0	148	22	79	46
1994	46	128	0	174	22	110	42
1995	42	117	0	159	23	68	68
1996	68	119	0	187	23	93	71
1997	71	111	0	182	24	85	72

Source: Canadian Wheat Board

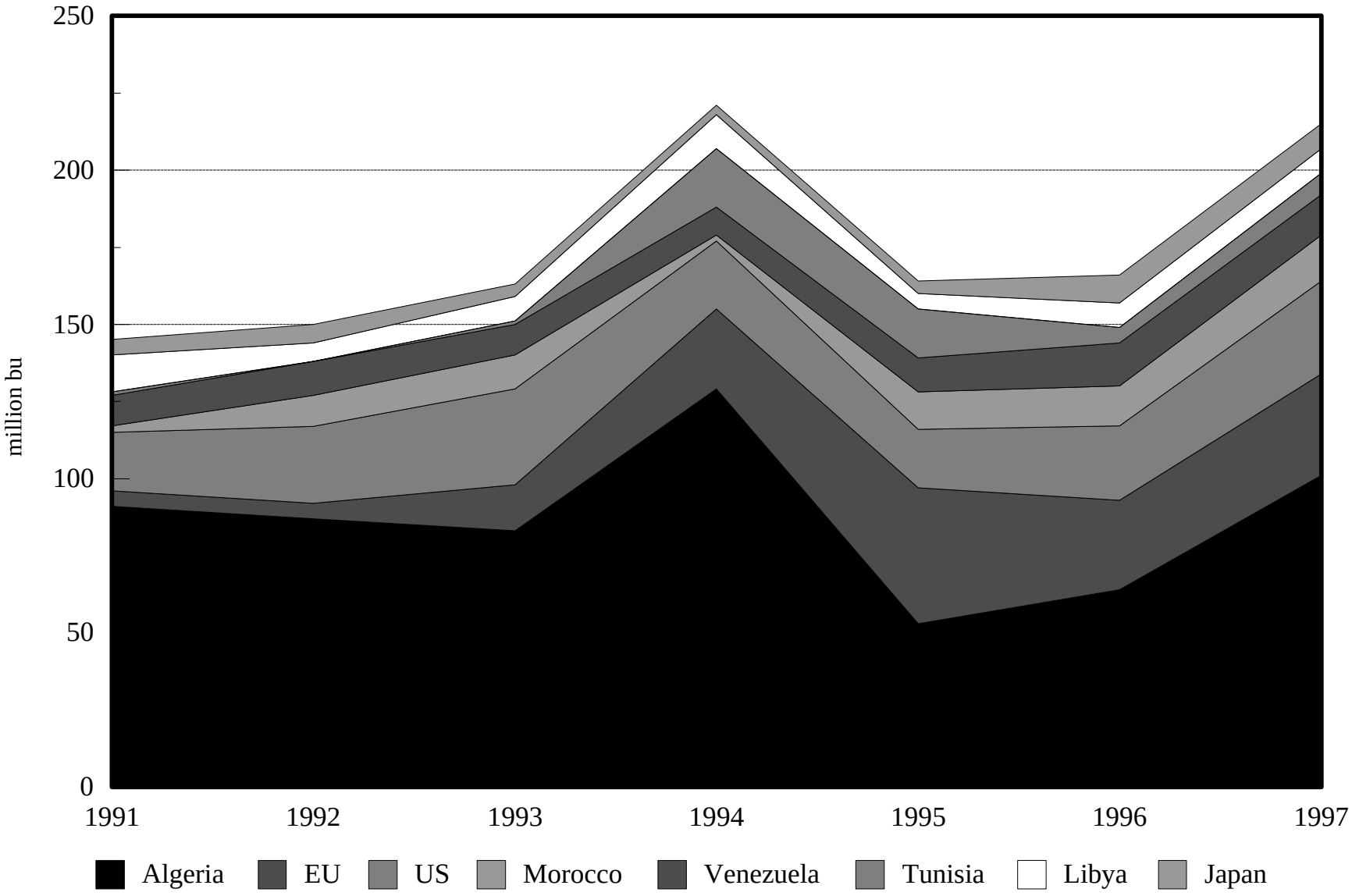


Figure 2.13. Imports of Durum Wheat of Major Durum Wheat Importing Countries

During the past five years, North Dakota produced over 88 percent of the durum wheat produced in the United States (Figure 2.14). On average, the state produced 70 million bushels of durum wheat during the 1993-97 period. However, North Dakota accounts for a much smaller share of total durum produced in North America. Canada produced about 159 million bushels per year during the 1993-97 period. When Canadian durum wheat production is included, the production share for North Dakota falls to about 29 percent (Figure 2.15). Figure 2.16 shows the production share of North Dakota durum wheat in the world market. North Dakota's share of world production averaged 7.7 percent during the 1993-97 period.

Changes in Durum and Hard Red Spring Wheat Production

Production and Production Potential

Traditionally, durum wheat production in North Dakota occurred in the northeastern corner of the state. In 1976, the counties with the largest planted acres for durum wheat were Ward (271 thousand acres), Ramsey (230 thousand acres), Towner (227 thousand acres), Bottineau (218 thousand acres), and Benson (200 thousand acres). Durum wheat production began to shift to the west with Ramsey county losing 90 thousand acres, Nelson, 67 thousand acres, Cavalier, 53 thousand acres, and Benson, 40 thousand acres by 1985. Mountrail county increased production of durum wheat from 12 thousand acres in 1976 to 165 thousand acres in 1985. By 1996, Ramsey county lost 171 thousand acres, Nelson, 149 thousand acres, Cavalier, 93 thousand acres, Towner, 87 thousand acres, and Benson, 81 thousand acres. The Northwestern counties increased their acreage of durum wheat substantially. Mountrail increased planted acres between 1985 and 1996 by 235 thousand acres, Williams, 135 thousand acres, Ward, 130 thousand acres, Divide, 129 thousand acres, McLean, 125 thousand acres, and Burke, 85 thousand acres (Figure 2.17).

The shift has occurred because of the disease problems, mainly scab, in the 1990's. The western part of the state does not receive as much rainfall, especially in late June and early July, and so is less prone to scab outbreaks.

The ratio of durum wheat acres to total wheat acres indicates that in most cases durum wheat replaced spring wheat in the west, and spring wheat replaced durum wheat in the east (Table 2.6). In 1985, durum was planted on 80 percent of the wheat acres in Mountrail county, but this increased to 95 percent by 1996. Between 1985 and 1996, the ratio increased from 45 percent to 60 percent in Burke county, and from 45 percent to 50 percent in Renville county. In contrast, the ratio for the eastern part of the state decreased. For example, Nelson county's ratio was 49 percent in 1985, and 4 percent in 1996. In Towner county the ratio was 93 percent in 1985 and 50 percent in 1996. In Benson county the ratio was 74 percent in 1986 and 41 percent in 1996. In both cases the total acreage of spring planted wheat was little changed.

A similar reaction occurred in the northeastern counties of Montana. Sheridan county increased durum wheat acres from 124 thousand acres in 1985 to 189 thousand acres in 1996. The ratio of durum wheat acres to total acres increased from 47 percent in 1985 to 59 percent in 1996. Daniels county increased durum wheat acres from 4 thousand in 1985 to 23 thousand in 1996. The ratio increased from 2 percent in 1985 to 8 percent in 1996 (Table 2.6).

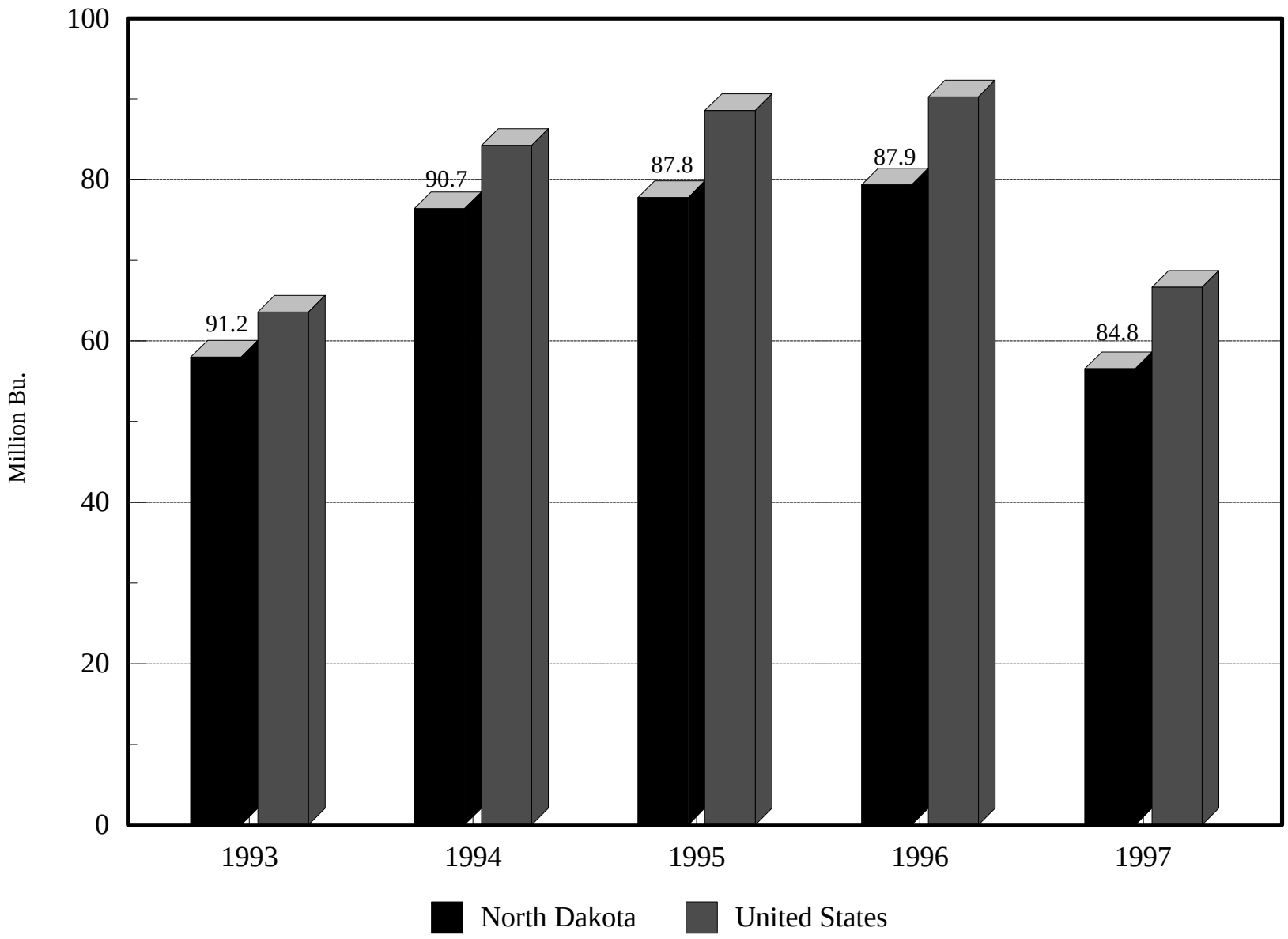


Figure 2.14. Production Share for North Dakota in the United States Market, Durum Wheat

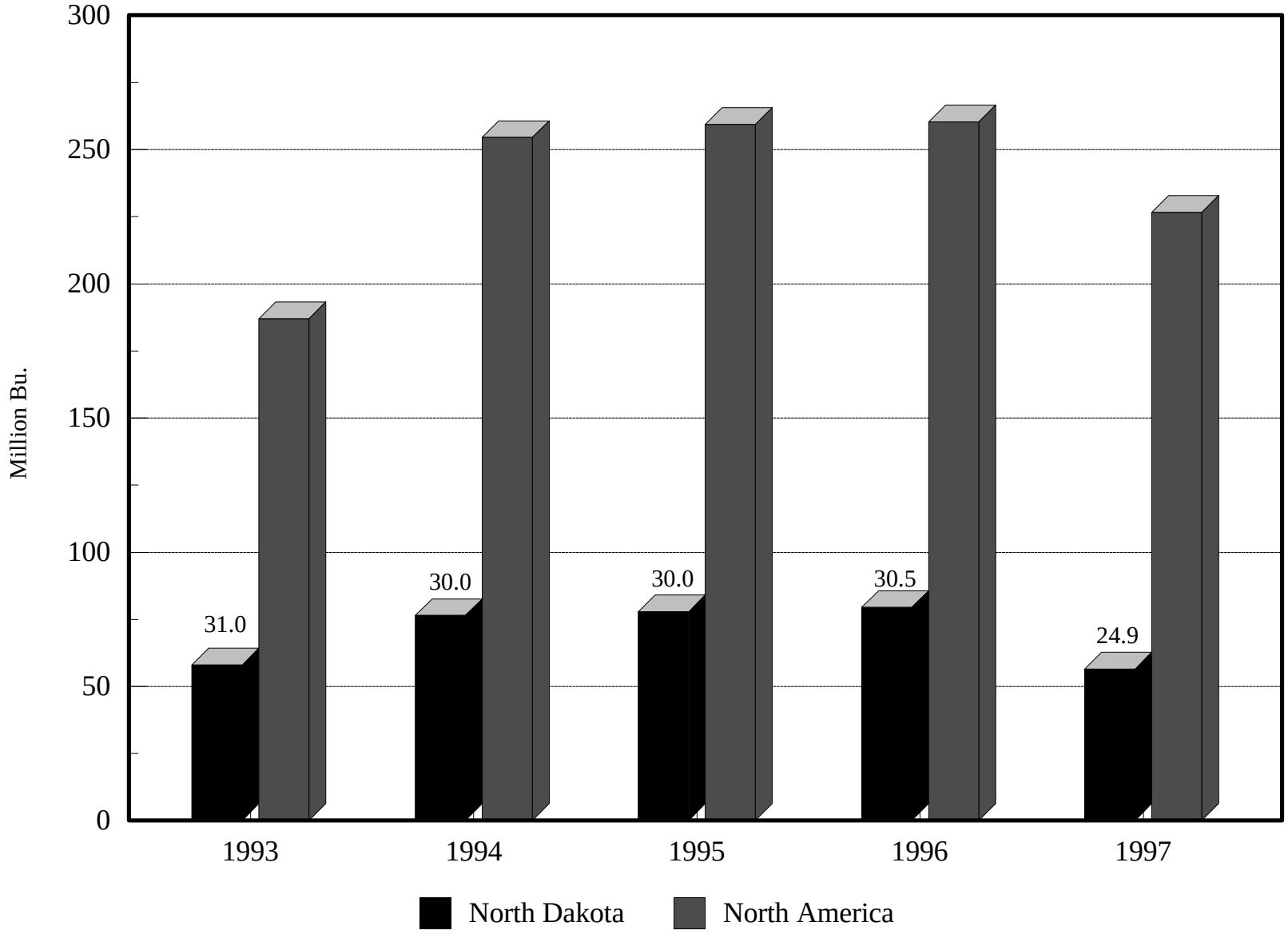


Figure 2.15. Production Share for North Dakota in the North American Market, Durum Wheat

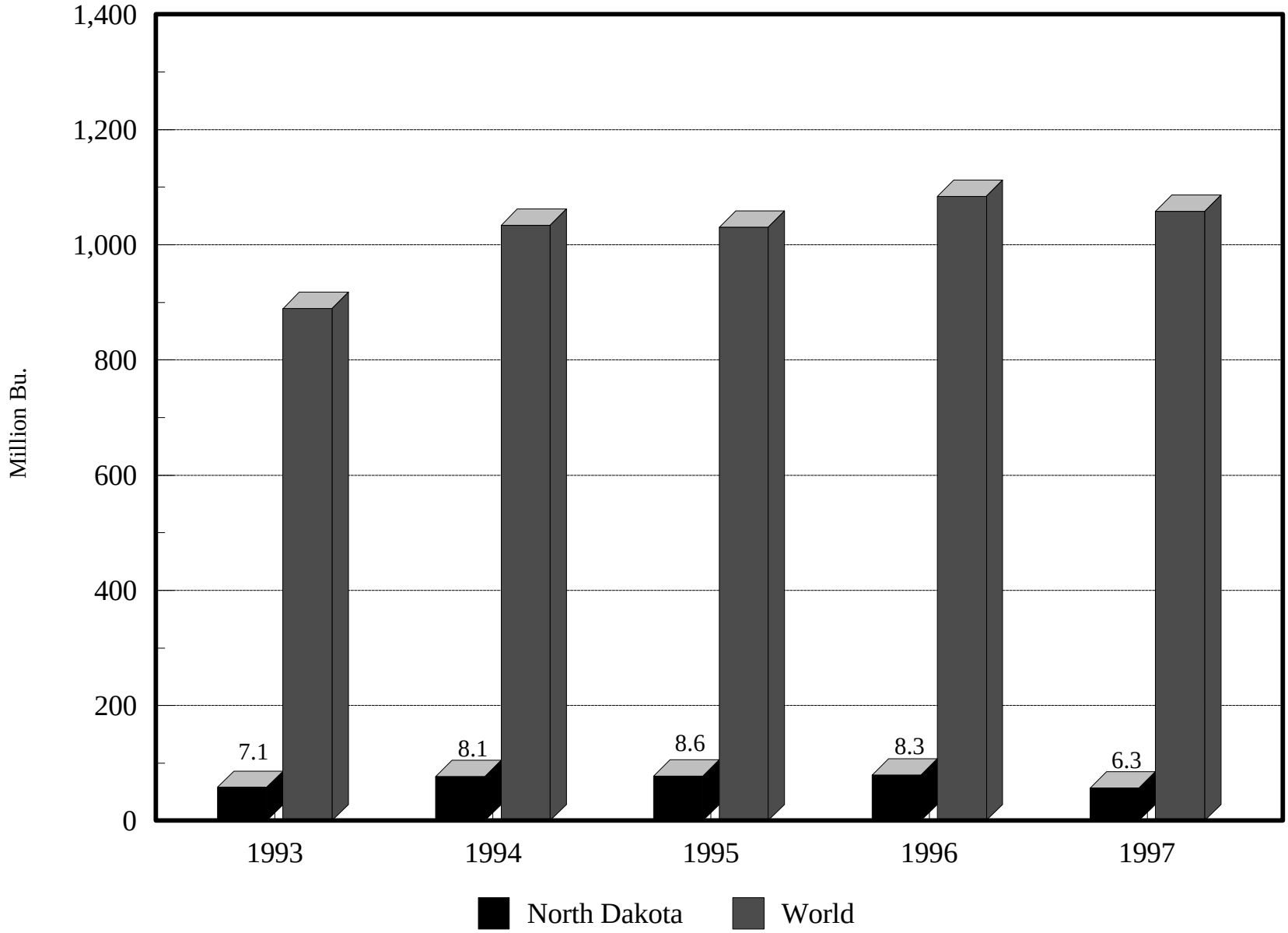


Figure 2.16. Production Share for North Dakota in the World Market, Durum Wheat

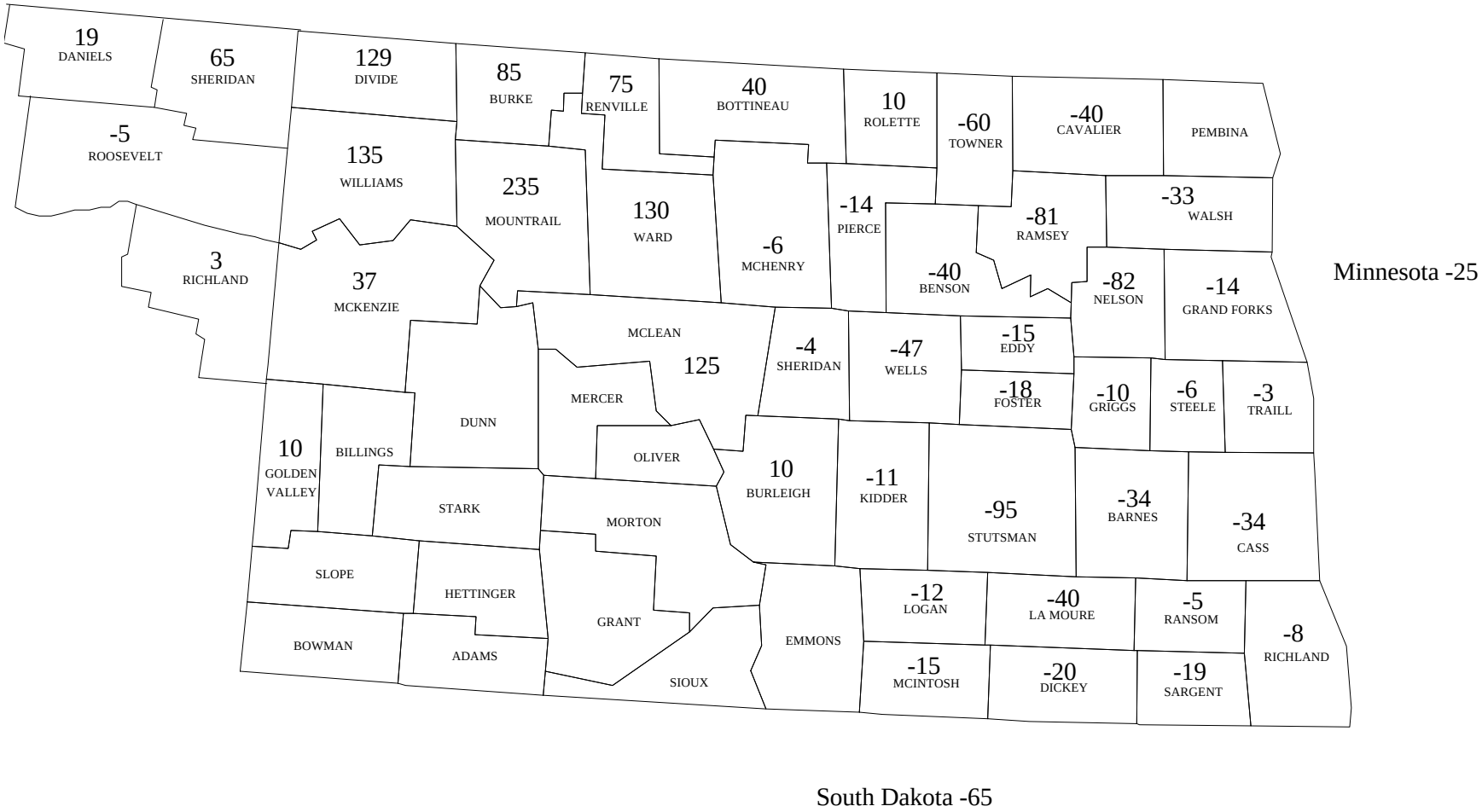


Figure 2.17. Shift in Durum Wheat Acres From 1985 to 1996, 1000 Acres

Table 2.6. Shifts in Durum and Spring Wheat Production Between 1985 and 1996

	Spring wheat		Durum wheat		Dur/total		Total wt
	1996	1985	1996	1985	1996	1985	1996
	--------(000) acre----------						(000) acre
North Dakota							
Mountrail	20	40	400	165	0.95	0.80	420
Williams	185	165	240	105	0.56	0.39	425
Ward	220	150	320	190	0.59	0.56	540
Divide	34	35	269	140	0.89	0.80	303
McLean	240	125	295	170	0.55	0.58	535
Burke	100	80	150	65	0.60	0.45	250
Renville	150	90	150	75	0.50	0.45	300
Bottineau	215	85	220	180	0.51	0.68	435
McKenzie	140	90	78	41	0.36	0.31	218
Golden Valley	75	50	30	20	0.29	0.29	105
Burleigh	170	140	20	10	0.11	0.07	190
Rolette	60	25	95	85	0.61	0.77	155
Benson	170	55	119	160	0.41	0.74	289
Cavalier	350	200	85	125	0.20	0.38	435
Ramsey	200	100	59	140	0.23	0.58	259
Towner	140	15	140	200	0.50	0.93	280
Stutsman	419	210	25	120	0.06	0.36	444
Nelson	190	95	8	90	0.04	0.49	198
Montana							
Sheridan	132	142	189	124	0.59	0.47	321
Daniels	263	229	23	4	0.08	0.02	286
Richland	196	107	4	1	0.02	0.01	200
Roosevelt	338	236	26	31	0.07	0.12	364
Minnesota	2,550		10	35	0.00		
South Dakota	2,300		25	90	0.01		

Source: NASS

The ratio of durum wheat acres to total wheat acres has risen substantially in the northwestern counties of North Dakota and in some cases durum wheat has almost totally replaced spring wheat. The ratio varies according to the price spread between durum and HRS. Williams, Ward, McLean, and Renville all have a ratio in the 50's. If that ratio would increase just 10 percent, durum acres would increase by 179 thousand acres. Likewise if the counties in Montana increased their durum wheat ratio to the level of adjacent North Dakota counties, their durum acres would increase by 519 thousand acres (Figure 2.18).

The states of Minnesota and South Dakota both reduced the number of acres planted to durum. In 1985 Minnesota planted 35 thousand acres and South Dakota planted 90 thousand acres. By 1996 the acres fell to 10 thousand in Minnesota and 35 thousand in South Dakota.

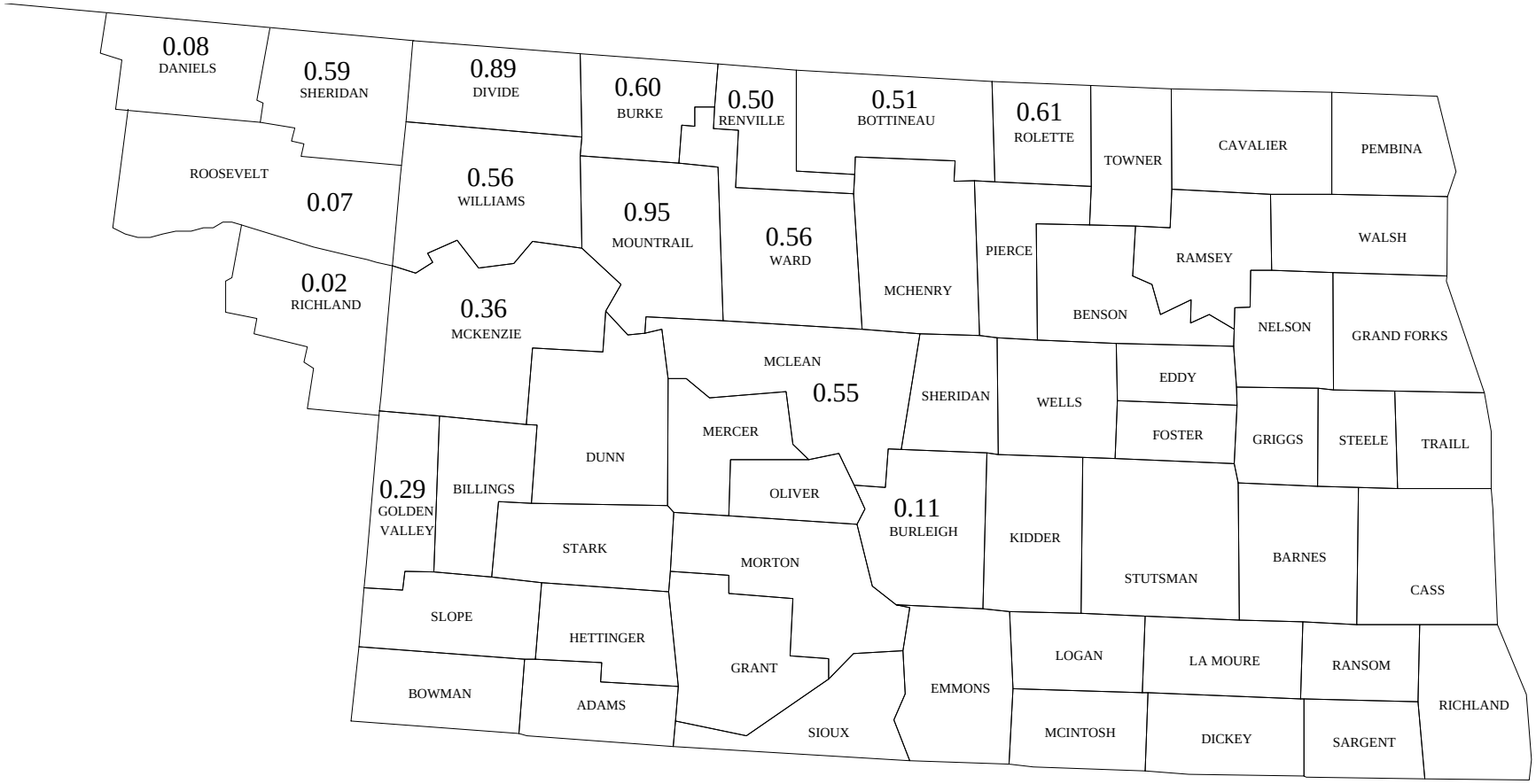


Figure 2.18. Percent of Durum Wheat Planted Acres to Total Wheat Acres in North Dakota and Montana, 1996

Arizona and California raise durum wheat under irrigation. During the past 12 years the planted acres in Arizona varied between 38 and 165 thousand acres, while planted acres in California varied between 55 and 140 thousand acres. Planted acres in the southwest region are very responsive to durum price changes (Table 2.7). The yield for irrigated durum in Arizona and California ranges between 85 and 100 bushels per acre.

The western states of Montana, Wyoming, Colorado, Utah, and Nevada irrigate 323 thousand acres of spring wheat. Some of this irrigated land could be used to grow durum wheat.

Table 2.7. Durum Production in Arizona and California Between 1985 and 1996

	Lowest acreage	Yield	Production	Highest acreage	Yield	Production
	(000) ac	bu	(000) bu	(000) ac	bu	(000) bu
AZ	38	90	5,130	165	90	14,760
CA	55	85	3,825	140	100	13,800

Source: NASS

3. A Brief Review of the Existing Pools for Agricultural Commodities and Operation of the CWB

Market Pool and Operation

A market pool is an arrangement by which producers market their crops collectively. This arrangement is formalized by means of a marketing agreement between a cooperative and its members. The marketing agreement is a legal instrument which outlines the rights and responsibilities of both producers and their cooperative (Dunn, Thurston, and Farris).

A market pool, typically a cooperative, combines the crops of many producers. Marketing functions are performed by a specialist or professional staff. The proceeds are divided among pool members with each member receiving the same average price for each unit of commodity delivered to the pool. However, adjustments are often made to reflect differences among pool members in commodity quality, transportation costs, or services rendered. The costs of operating the pool are deducted from the proceeds of the sale of the commodity.

Producers turn over the pricing and marketing decisions to the pool's marketing specialists and agree to accept the average pool price. In a typical case, the producer receives an advance payment when he delivers the commodity. This payment is usually stated as a percentage of current market price or CCC loan rate if applicable (Dunn, Thurston, and Farris). As commodities of the pool are sold, interim payments may be made. Once the pool is liquidated, operating expenses and other costs are deducted and the remaining proceeds are divided among pool members in a final payment.

The main purpose of a market pool is to provide additional revenue to its members through (1) improved marketing efficiency and (2) market power. There may be efficiency gains from entrusting marketing decisions to trained specialists, who have greater access to information about available supplies and market opportunities than individual members. A market pool also may be able to exercise limited market power. A pool exerts market power to the extent that it can raise the price of a commodity by restricting supply, or by effectively discriminating between markets—offering higher prices in some market segments, and lower prices in others, in order to maximize net revenue.

Types of Pools

There are two main types of pools: seasonal and contract pools (Dunn, Thurston, and Farris). Both pools have some form of volume commitment by producers, but differ in the degree of control over price retained by the producer. Pools may take a variety of forms based on the commodity and the markets involved. Variations may exist with respect to (1) duration of the pool, (2) number of commodities in the pool, (3) treatment of commodity grades, and (4) special characteristics of the commodity or its production.

The seasonal pool forms the basis of most pooling operations. The producer agrees to deliver some specified portion of his crop and to accept the adjusted pool price. The producer has little or no control over the price he receives under a seasonal pooling arrangement.

There are two general types of contractual pools: call pool and purchase pool. In a call pool, the producer retains some control over price by setting a minimum or reservation price below which his commodity may not be sold. Delivery of his committed volume is usually made prior to some fixed date early in the pooling period. In a typical purchase pool, the producer determines price by the timing of his delivery to the pool. The price he receives is usually the expected cash price on the day of delivery.

A contractual pool is not a true market pool, while having many of the characteristics of a market pool. In the contract pool, producer prices are determined on an individual basis as in buy-sell transactions. In a true market pool, exemplified by the seasonal pool, the producer price received is the average price, based on all sales during the marketing period. A contractual pool mainly facilitates the pooling of expenses.

Advantages and Disadvantages of Seasonal Pooling

The following discussion is based on a research report by Dunn, Thurston, and Farris.

1. Advantages of Seasonal Pooling

Marketing decisions made at a specialized level: Returning the highest possible price to pool members is a main objective of the pool's marketing specialists. They are able to study market conditions and trends, and attempt to stay attuned to both the desires of pool participants and the needs of existing and potential buyers.

Reduction of price risk: Since all pool participants receive an average price (with adjustments for quality) for their commodity, the risk of an individual participant receiving a lower-than-average price is eliminated. Losses from lower-than-average market price sales are spread among all pool participants, as are gains from higher-than-average market price sales.

More orderly marketing and increased price stability: The certain volume of the crop from pool participants gives the pool's marketing specialists a great deal of flexibility. Given an inventory of known size, the specialists are able to control the form, timing, and location of sales and to meet the volume and quality specifications of large customers either in single sales or through long-term agreements. It is possible to make sales in advance of harvest and to reduce the impacts of temporary surplus or shortage and the effects of day-to-day price fluctuations.

Higher than market wide average returns: A properly managed pool can provide its participants with a higher price than the average received by non-pool producers. While individual non-pool producers should not be expected to be aware of all marketing opportunities, the pool's marketing specialist should be able to take advantage of as many as possible. The advantages held by pools in obtaining higher prices are (1) a readily available large quantity of commodity, (2) access to and time to utilize more complete market information, (3) the ability to develop meaningful quality measures, (4) flexibility to meet buyer's needs, and (5) a possible increase in market power. A pooling operation may have advantages relative to private grain merchandisers in providing buyers with access to a large, specialized supply of guaranteed quality.

Improved quality and quantity control: In the early distribution process, the pool is able to control the quality and quantity of its inventory more effectively. Improved quality and quantity control aids the pool's marketing in two ways: (1) by decreasing losses due to damage, and (2) by enhancing the pool's reputation as a reliable supplier providing quality and quantity and satisfying buyers' needs.

Promotion of unity of purpose among producers: The fact that producers working together for a joint marketing effort can earn higher potential returns increases participants' awareness of their market interdependency. Pooling may enhance the future security of family farm operators.

2. Disadvantages of Seasonal Pooling

Delay in receipt of full payment: Pool participants receive partial payment at the time of their delivery; however, full payment occurs later, after close of the marketing period. This may be disadvantageous to producers who face a cash-flow squeeze.

Change in cooperative marketing philosophy: The transition from a buy-sell to a pooling approach involves changes in producers' marketing philosophy. Until these changes have been made, which may take some time, pool returns may not be satisfactory to participants. Both managers of buy-sell cooperatives and market-oriented pooling cooperatives are interested in obtaining the highest possible prices for their participants. Buy-sell managers are limited in the extent to which they are able to seek higher prices. On any given day they must be able to provide bids to producers. They have no other alternative than currently available prices upon which to base their bids. They orient their bidding procedures toward obtaining the necessary margin, given market prices on a particular day. However, the pool manager does not have to make daily bids or concern himself with obtaining margins. He can coordinate his deliveries and storage to take advantage of prices over a much longer period of time.

Loss of marketing control by the producers: Under pooling the producer may miss an occasional opportunity to obtain a price higher than the pool average. Some producers may not wish to lose their ability to market independently.

Inadequate pool size: Without substantial supply commitments from participants, inadequate volume is often a problem for new pools. For substantial returns, the pool must control a volume large enough to supply the needs of large commercial and export customers. However, if it lacks adequate volume, the pool has few marketing outlets that are not available to a non-pool cooperative. An insufficient number of marketing outlets causes higher per-unit administration costs when the pool is small.

Loss of some short-term marketing opportunities: Because a primary strategy of a market pool is to minimize the effect of wide price fluctuations and to reduce short-run selling options in favor of long-term agreements, the pool may not be able to take full advantage of unexpected price increases.

Producer misunderstanding of need for capital retention: Many pools retain a portion of their payments to meet the future capital needs of the cooperative. Unless this need is thoroughly explained to members, capital retention may appear to be a non-productive expense that lowers the participants' net returns.

Voluntary and Mandatory Pools

In a voluntary pool, producers are free to either join the pool or stay outside. Since the pool exists alongside a cash market (or open market), this is known as a dual marketing system. This is contrasted with mandatory pooling, as exemplified by the Canadian Wheat Board (CWB) system. Another form of voluntary pool is a contractual pool; under this alternative, farmers sign a contract to deliver a specified portion of their production to the pool. Farmers who have contracted with the pool should be able to obtain the average price over the year. There would be no dilution of the pool by farmers selling to the cash market during high price periods. Also, a typical contract with producers is for more than one year. Hence, under this system, the pool can make a longer term marketing plan, which provides more stability in operating the pool than a pure voluntary pool.

A study by Fulton and Vercammen raises concerns about the viability of voluntary and contractual pools. They argue that a voluntary pool cannot operate in tandem with a cash market. Pooling is a system whereby high and low prices are averaged; this means that the pooled price is lower than the cash price roughly 50 percent of the time. Producers choose the cash market whenever the cash price is greater than the expected pool price and sell to the pool in the reverse case. As the pool price falls, the number of periods during which the cash price exceeds the pool price increases. As this process continues, the pool price falls further and more producers choose to sell in the cash market (Fulton and Vercammen).

Fulton and Vercammen also argue that contractual pools are not viable. First, farmers take on production risk when they sign fixed delivery contracts. Consequently, farmers may contract only a portion of their crop to reduce the risk of not being able to deliver, which limits the size of the pool. Second, delivery contracts are not ironclad. A farmer can decide not to deliver on the contract, and pay the specified penalty. Enforcement can be expensive, and contractual price pools could face considerable uncertainty over the amount of grain that will be delivered. Because the penalties cannot be made punitive, contractual pools can expect to see deliveries fall off during periods of rapid price increase (Fulton and Vercammen).

However, marketing pools in the United States are all voluntary contractual pools and have successfully operated for several decades. One of them is the Farmers Rice Cooperative located at Sacramento, California.

The Farmers' Rice Cooperative was established in 1944 and is the largest rice marketing cooperative with a stable base of over 1,350 Northern California growers. The cooperative handles about 40 percent of the rice produced in California, or about 10 million cwt. The main mission of this cooperative is to supply high quality milled rice to domestic and foreign customers.

Net marketing pool proceeds for the company were $99.4 million in 1997 and sales and service revenue was $176.8 million. The return to members from marketing operations for average quality medium grain rice was $8.91 per cwt. This is $2.80 per cwt over loan (Table 3.1). The return is much higher for higher quality rice.

Table 3.1. The Return to the Member From the Cooperative's Marketing Operation

Pool	Price support Loan Value	Gross Return	Return Over Loan	Net Return
Calrose	6.11	8.91	2.80	8.34
Short Grain Premium	6.12	9.67	3.55	9.10
Medium Grain	5.94	10.59	5.25 - 3.67	10.02

Source: Farmer's Rice Cooperative

Most voluntary contractual pools are pressured to be efficient because they must compete with grain companies in the open market system. Under voluntary pooling, free riders can be a major problem. However, as long as the pool has a market share of 50 percent or higher, the pool can provide additional revenue to its members (Schmitz et al., 1981).

Other Examples of Marketing Pools

The following are two examples of pooling operations discussed in a report by Dunn, Thurston, and Farris. The two associations, Riceland Foods, Inc. and Calcot, Ltd., operate both a seasonal pool and a contract pool. These pools have been reasonably successful, as their long-run results indicate. Each has experienced an occasional bad year when volatile market conditions led to lower-than-average returns. This can and does happen to every marketer from the individual producer to the most professionally operated pool, since prices in the future are never known with certainty. The long-run success of any pool is dependent upon a high quality management staff and continued support by members who are willing to stay with the pool in good years and bad. Movement of the decision making prerogatives to the specialized marketing level of a pooling operation can result in higher producer returns than in a buy-sell operation.

Riceland Food, Inc., Stuttgart, Arkansas, operates both a seasonal pool and a purchase pool for soybeans. Riceland receives soybeans from producers through member local cooperative elevators and processes soybeans into oil and meal products at their three plants. Distribution is made to domestic and export markets.

Calcot, Ltd., Bakersfield, California, operates both a seasonal pool and a call pool for cotton. The producer signs a membership and marketing agreement and agrees to deliver all his cotton to the association. All the producer's cotton is placed in the seasonal pool unless the producer states he wants some or all of his cotton to go into the call pool. The producer must designate how many bales will go into the call pool by March 1, prior to planting. Approximately 60-65 percent of Calcot's volume is marketed through the seasonal pool. The producer must

price the cotton in the call pool before May 31, the following year. If the producer fails to do so the pool will price the cotton at the market price on that day.

The Canadian Wheat Board (CWB)

The Canadian Wheat Board (CWB) was established as a Crown Agency by the Canadian Wheat Board Act of 1935. The CWB is a single-desk state trading agency responsible for the marketing of all wheat and barley sold for human domestic consumption and export. The CWB uses a price pooling system to return its net sales revenue to farmers.

Objectives of the CWB

Three pillars provide the basis of CWB operations: 1) single-desk selling to capture market premiums; 2) price pooling, as a cost-effective method of risk management for farmers; and 3) the association with the federal government, which provides the benefits of guaranteed initial prices, credit guarantees, and a low interest rate on CWB borrowing (CWB, 1994/95, p.4). The CWB's institutional objectives are laid out in its 1992/93 Annual Report. They are:

1) to create competitive advantage for grain producers through creative marketing and the inherent strengths of single-desk selling;

2) to adapt products and services to meet and exceed the demands of customers;

3) to provide quality service to farmers—CWB stakeholders and suppliers—including price pooling and equal access to markets; and

4) to provide industry leadership and foster partnerships and cooperation to improve the Canadian grain sector as a whole (CWB, 1992/93, p.14).

The CWB's objectives are described more plainly in a study by Simonot as follows. The first is to maximize revenue for western Canadian wheat producers from wheat sales in the export and domestic markets. Aggressive market development is directed at this objective. Secondly, producers are paid a pooled price regardless of when they deliver their grain during the marketing year. This reduces the price risk that producers would otherwise face in marketing their grain. Finally, the CWB strives to provide all producers in western Canada with equitable access to the constrained transportation resources, as well as the markets for their commodities.

Operation of the CWB

The CWB has the role of administering access to western Canada's limited grain transportation and handling resources through quotas and contracts with farmers. Grain sales must be coordinated with internal logistics (i.e., railcar allocation) and farmer deliveries to elevators. These functions, which are market-driven in the United States, are accomplished through non-market (administrative) mechanisms in Canada. The CWB sells grain directly to buyers (whether they are private or government entities) and also makes use of accredited exporters, companies that sell wheat on behalf of the CWB.

The Canadian Wheat Board Act provides the legal basis for CWB operation. Farmers are required by law to market through the CWB. This has been a somewhat contentious issue in Canada, with some farmers and commodity organizations arguing for elimination of the CWB's single-desk authority. In response to public pressures for a more responsive and flexible CWB, a number of reforms have now been instituted under the C-4 legislation. Among these are the recent adoption of a board of governors (replacing appointed commissioners), which consist primarily of elected producers, and changes that will facilitate new types of marketing alternatives for producers.

Previous Studies of the CWB

The performance of the CWB has been assessed in several studies. Among the most important are a study by Kraft, et al., which was commissioned by the CWB, and a study by Carter and Loyns (1996), commissioned by Alberta Agriculture. These reached diametrically opposed conclusions about the effectiveness of the CWB in raising returns to Canadian farmers.

Kraft et al. (1996) used confidential CWB data to estimate the benefits associated with single-desk selling of Canadian wheat. Their analysis involved comparing actual CWB transaction prices to (hypothetical) prices that would have occurred in a competitive trading environment. The latter prices were estimated from available U.S. data for 'comparable' wheat.[1] Over a fourteen-year period, 1980-94, Kraft et al. found that the CWB earned an average premium of C$13.35 per metric ton of wheat sold (p. 54). For the period when the U.S. Export Enhancement Program (EEP) was active (i.e., the last ten years of their sample), they estimated a substantially higher average premium, reasoning that in absence of single-desk selling Canada's wheat price would have fallen to that of EEP-subsidized markets (less transport costs).

Carter and Loyns (1996) focus on the extra costs associated with Canada's grain marketing system. Their study lists several economic costs (some are opportunity costs). Costs include the straightforward expenses of CWB administration, taxpayer costs due to occasional pool deficits, costs incurred by farmers (lost interest and storage expenses), excessive cleaning, port congestion, production inefficiency due to poor price signals, delay and bias in varietal development, inefficiencies in handling and freight, and inefficiencies created by cross-subsidization among producers. The taxpayer cost involved in underwriting CWB borrowings is also mentioned. This study points to several types of systemic inefficiency in the Canadian system, many of which are related to functions of the CWB. Although the authors' cost estimates are somewhat rough, they raise legitimate questions about whether benefits of single-desk selling are outweighed by the additional costs borne by Canadian producers.

Schmitz et al. (1997) examined CWB operations with respect to malt and feed barley. Findings include large premiums for malting barley due to price discrimination and smaller, but still significant premiums for feed barley. The methodology used to calculate these premiums was somewhat different than that used by Kraft et al.; rather than conduct price comparisons for

[1]This is problematic, for reasons that have to do with the inadequacies of U.S. price data and differences in export standards between the United States and Canada.

individual CWB transactions, Schmitz et al. base their analysis on a mathematical programming model of barley trade, with parameters adjusted to reflect market conditions in individual years. In addition to the trade model, they provide an estimate of losses due to the lack of arbitrage between CWB feed barley prices and U.S. barley prices. These losses were found to be smaller than the gains from single-desk selling.

The U.S. General Accounting Office (GAO,1996) has also examined the operation of the CWB. The purpose of the GAO report was to analyze three state trading enterprises (STEs)—the Canadian Wheat Board (CWB), the Australian Wheat Board (AWB), and the New Zealand Dairy Board (NZDB)—to determine if these could significantly distort world markets. The GAO found that the CWB had some potential to distort markets, but did not quantify the net impacts on prices or trade flows.

Enumeration of CWB Benefits and Costs

The following discussion draws heavily from Simonot (1997). According to that study, the three primary benefits associated with the operation of the CWB are single-desk selling, its association with the federal government, and risk management through price pooling. Each of these features provide a measurable monetary benefit.

First, single-desk selling (SDS) allows the CWB to capture price premiums in export markets. Kraft et al. (1996) provided an estimate of the value of SDS for the wheat pool over the period 1980/81-1993/94 (C$265 million annually during 1980/81-1984/85 and between C$557 and C$690 million per year over the crop years 1985/86-1993/94).

The second "pillar" of CWB operations is the benefits of association with the federal government. This association provides two sources of benefits to farmers. First, the government guarantees the initial payment. Both Kraft et al. and Carter and Loyns arrived at a value of C$2.50 per tonne (just under C$50 million per year) as the value of the guarantee over the 1980/81 to 1993/94 period. This is a simple transfer from the federal government to farmers, almost all of which occurred in the 1990/91 crop year.

Estimated costs and benefits associated with the CWB have been taken from previous studies and are summarized in Table 3.2. Results of a risk model (Simonot, 1997) determined that farmer self-insurance through the CWB is an advantage when compared to non-board commodities. Producers retain these risk premiums by marketing their wheat through the CWB. Government underwriting of initial payments also absorbed some of the price risk facing farmers. The value of this benefit was estimated at C$3.90 per tonne for the 1980/81 to 1993/94 period. An additional C$2.13 per tonne is attributable to self-insuring through the withholding of the final payment.

Table 3.2. Summary of CWB Benefits and Costs for the Wheat Pool Account (1980/81- 1993/94)

	Total per tonne	Total per bushel
BENEFITS		
SDS average[1]	$13.35	$0.360
Initial payment guarantee[2]	$2.50	$0.068
Guaranteed borrowing[3]	$1.35	$0.037
Risk-bearing: government[4]	$3.90	$0.106
Risk-bearing: farmers[5]	$2.13	$0.058
Total Benefits	**$23.23**	**$0.629**
COSTS[6]		
Carrying charges	$5.02	$0.1365
Demurrage/dispatch	$0.19	$0.0051
Additional freight	$0.74	$0.0202
Drying	$0.14	$0.0038
Administration	$1.10	$0.0300
Pool deficits	$2.50	$0.0680
Taxpayer risk	$3.90	$0.1060
Total Costs	**$13.59**	**$0.3700**
NET BENEFITS	**$9.64**	**$0.2600**

Sources: Estimates by Kraft et al., 1996, Carter and Loyns, 1996, Simonot, 1997
(Costs based on CWB Annual Reports, 1980/81 to 1993/94)

[1]Kraft et al., pp. 50-51.
[2]Simonot, pp. 37-38.
[3]Simonot, p. 39.
[4]Simonot, pp. 99-100.
[5]Simonot, pp. 99-100.
[6]Simonot, pp. 40-42.

The CWB was shown by Kraft et al. (1996) to provide substantial benefits through single-desk selling. The value of this benefit was calculated to be at least C$13.35 per tonne, and may have averaged C$27.80 per tonne during the years when EEP was active. (We use the lower figure in this analysis.) The transfer of C$2.50 per tonne from taxpayers to farmers in western Canada due to pool account deficits was another benefit over this period. Lastly, government guarantees on CWB borrowing provided an additional savings on interest costs of approximately C$1.35 per tonne.

The costs associated with CWB operations include carrying charges, demurrage, additional freight, drying, and administration. These costs are listed in Table 3.2. These costs would not disappear in the absence of the CWB, but it has been argued that they are larger with the CWB than they would be without the CWB due to inefficiencies. These costs sum to C$7.19

per tonne over the period studied. The transfer of C$2.50 per tonne for pool deficits has been counted as a cost to taxpayers. The cost of taxpayer risk has been included at C$3.90 per tonne to recognize that government risk absorption imposes costs on taxpayers. This amount most likely overstates the true cost since the government has a greater capacity to bear risk than an individual grain company. The costs total to C$13.59 per tonne over the 1980/81 to 1993/94 period.

The federal government association amounts to a farmer benefit of C$7.75/tonne (C$3.90 risk-bearing plus C$2.50 deficit transfers plus C$1.35 interest savings) and a taxpayer cost of C$6.40/tonne (only C$2.50/tonne out-of-pocket for deficits, plus C$3.90 imputed for risk-bearing) assuming the government cannot diversify any better than any of the grain companies. The actual C$2.50 per tonne transfer due to pool account deficits is significant, but less than one-third the total benefit. Government absorption of risk and access to debt at government rates are more important benefits. Farmer self-insurance through the CWB allows farmers to capture an additional C$2.13 per tonne that would otherwise be demanded by grain companies as a risk premium. Single-desk selling is the most important source of CWB benefits.

The total benefits of the CWB, including SDS, pool account deficit transfers, guaranteed borrowing, and risk management sum to C$23.23/tonne over the 1980/81 to 1993/94 period. This amount is based on conservative estimates for each source of benefit. Total costs sum to C$13.59/tonne. These costs may be overstated since the operational costs that were examined also appear in the basis of open market crops. The value of C$3.90 per tonne to acknowledge taxpayer risk is also an overestimate of the actual cost of risk-bearing. Subtracting the costs from the benefits leaves a net benefit of C$9.64/tonne. By these calculations, the benefits of CWB operations outweigh the costs by approximately 1.7 to 1.

These numbers suggest that the CWB does provide net benefits to Canadian farmers. The net benefit of approximately C$9.64/tonne (or C$0.26 per bushel) for the 1980/81 to 1993/94 period includes the three pillars of single-desk selling, government association, and risk management through pooling, self-insurance and government underwriting. These are net benefits after accounting for costs related to CWB operations and taxpayer costs of government association.

4. The Theory of Pooling and Development of an Empirical Model

The Theory of a Market Pool

A marketing pool is similar to a cartel that must deal with competitive fringe suppliers. Those who do not participate in the pool are fringe suppliers. They stand to gain if the pool succeeds in raising the market price, but incur none of the costs of participation; this makes them 'free-riders'. This is illustrated in Figure 4.1. Suppose D is the demand schedule for a single time period and S_p is the supply schedule of pool members. Given the supply of the competitive fringe members (schedule S_{np}), the excess demand curve ED facing pool members can be drawn. MR is the marginal revenue associated with ED. The pool will equate MR with the supply curve S_p and charge price P_1 to maximize its profit. At this price the pool's supply is $0Q_1$ and fringe suppliers will sell $Q_1 Q_2$. The price for the fringe suppliers is $P_{1,}$ which is higher than in the absence of a pool. Without the pool, the fringe would only receive price $P_{f.}$

Fringe suppliers can increase returns by pricing at the pool price P_1. At the free-trade price P_f, the fringe suppliers sell Q_3Q_4 while the pool sells $0Q_3$. Fringe suppliers gain proportionally more from the pool than do pool members; this is mainly because the fringe suppliers increase output at the higher price, while members reduce output. The fringe suppliers' revenue increases from area ehQ_4Q_3 to area fgQ_2Q_1, indicating that fringe suppliers are better off under the pool. The pool's revenue changes from area P_feQ_30 to area P_1fQ_10. If ED is inelastic, the revenue under the pool is larger than that under a competitive market.

Assume that demand for a product in a market is a function of the price of the product as follows:

$$Q_d = \beta_1 - \beta_2 P, \tag{1}$$

and supply of the product in the market is

$$Q_s = h_1 + h_2 P.$$

where Q_d is the quantity of the product purchased in the market, Q_s is the quantity supplied to the market, and P is the price of the product. (2)

In a competitive market, the equilibrium quantity and price are determined by equating demand for the product with supply as

$$P^* = \frac{\beta_1 - h_1}{h_2 + \beta_2} \quad \text{and} \tag{3}$$

$$Q^* = \beta_1 - \beta_2\left((\beta_1 - h_1)/(h_2 + \beta_2)\right) . \tag{4}$$

where P* is the equilibrium price of the product and Q* is the equilibrium quantity.

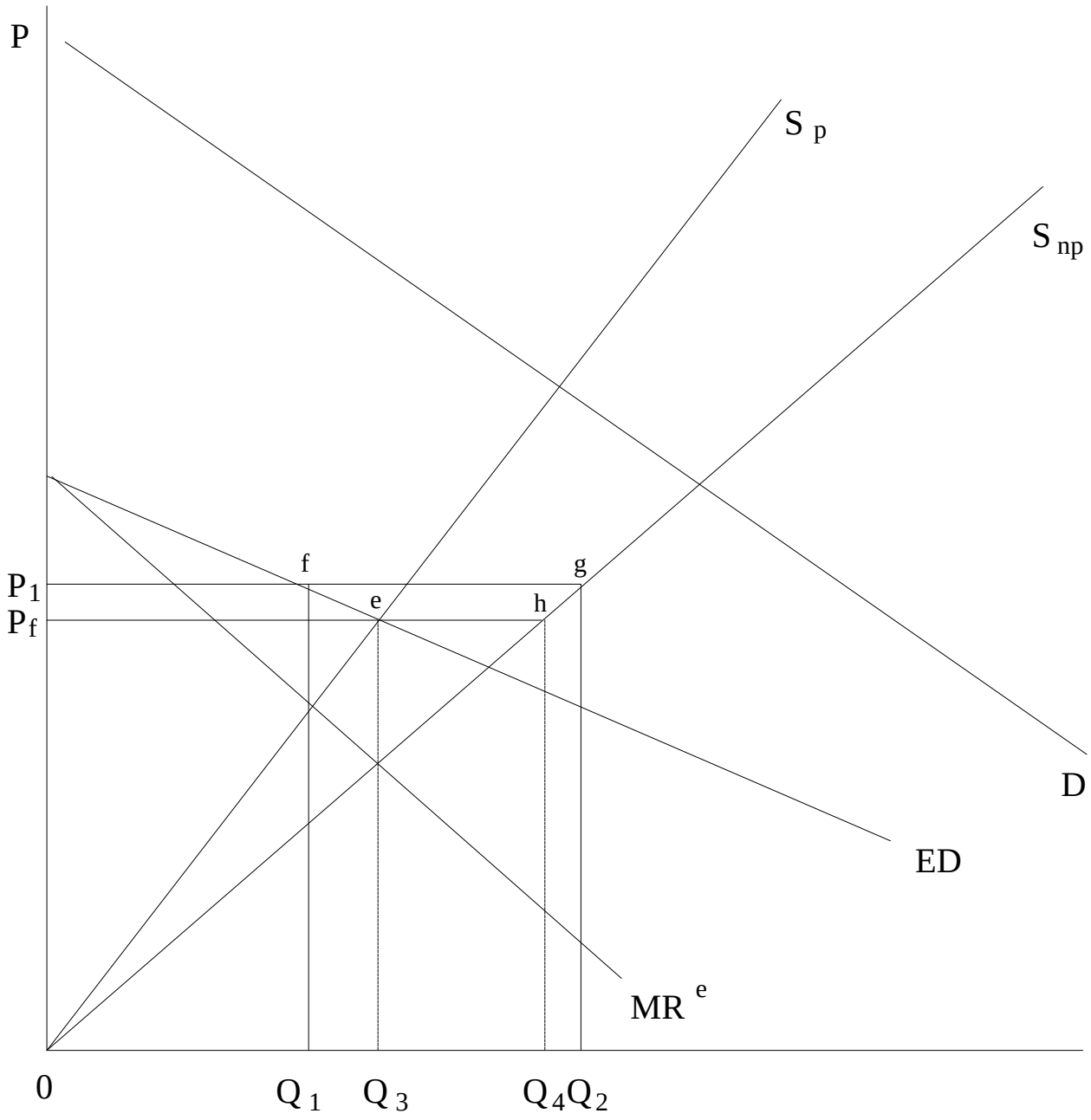


Figure 4.1. Relationship Between Pool Supplier and Competitive Fringe

When some of the suppliers form a pool, the supply of the product is divided into supply of the product by pool participants and that by non-participants. The purpose of the pool is to maximize the pool's net revenue by raising the price of product in its domestic market. (In the next section, we expand the analysis to consider both domestic and foreign markets.) Under the operation of the pool, the non-participants supply their commodities at the price set by the pool. Supplies of products by the participants (Q_s^P) and non-participants (Q_s^{NP}) are shown in Equations 5 and 6, respectively, as follows:

$$Q_s^P = \alpha_1 + \alpha_2 P \tag{5}$$

$$Q_s^{NP} = \gamma_1 + \gamma_2 P \tag{6}$$

where the total supply is equal to the sum of the quantity supplied by the participants (Q_s^P) and the quantity supplied by non-participants (Q_s^{NP}).

The pool faces the demand not satisfied by non-participants. Thus, the excess demand facing the pool is obtained by subtracting Equation 6 from Equation 1 as

$$Q_e = Q_d - Q_{NP} = (\beta_1 - \gamma_1) - (\beta_2 + \gamma_2)P \tag{7}$$

where Q_e is excess demand for the product.

Inverse excess demand for the product is

$$P = \frac{\beta_1 - \gamma_1}{\beta_2 + \gamma_2} - \frac{1}{\beta_2 + \gamma_2} Q_e \tag{8}$$

$$= \lambda_1 - \lambda_2 Q_e$$

where

$$\lambda_1 = \frac{\beta_1 - \gamma_1}{\beta_2 + \gamma_2} \text{ and } \lambda_2 = \frac{1}{\beta_2 + \gamma_2}.$$

The pool's total revenue is calculated by multiplying the total quantity demanded by the price as

$$TR = P \cdot Q_e = (\lambda_1 - \lambda_2 Q_e)\, Q_e. \tag{9}$$

The pool's marginal revenue is calculated by differentiating the total revenue equation with respect to the quantity demanded as follows:

$$MR = \frac{\partial TR}{\partial Q_e} = \lambda_1 - 2\lambda_2 Q_e \quad . \tag{10}$$

The pool determines the quantity of the product supplied by equating marginal revenue (Equation 10) with marginal cost (Equation 5). The pool's marginal cost function is the same as its supply function. Thus, inverse supply equation from Equation 5 is

$$P = -\frac{\alpha_1}{\alpha_2} = \frac{1}{\alpha_2}Q_s^P = -\delta_1 + \delta_2 Q_s^P \tag{11}$$

Then the quantity of wheat supplied by the pool is obtained by equating Equation 11 with Equation 10 as follows;

$$Q^m = \frac{\lambda_1 + \delta_1}{\delta_2 + 2\lambda_2} \tag{12}$$

The price of wheat received by the pool is obtained from the excess demand equation (Equation 8) as

$$\begin{aligned} P^m &= \frac{\beta_1 - \gamma_1}{\beta_2 + \gamma_2} - \frac{1}{\beta_2 + \gamma_2}Q^m \\ &= \frac{\beta_1 - \gamma_1}{\beta_2 + \gamma_2} - \frac{1}{\beta_2 + \gamma_2}\left(\frac{\lambda_1 + \delta_1}{\delta_2 + 2\lambda_2}\right) \end{aligned} \tag{13}$$

Thus, the pool's total revenue is

$$TR^P = Q^m \cdot P^m \tag{14}$$

where the quantity supplied under the pool (Q^m) is smaller than the quantity supplied under competitive market conditions (Q*), but the price of the product under the pool (P^m)is higher than that under competitive market conditions (P*).

If the percentage change in Q^m is larger than that in P^m, the pool's revenue is smaller than under competitive market conditions. However, if percentage change in Q^m is smaller than in P^m, the pool's revenue is larger. This implies that the pool must face an inelastic demand schedule to increase its revenue by restricting supply.

The total revenue of the non-participants (TR^{NP}) is

$$TR^{NP} = P^m Q_s^{NP} = P^m(\gamma_1 + \gamma_2 P^m) \tag{15}$$

Since the price of the product under the pool (P^m) is higher than that under competitive market conditions (P*), the quantity of wheat supplied by non-participants increases in Equation 6 and the total revenue for the non-participants also increases when the pool maximizes its revenue by equating MR with MC. This implies that both participants and non-participants are able to increase their revenue.

The quantity of the product supplied by non-participants Q_s^{NP} depends upon the price elasticity of supply. If the price elasticity of supply is elastic (>1), and the price elasticity for the non-participants is larger than that for the participants, supply by the non-participants increases

and that by the pool decreases, resulting in a decrease in the pool's revenue. If the price elasticity of supply is inelastic (<1) and the price elasticity for the non-participants is smaller than that for the participants, increases in supply by non-participants may not significantly affect the operation of the pool.

Development of an Empirical Model

An empirical model was developed on the basis of the theory described above. Wheat is divided into HRS and durum wheat. Because their supply and demand relationships are quite different, two empirical models are developed: one for durum wheat and the other for HRS wheat.

Pooling alternatives considered in this study are (1) North Dakota pool and (2) a joint North Dakota and Canada pool. Since the proposed pool is based on a voluntary participation, the model allows the existence of competitive fringe suppliers. In the case of the ND pool, fringe suppliers are non-participants in North Dakota, producers in the other states of the United States, Canadian producers, and suppliers in the rest of world, including the EU. In the joint pool scenario, fringe suppliers are non-participants in North Dakota, producers in other states of the United States, and the rest of world.

Assumptions introduced in developing the models are

1. The U.S. domestic market is separated from the world market by relatively high costs of shipping wheat between the United States and the rest of world. (In effect, in absence of trade restrictions, shipping costs put a limit on price differences between different regions of the world.)

2. The pool can exert market power (raising price) in the domestic market, but faces a competitive world market.

3. Substitution between durum wheat and other wheats is almost nil (substitution elasticity is 0), while substitution between HRS and HRW wheat is almost perfect (substitution elasticity is 2).

Two market power models are developed; one for a ND Wheat Pool model and the other for a joint ND/Canada Wheat Pool.

ND Wheat Pool Model

This is a voluntary pool without any cooperation with the CWB. In this case, the pool's market share in the U.S. domestic market is assumed to range between 30 percent to 60 percent of U.S. domestic consumption.

Assume that a group of farmers, who decide to participate in the pool, supply Q^c units of wheat to the domestic market and export X^c units at a market price of P^w before operation of the pool. The total revenue is calculated as

$$TR^c = (Q^c + X^c)\, P^w \tag{16}$$

After forming the pool, the pool determines the quantity of wheat supplied by equating its MR with MC as shown in Equation 12. In this case, the quantity of wheat supplied by the pool (Q^m) is smaller than that supplied under a competitive condition (Q^c). As a result, the pool can set the domestic price higher than the world price. Assuming that the United States exports the additional surplus of wheat ($Q^c - Q^m$) to the world market, the world price of wheat will be reduced on the basis of the world import demand equation for wheat as follows:

$$P^{wp} = a_0 - a_1(X^c + CX^c) \tag{17}$$

where P^{wp} is the world price of wheat under the pool operation and CX^c is changes in exports of wheat under the pool operation.

The pool's revenue from the world market is raised by $(Q^c - Q^m)\, P^{wp}$. The total revenue for the pool is the sum of the revenue from domestic market (TR^d) and that from the world market (TR^W) as

$$TR^p = TR^d + TR^w \tag{18}$$

This is also expressed as

$$TR^p = Q^m P^d + X^c P^{wp} + (Q^c - Q^m)\, P^{wp} \tag{19}$$

where TR^d = the pool's revenue from the U.S. domestic market
TR^w = the pool's revenue from the world market (export revenue)
X^c = the quantity of wheat exported before forming the pool

The first term in the right hand side of the equation represents the pool's revenue from the U.S. domestic market and the second and third terms represent the pool's revenue from the world market.

Change in total revenue after joining the pool is given by

$$\begin{aligned} CTR = TR^p - TR^c &= Q^m P^d + X^c P^{wp} + (Q^c - Q^m)\, P^{wp} - (Q^c + X^c)P^w \\ &= Q^m P^d - Q^c P^w + (Q^c - Q^m)P^{wp} + (P^{wp} - P^w)X^c \end{aligned} \tag{20}$$

<u>Joint U.S./Canada Wheat Pool Model</u>

If the CWB cooperates with the pool, Canada's domestic price is the same as the U.S. domestic price of wheat under the pool operation. This implies that the CWB sells its wheat to Canadian domestic millers at the U.S. domestic price. Since the CWB is a mandatory pool, there

are no free riders in Canada and the CWB supplies the total quantity of wheat demanded by Canadian mills. Canadian domestic demand is given by

$$Q^{cd} = b_1 - b_1 P^d. \tag{21}$$

where Q^{cd} is the quantity of wheat demanded by mills in Canada.

The pool also allows the CWB to export a certain quantity of wheat to the U.S. market. In this case, Canada's exports to the United States decrease at the same percentage as the pool's percentage reduction in the U.S. market or is determined through negotiation between the pool and the CWB. The CWB's revenue before joining the pool is

$$TR^{cc} = (Q^{cc} + X^{cc})P^w + X^{c\,us}P^w. \tag{22}$$

where TR^{cc}= the CWB's revenue under a competitive market condition
Q^{cc} = the CWB's supply of wheat to Canadian mills
X^{cc} = the CWB's exports of wheat to off-shore markets
$X^{c\,us}$ = the CWB's exports to the U.S. markets

Under a joint pool the CWB supply Q^{cm} to its mills at the pool price P^d. Since the pool price is higher than the competitive price, Q^{cm} is smaller than Q^{cc}. It is assumed that the CWB exports additional surplus (Q^{cc}-Q^{cm}) to the world market. The CWB also exports wheat to the United States. This export volume may be different than that under the competitive market condition.

The CWB's revenue under the pool operation is

$$TR^{cp} = Q^{cm} P^d + X^{cc} P^{wp} + (Q^{cc} - Q^{cm})P^{wp} + X^{cp\,us} P^d$$

where Q^{cm} = the quantity of wheat demanded by Canadian mills at the pool price
$X^{cp\,us}$ = the CWB's exports of wheat to the United States under the pool operation

Change in total revenue is

$$CTR^c = TR^{cp} - TR^{cc}$$
$$= Q^{cm} (P^d - P^{wp}) + X^{cc} (P^{wp} - P^w) + Q^{cc}(P^{wp} - P^w) + X^{cp\,us}P^d - X^{c\,us}P^w \tag{23}$$

<u>Data for the Market Power Model and Alternative Scenarios</u>

Price elasticities of demand are estimated to be -0.15 for hard wheat and -0.1 for durum wheat. Durum wheat demand is more inelastic than hard wheat demand because of more limited substitution possibilities. The price elasticity of HRS wheat is calculated from the price elasticity of hard wheat and the substitution elasticity by using the following formula (Armington):

$$e_{ii} = S_i\, e - (1 - S_i)\, \eta \tag{24}$$

where e_{ii} is the price elasticity of demand for HRS wheat, e is the price elasticity of demand for hard wheat, S_i is market share of spring wheat in the hard wheat market, and η is substitution elasticity between HRS and winter wheat.

The calculated price elasticity of demand for HRS wheat is -1.58, which is much larger than the price elasticity of demand for durum wheat.

On the supply side, price elasticities of supply of durum wheat are estimated to be 0.86 in North Dakota and 0.98 for other regions in the United States. However, price elasticities of supply of spring wheat are 0.3 for North Dakota and other regions of the United States.

North Dakota produces about 85 percent of durum wheat produced in the United States and North Dakota supplies over 65 percent of durum wheat consumed in the United States. Canadian exports of durum wheat in the last 5 years have represented about 15 percent of U.S. domestic consumption. Therefore, North Dakota and Canada supply over 85 percent of durum wheat consumed in the United States. The remaining portion is supplied by other regions in the United States, mainly Montana, Arizona, and California.

North Dakota produces about 50 percent of U.S. HRS production but about 10 percent of hard wheat produced in the United States. North Dakota's market share in the U.S. hard wheat industry is less than 10 percent. North Dakota and Canada together supply about 15 percent of hard wheat consumed in the United States.

This analysis is based on four scenarios. They are: (1) the competitive market scenario; (2) an unlimited quantity restriction scenario, in which the quantity of wheat is restricted at the level where MR=MC; (3) the 10 percent reduction scenario, in which the quantity of wheat supplied is reduced by 10 percent; and (4) the 15 percent reduction scenario, in which the quantity of wheat is reduced by 15 percent.

5. Market Power and Implications for Farm Revenue

Durum Wheat Pool

North Dakota Durum Wheat Pool

Table 5.1 shows the quantities and prices of durum wheat under competitive and alternative pool scenarios, and with various levels of market share for the pool. Alternative market shares are considered in order to show the sensitivity of results to this key parameter. The pool's market share is allowed to range between 60 percent and 30 percent of U.S. domestic consumption. Currently, North Dakota supplies about 60 percent of domestic durum wheat consumption. Under the competitive market scenario, the quantity of durum wheat supplied by North Dakota is 49.55 million bushels at a market price of $3.50 per bushel, given a 60 percent market share, and 24.96 million bushels given a 30 percent market share. Total revenue under the competitive market scenario is the product of the quantity supplied and price. The revenue from domestic sales ranges between $173.4 million (given a 60 percent market share) and $86.7 million (given a 30 percent market share). Total revenue, including revenue from the world market, is $264.4 million with a 60 percent market share and $132.2 million with a 30 percent market share.

Under the unlimited quantity reduction scenario, the pool is allowed to reduce the quantity supplied to the level where MR=MC, and pool revenue is maximized. Given a 60 percent market share, the pool reduces its supply of durum wheat from 49.55 million bushels to 32.66 million bushels to obtain domestic revenue of $162.65 million. The price of durum wheat increases from $3.50 per bushel to $4.98 per bushel under this scenario. The remaining durum wheat (49.55-32.66) is sold in the world market at the competitive market price, which is determined by external demand and supply conditions. The world price decreases from $3.50 per bushel to $3.46, as the pool increases the supply of durum wheat in the world market. Revenue from durum wheat exports is $147.99 million (=(49.50-32.64)*3.46) under the 60 percent market share case. Total revenue is $310.64 million, which is the sum of the revenue from domestic sales ($162.65 million) and revenue from the world market ($148.0 million). The increase in total revenue under this scenario, relative to the competitive scenario, is $46.29 million ($10.7 million reduction in the value of domestic sales and $57.0 increase in export sales).

Total revenue decreases as the pool's market share declines. For a 30 percent market share, total revenue is only $137.4 million; this represents an increase of $5.2 million relative to the competitive market scenario ($11.9 million reduction in the value of domestic sales, and $17.1 million increase in export sales). Note that the revenue from domestic sales is smaller than under the competitive market scenario. Increases in total revenue, however, are positive because increases in revenue from the world market more than offset the lost domestic revenue.

It should be noted that fringe suppliers enjoy higher revenues, compared to the competitive market scenario, in all market share cases. A higher market price (caused by pool supply reductions) induces a supply expansion by the competitive fringe.

Under the 10 percent reduction scenario, the pool's supply is 10 percent lower than the competitive market supply. The pool supply is larger than under the unlimited quantity reduction scenario, but prices are much lower. As a result, increases in total revenue under this scenario are smaller than those under the unlimited quantity reduction scenario. Increases in total revenue under this scenario (relative to the competitive market scenario) range from $18.9 million (assuming a 60 percent market share) to $2.9 million (assuming a 30 percent market share).

Table 5.1. The Quantities and Prices of Durum Wheat Under Competitive Market and Alternative North Dakota Pool Options

	Market Share						
	0.6	**0.55**	**0.5**	**0.45**	**0.4**	**0.35**	**0.3**
Competitive Market							
Quantity Supplied by Pool (million bu)	49.55	45.51	41.47	37.07	33.03	28.99	24.96
World Price ($/bu)	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Domestic Sales Revenue ($ million)	173.41	158.96	144.51	130.06	115.61	101.15	86.70
Export Sales ($ million)	90.94	83.36	75.79	68.21	60.63	53.05	45.47
Total Revenue ($ million)	264.35	242.32	220.30	198.27	176.24	154.20	132.17
Unlimited Quantity Reduction Scenario							
Quantity Supplied to Domestic Market	32.66	30.83	28.99	26.79	24.59	22.39	19.82
Price Set by Pool	4.98	4.66	4.40	4.19	4.02	3.88	3.77
Domestic Sales Revenue	162.65	143.85	127.45	112.78	99.35	86.77	74.73
Export Sales Revenue	147.99	132.85	117.98	103.47	89.37	75.75	62.69
Total Revenue	310.64	276.70	245.43	216.24	188.72	162.53	137.42
Changes in TR	46.29	34.38	25.14	17.98	12.48	8.32	5.24
10% Reduction Scenario							
Quantity Supplied to Domestic Market	44.77	40.74	37.07	33.40	29.73	26.06	22.39
Price Set by Pool	3.93	3.86	3.80	3.75	3.71	3.67	3.64
Domestic Sales Revenue	175.41	157.85	141.27	125.44	110.20	95.44	81.07
Export Sales Revenue	107.87	98.94	89.99	81.03	72.06	63.07	54.08
Total Revenue	283.28	256.79	231.26	206.47	182.26	158.51	135.14
Changes in TR	18.93	14.47	10.97	8.21	6.02	4.31	2.97
15% Reduction Scenario							
Quantity Supplied to Domestic Market	42.21	38.54	35.23	31.56	28.26	24.59	20.92
Price Set by Pool	4.15	4.04	3.95	3.88	3.81	3.75	3.70
Domestic Sales Revenue	174.80	156.07	138.71	122.43	106.99	92.22	77.99
Export Sales Revenue	116.28	106.69	97.07	87.42	77.75	68.07	58.37
Total Revenue	291.08	262.76	235.78	209.85	184.74	160.28	136.36
Changes in TR	26.73	20.43	15.49	11.59	8.51	6.08	4.19

Under the 15 percent reduction scenario, the pool supply is 15 percent lower than the competitive market supply. Increases in the total revenue under this scenario, relative to the competitive scenario, range from $26.7 million (with a 60 percent market share) to $4.2 million (with a 30 percent market share).

Figure 5.1 shows changes in the total revenue from durum wheat marketing under alternative pooling scenarios. Changes in domestic sales revenue (relative to the competitive scenario) are negative. However increases in total revenue are positive, because the revenues from the world market are large enough to offset the lost domestic sales revenue.

The pool's share of the higher-priced domestic market depends on Canadian exports to the United States. If Canada supplies unlimited quantities of durum wheat to the United States, the pool cannot increase the price of durum wheat by restricting its supply. If the price of durum wheat in the United States is higher than that in Canada, Canada will continue to supply durum wheat to the United States until the U.S. domestic price (net of transportation costs) equals that in Canada. This implies that the ND durum wheat pool may not be able to raise the domestic price effectively unless the pool has strong cooperation from the Canadian Wheat Board.

Joint U.S./Canada Durum Wheat Pool

In the case that the United States and Canada jointly supply durum wheat to the U.S. market, their supply would be equivalent to about 95 percent of consumption. The pool's market share considered in this case ranges between 95 percent and 65 percent of U.S. consumption (Table 5.2).

Under the competitive market scenario, both countries supply 78.54 million bushels at the market price of $3.50, resulting in total domestic sales revenue of $274.56 million, given a 95 percent market share. The revenues decrease with the decreased joint market share. Given a market share of 65 percent, domestic sales revenue is $187.86 million. Total revenue, including revenue from the world market, ranges between $404.2 million with a 95 percent market share and $276.5 million with a 65 percent market share.

Under the unlimited quantity reduction scenario, the quantity of durum wheat supplied by the pool is reduced substantially from 78.54 million bushels under the competitive scenario to 42.57 million bushels. However, the domestic price in this scenario is much higher than that under the competitive scenario, resulting in larger revenue for the pool. Total revenue under this scenario could reach $798.44 million (given a 95 percent market share), which is the sum of domestic sales revenue ($586.2) and export sales revenue ($212.2). Given a 65 percent market share, total revenue would be $330.8 million. Changes in total revenue (relative to the competitive scenario) range from $394.29 million (given a 95 percent market share) to $54.3 million (given a 65 percent market share). Under this scenario, the domestic price of durum wheat set by the pool in the North American market is much higher than under the competitive scenario -- $10.31 per bushel higher, given a 95 percent market share and $1.88 per bushel higher, given a 65 percent market share. However, the pool cannot raise the domestic price so high that it induces imports from third parties. If the domestic price exceeds the world price by more than the transportation costs plus handling charges at ports, other exporting countries could export to the United States and the domestic price would decrease.

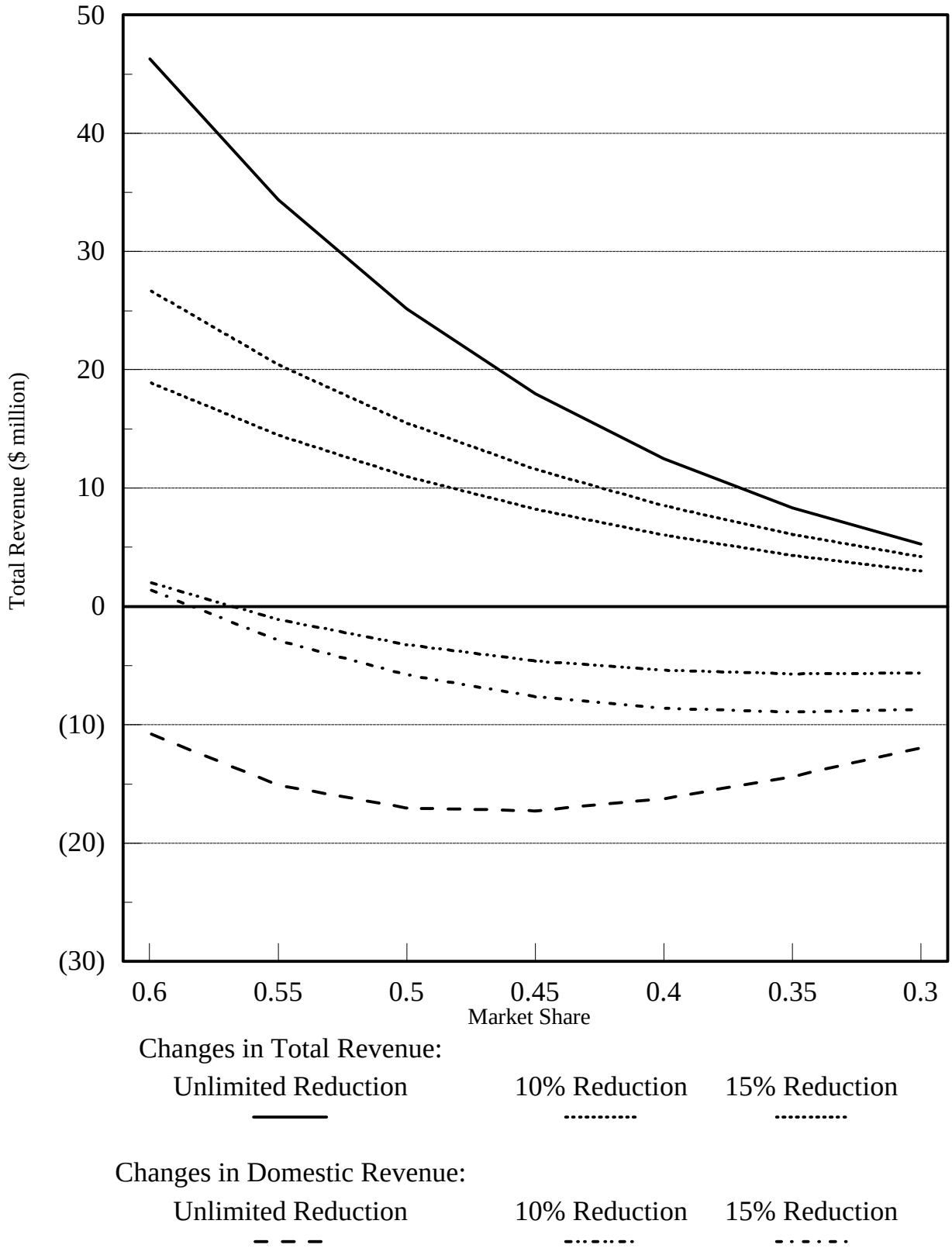


Figure 5.1 Changes in Total Revenue for Durum Wheat Under Alternative North Dakota Pool Options

Table 5.2. The Quantities and Prices of Durum Wheat Under Competitive Market and Joint U.S./Canada Pool Options

	Market Share						
	0.95	**0.90**	**0.85**	**0.8**	**0.75**	**0.7**	**0.65**
Competitive Market							
Quantity Supplied to Domestic Market (million bu)	78.54	74.50	43.67	66.06	62.02	57.99	53.58
World Price ($/bu)	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Domestic Sales Revenue ($ million)	274.56	260.11	245.66	231.21	216.76	202.31	187.86
Export Sales ($ million)	129.59	122.77	115.95	109.13	102.31	95.49	88.67
Total Revenue ($ million)	404.15	382.88	361.61	340.34	319.07	297.80	276.53
Unlimited Quantity Reduction Scenario							
Quantity Supplied to Domestic Market	42.57	41.47	40.00	38.90	37.43	35.97	34.50
Price Set by Pool	13.80	10.63	8.72	7.46	6.56	5.89	5.38
Domestic Sales Revenue	586.24	439.50	349.97	289.35	245.32	211.64	184.79
Export Sales Revenue	212.20	206.84	197.18	185.50	172.77	159.52	146.04
Total Revenue	798.44	646.33	547.15	474.85	418.10	371.16	330.83
Changes in TR	394.29	263.46	185.54	134.52	99.03	73.36	54.30
10% Reduction Scenario							
Quantity Supplied to Domestic Market	70.46	66.79	63.12	59.45	55.78	52.11	48.44
Price Set by Pool	5.75	5.11	4.72	4.46	4.27	4.13	4.02
Domestic Sales Revenue	405.72	341.60	298.12	265.10	238.12	214.93	194.28
Export Sales Revenue	150.05	143.30	135.99	128.41	120.66	112.81	104.90
Total Revenue	555.77	484.89	434.11	393.51	358.78	327.74	299.17
Changes in TR	151.62	102.01	72.50	53.17	39.71	29.95	22.65
15% Reduction Scenario							
Quantity Supplied to Domestic Market	66.79	63.12	59.82	56.15	52.48	49.18	45.51
Price Set by Pool	6.87	5.91	5.33	4.94	4.66	4.45	4.28
Domestic Sales Revenue	458.08	373.38	317.92	277.29	245.21	218.50	195.39
Export Sales Revenue	159.77	153.21	145.77	137.86	129.70	121.37	112.93
Total Revenue	617.85	526.59	463.69	415.16	374.91	339.87	308.32
Changes in TR	213.70	143.71	102.08	74.82	55.84	42.07	31.79

Under the 10 percent reduction scenario, the pool supplies a larger quantity at lower prices, relative to the unlimited quantity reduction scenario; this results in smaller revenues. Total revenue from domestic sales ranges from $405.7 million (given a 95 percent market share) to $194.3 million (given a 65 percent market share). Export revenues range from $150.05 million (given a 95 percent market share) to $104.9 million (given a 65 percent market share). Increases in total revenue under this scenario, compared with the competitive market scenario, range between $151.6 million (given a 95 percent market share) and $22.7 million (given a 65 percent market share).

Results under the 15 percent reduction scenario are similar to those for the 10 percent reduction scenario. Total revenue under this scenario is larger than under the 10 percent reduction scenario because of higher domestic prices. Total revenue ranges between $617.9 million (95 percent market share) and $308.3 million (65 percent market share). Increases in total revenue under this scenario, relative to the competitive market scenario, range between $213.7 million (95 percent market share) and $31.8 million (65 percent market share).

Changes in total revenue also are shown in Figure 5.2. Unlike the ND Wheat Pool, changes in domestic revenue are positive for all levels of market share considered (65 percent to 95 percent).

Currently, producers in the United States and Canada supply about 95 percent of durum wheat consumed in the North American market. However, the joint pool's market share may be smaller than the current market share, because producers in the other states (and possibly overseas) may expand production in response to higher prices in the North American market.

Benefits for the Canadian Durum Wheat Producers

The CWB will get the pool price for its domestic supply of durum wheat and its exports to the United States under the joint pool scenario. Canadian domestic demand for durum wheat will decrease slightly because of a higher domestic price. The price elasticity of domestic demand is relatively low (-0.1). The CWB's exports to the United States are assumed to decrease in line with supply reductions by U.S. pool members as determined by negotiation between the CWB and the pool. It is assumed that the CWB simultaneously increases its exports to the world market.

Table 5.3. shows increases in the CWB's revenue from durum wheat under alternative levels of exports to the United States and pool prices. Canadian exports to the United States are set at 100 percent, 90 percent, 80 percent, 70 percent, and 60 percent of average levels for the last five years. Alternative pool prices considered are $5.00, $4.60, $4.30, and $4.00 per bushel for durum wheat. The second column represents Canada's domestic demand, exports, and sales revenue under competitive conditions. The remaining columns represent Canada's domestic demand, exports, and sales revenue from alternative exports to the United States. If pool price is set at $5.00 per bushel, Canada's domestic demand decreases from 31.17 million bushels to 29.83 million bushels and its exports to the world market increase compared to that of the competitive scenario. World prices also change based on an import demand elasticity of -1.2.

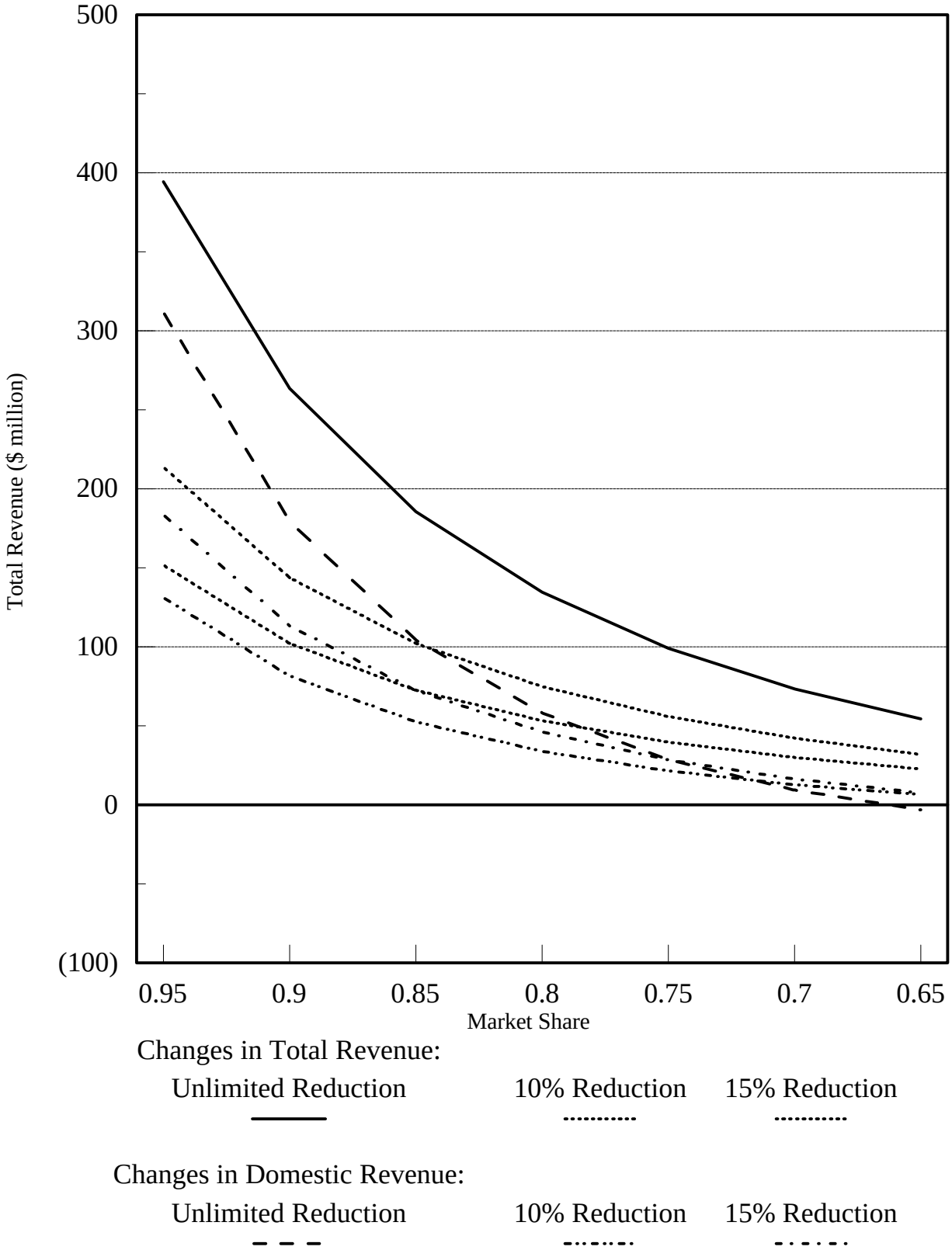


Figure 5.2 Changes in Total Revenue for Durum Wheat Under Alternative Joint U.S./Canada Pool Options

Table 5.3. Increases in Canadian Revenue from the Durum Wheat Pool

		Percent of Average Export (1993-1997				
	5 Year Average	**100%**	**90%**	**80%**	**70%**	**60%**
Pool Price = $5.00						
Domestic Demand (million bu.)	31.17	29.83	29.83	29.83	29.83	29.83
Export to World (million bu.)	127.61	128.95	130.27	131.59	132.91	134.23
Export to U.S. (million bu.)	13.20	13.20	11.88	10.56	9.24	7.92
World Price ($/bu.)	3.50	3.47	3.47	3.47	3.47	3.47
Total Revenue ($million)	601.93	662.54	660.61	658.63	656.65	654.67
Export Sales Revenue ($ million)	492.84	513.37	511.44	509.46	507.48	505.50
Domestic Sales Revenue ($ million)	109.10	149.17	149.17	149.17	149.17	149.17
Changes in Total Revenue ($million)	--	60.61	58.68	56.70	54.72	52.74
Pool Price = $4.60						
Domestic Demand (million bu.)	31.17	30.19	30.19	30.19	30.19	30.19
Export to World (million bu.)	127.61	128.59	129.91	131.23	132.55	133.87
Export to U.S. (million bu.)	13.20	13.20	11.88	10.56	9.24	7.92
World Price ($/bu.)	3.50	3.48	3.47	3.47	3.47	3.47
Total Revenue ($ million)	601.93	646.78	644.32	642.87	641.41	639.96
Export Sales Revenue ($ million)	492.84	507.90	505.44	503.99	502.54	501.09
Domestic Sales Revenue ($ million)	109.10	138.88	138.88	138.88	138.88	138.88
Changes in Total Revenue ($ million)	--	44.85	42.39	40.94	39.48	38.03
Pool Price = $4.30						
Domestic Demand (million bu.)	31.17	30.46	30.46	30.46	30.46	30.46
Export to World (million bu.)	127.61	128.32	129.64	130.96	132.28	133.60
Export to U.S. (million bu.)	13.20	13.20	11.88	10.56	9.24	7.92
World Price ($/bu)	3.50	3.48	3.47	3.47	3.47	3.47
Total Revenue ($ million)	601.93	634.77	631.91	630.85	629.80	628.74
Export Sales Revenue ($ million)	492.84	503.80	500.94	499.89	498.83	497.78
Domestic Sales Revenue ($million)	109.10	130.97	130.97	130.97	130.97	130.97
Changes in Total Revenue ($ million)	--	32.84	29.98	28.92	27.87	26.81
Pool Price = $4.00						
Domestic Demand (million bu.)	31.17	30.72	30.72	30.72	30.72	30.72
Export to World (million bu.)	127.61	128.06	129.38	130.70	132.02	133.34
Export to U.S. (million bu.)	13.20	13.20	11.88	10.56	9.24	7.92
World Price ($/bu)	3.50	3.49	3.47	3.47	3.47	3.47
Total Revenue ($ million $)	601.93	622.59	619.34	618.68	618.02	617.36
Export Sales Revenue ($ million)	492.84	499.69	496.44	495.78	495.12	494.47
Domestic Sales Revenue ($ million)	109.10	122.90	122.90	122.90	122.90	122.90
Changes in Total Revenue ($ million)	--	20.66	17.41	16.75	16.09	15.43

Increases in the CWB's revenue from the pool operation for durum wheat range between $60.6 million under the 100 percent scenario (100 percent of average exports to the United States) and $52.7 million under the 60 percent scenario (60 percent of average exports to the United States) when the pool price is $5.00 per bushel. As the pool price decreases, additional revenue for the CWB also decreases. When the pool price is $4.00 per bushel, increases in the CWB's revenue ranges between $20.7 million per year under the 100 percent scenario and $15.4 million per year under the 60 percent scenario.

Hard Red Spring Wheat Pool

North Dakota Hard Red Spring Wheat Pool

Since North Dakota supplies less than 50 percent of the hard wheat consumed in the United States, the range of market shares considered in this pooling option is between 55 percent and 30 percent of U.S. domestic consumption (Table 5.4). The quantities of hard wheat supplied by North Dakota range between 154.87 million bushels (given a 55 percent market share) and 84.41 million bushels (given an estimated 30 percent market share). The domestic price under the competitive market scenario is $3.15 per bushel. Total domestic sales revenue under the competitive market scenario ranges from $488.3 million (given a 55 percent market share) to $266.3 million (given a 30 percent market share). Total revenue, including export sales, is $979.8 million with a 55 percent market share and $534.4 million with a 30 percent market share.

When the pool maximizes its profit by restricting its supply optimally (to the level where MR=MC), the quantity of hard wheat supplied by the pool decreases to 141.66 million bushels with a 55 percent market share and to 80.37 million bushels with a 30 percent market share. However, there is a little increase in the price of HRS wheat under this scenario because demand for HRS wheat is highly elastic (due to a high degree of substitution between HRS and HRW wheat). Changes in domestic revenue are negative. However, these are counterbalanced by changes in export sales revenue, leaving little net change in total revenue. Increases in total revenue, relative to the competitive scenario, range from $8.5 million (given a 55 percent market share) to $1.5 million (given a 30 percent market share)
.

Under both 10 percent and 15 percent reduction scenarios, losses in domestic revenue (relative to the competitive market scenario) are even larger. Changes in total revenue are insubstantial.

Figure 5.3 shows changes in the total revenue from the pool operation. Changes in the pool's total revenue from domestic sales are negative for all market shares. However, changes in the pool's total revenue are positive and increase with the market share.

Table 5.4. The Quantities and Prices of Spring Wheat Under Competitive Market and North Dakota Pool Options

	Market Share					
	0.55	**0.5**	**0.45**	**0.4**	**0.35**	**0.3**
Competitive Market						
Quantity Supplied to Domestic Market (million bu)	154.87	140.93	126.98	112.67	98.72	84.41
World Price ($/bu)	3.15	3.15	3.15	3.15	3.15	3.15
Domestic Sales Revenue ($ million)	488.29	443.90	399.51	355.12	310.73	266.34
Export Sales ($ million)	491.48	466.80	402.11	357.44	312.76	268.08
Total Revenue ($ million)	979.77	890.70	801.62	712.56	623.49	534.42
Unlimited Quantity Reduction Scenario						
Quantity Supplied to Domestic Market	141.66	129.92	117.81	105.33	93.22	80.37
Price Set by Pool	3.24	3.23	3.21	3.20	3.19	3.18
Domestic Sales Revenue	459.53	418.91	378.27	337.54	296.65	255.53
Export Sales Revenue	528.78	478.30	428.17	378.45	329.18	280.38
Total Revenue	988.30	897.21	806.44	715.99	625.82	535.91
Changes in TR	8.54	6.51	4.81	3.43	2.33	1.49
10% Reduction Scenario						
Quantity Supplied to Domestic Market	139.46	126.98	114.14	101.29	88.81	75.97
Price Set by Pool	3.26	3.25	3.24	3.23	3.22	3.21
Domestic Sales Revenue	454.76	412.04	369.61	327.48	285.63	244.05
Export Sales Revenue	534.59	486.50	438.31	390.01	341.60	293.09
Total Revenue	989.35	898.54	807.92	717.49	627.23	537.14
Changes in TR	9.58	7.84	6.29	4.93	3.74	2.72
15% Reduction Scenario						
Quantity Supplied to Domestic Market	131.75	119.64	107.90	95.79	83.68	71.93
Price Set by Pool	3.31	3.30	3.28	3.27	3.25	3.24
Domestic Sales Revenue	436.72	395.06	353.82	313.00	272.58	232.55
Export Sales Revenue	555.75	506.04	456.15	406.09	355.87	305.48
Total Revenue	992.48	901.10	809.98	719.09	628.45	538.03
Changes in TR	12.71	10.40	8.35	6.54	4.96	3.61

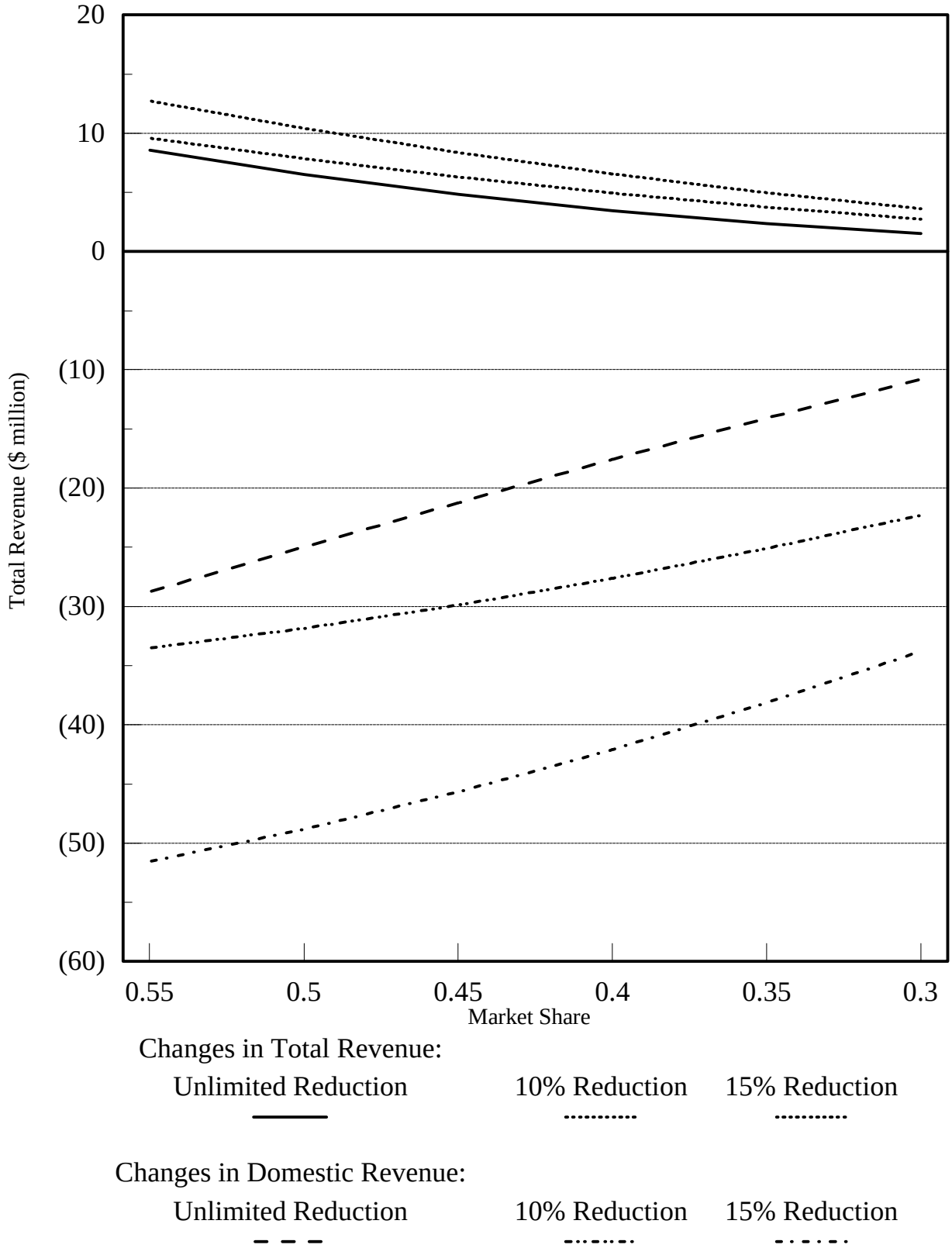


Figure 5.3 Changes in Total Revenue for Spring Wheat Under Alternative North Dakota Pool Options

Joint U.S./Canada Pool

The United States and Canada supply about 70 percent of the hard wheat consumed in the U.S. market. In the following analysis, the joint pool's market share is varied between 75 percent and 50 percent of the U.S. hard wheat consumption (Table 5.5). Quantities of hard wheat supplied vary between 211.39 million bushels (75 percent market share) and 140.93 million bushels (50 percent market share). Total domestic sales revenue under the competitive market scenario ranges between $665.9 million (75 percent market share) and $443.9 million (50 percent market share). Total revenue, including export sales, is $1,336 million with a 75 percent market share and $890.7 million with a 50 percent market share.

When the pool maximizes its profit by restricting its supply optimally (to the level where MR=MC), the quantity of hard wheat supplied by the pool decreases to 187.17 million bushels, given a 75 percent market share, and 129.92 million bushels, given a 50 percent market share. However, there is only a small increase in the price of HRS wheat under this unlimited quantity reduction scenario because of the high price elasticity of demand for HRS wheat. Domestic sales revenue is smaller than under the competitive market scenario. However, there are small, positive changes in total revenue, as export revenues offset the value of lost domestic revenue.

Under both 10 percent and 15 percent reduction scenarios, losses in domestic revenue (relative to the competitive market scenario) are even larger. Losses in domestic revenue range from -$37.0 million (75 percent market share) to -$31.9 million (50 percent market share) under the 10 percent reduction scenario. The domestic losses are even larger under the 15 percent reduction scenario. Due to the high price elasticity of demand for HRS wheat, the pool is unable to generate additional domestic sales revenue by restricting supply. However, these are counterbalanced by changes in export sales revenue, leaving little change in total revenue. Increases in total revenue, relative to the competitive scenario, range from $12.73 million with a 75 percent market share to $5.39 million with a 30 percent market share, under the 10 percent reduction scenario. Increases in total revenue under the 15 percent reduction scenario are similar to those under the 10 percent reduction scenario.

Figure 5.4 shows changes in the total revenue from the pool operation. Changes in the pool's total revenue from domestic sales are negative for all market shares. However, changes in the pool's total revenue from both domestic and export sales are positive and increase with market share.

Benefits for Canadian Spring Wheat Producers

The CWB will get the pool price for its domestic supply and its exports of HRS wheat to the United States under the joint pool scenario. Canadian domestic demand for HRS wheat will decrease slightly because of a high domestic price, based on the price elasticity of domestic demand for HRS wheat (-0.15). The CWB's exports of HRS wheat to the United States are assumed to decrease in line with supply reduction by the U.S. pool members as determined by negotiation between the CWB and the pool. The CWB is assumed to increase its exports to the world market.

Table 5.5. The Quantities and Prices of Spring Wheat Under Competitive Market and Joint U.S./Canada Pool Options

	Market Share					
	0.75	**0.7**	**0.65**	**0.6**	**0.55**	**0.5**
Competitive Market						
Quantity Supplied to Domestic Market (million bu.)	211.39	197.45	183.13	169.19	154.87	140.93
World Price ($/bu)	3.15	3.15	3.15	3.15	3.15	3.15
Domestic Sales Revenue ($ million)	665.86	621.47	577.08	532.68	488.29	443.90
Export Sales ($ million)	670.19	625.51	580.83	536.15	491.47	446.79
Total Revenue ($ million)	1336.05	1246.98	1157.91	1068.83	979.76	890.69
Unlimited Quantity Reduction Scenario						
Quantity Supplied to Domestic Market	187.17	176.16	164.78	153.41	141.66	129.92
Price Set by Pool	3.33	3.30	3.28	3.26	3.24	3.23
Domestic Sales Revenue	623.05	581.88	540.95	500.19	459.53	418.91
Export Sales Revenue	726.76	676.56	626.36	576.23	526.22	476.39
Total Revenue	1349.80	1258.44	1167.31	1076.42	985.75	895.30
Changes in TR	13.76	11.46	9.40	7.58	5.98	4.60
10% Reduction Scenario						
Quantity Supplied to Domestic Market	190.11	177.63	164.78	152.31	139.46	126.98
Price Set by Pool	3.31	3.29	3.28	3.27	3.26	3.25
Domestic Sales Revenue	628.84	584.83	541.15	497.80	454.76	412.04
Export Sales Revenue	719.94	673.13	626.13	578.95	531.59	484.05
Total Revenue	1348.77	1257.96	1167.28	1076.75	986.35	896.09
Changes in TR	12.73	10.98	9.37	7.91	6.58	5.39
15% Reduction Scenario						
Quantity Supplied to Domestic Market	179.83	167.72	155.61	143.86	131.75	119.64
Price Set by Pool	3.38	3.37	3.35	3.33	3.31	3.30
Domestic Sales Revenue	607.87	564.38	521.37	478.82	436.72	395.06
Export Sales Revenue	743.67	695.96	647.95	599.64	551.06	502.20
Total Revenue	1351.53	1260.34	1169.31	1078.46	987.78	897.26
Changes in TR	15.49	13.36	11.41	9.63	8.01	6.56

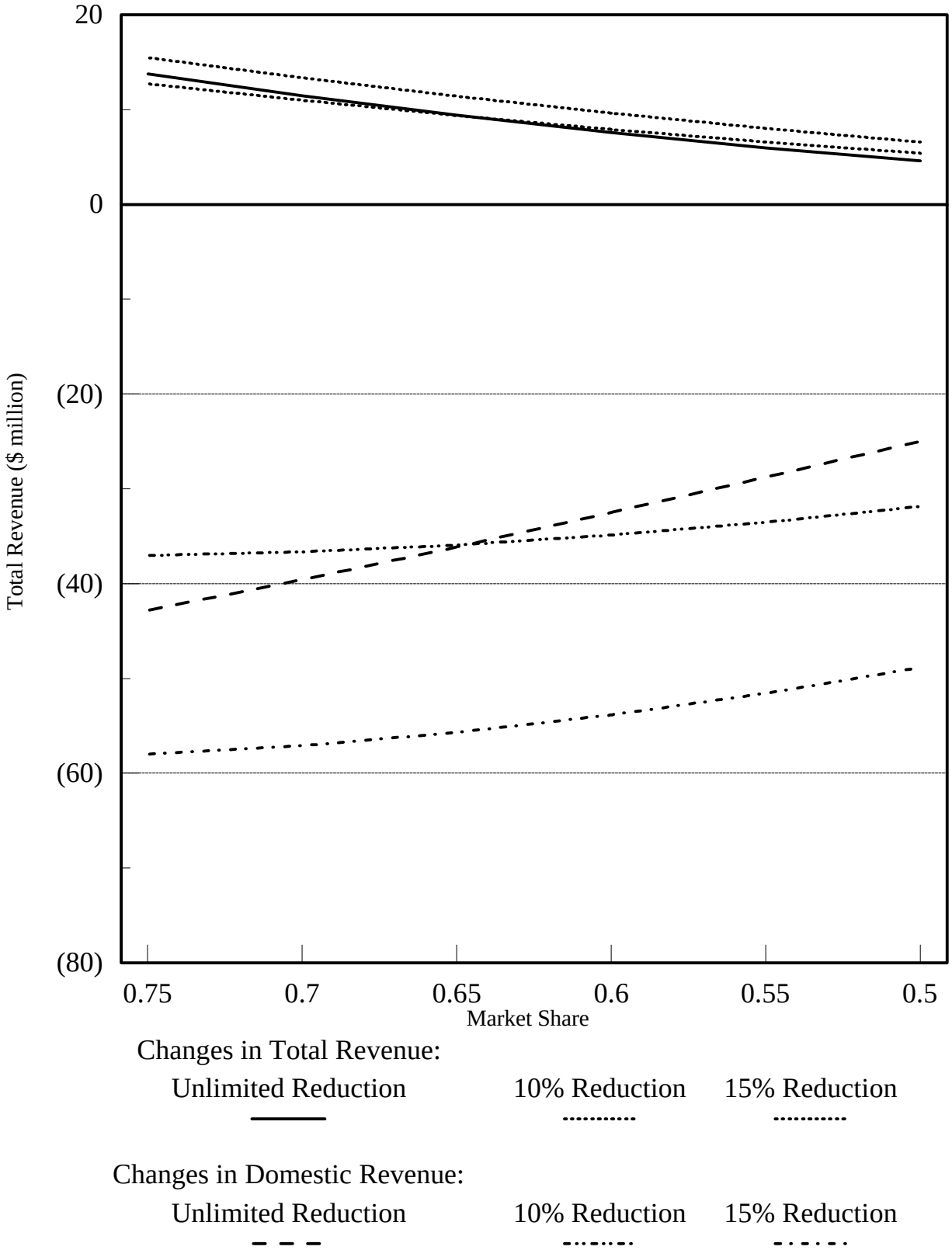


Figure 5.4 Changes in Total Revenue for Spring Wheat Under Alternative Joint U.S./Canada Pool Options

Increases in the CWB's revenue from HRS wheat under alternative levels of exports to the United States are presented in Table 5.6. Canadian exports of HRS wheat to the United States are set at various percentages of the 1993-1997 average. Alternative pool prices of HRS wheat considered are $3.50 and $3.20 per bushel. If pool price is set at $3.50 per bushel, Canada's domestic demand decreases and its exports to the world market increase compared to that in the competitive scenario. World prices also change accordingly based on import demand elasticity of -1.68.

Increases in the CWB's revenue from the pool operation for HRS wheat range between $64.5 million with the 100 percent export scenario and $52.8 million with the 60 percent export scenario when the pool price is $3.50 per bushel. However, when the pool price is set at $3.20, increases in the CWB's revenue are $9.3 million with the 100 percent export scenario and become negative with the other export scenarios. This is mainly because increases in Canada's exports to the world market depress the world price below the competitive price ($3.15 per bushel).

Table 5.6. Increases in Canadian Revenue From the Hard Red Spring Wheat Pool

		Percent of Average Exports (1993-1997)				
Export	**5 Year Average**	**100%**	**90%**	**80%**	**70%**	**60%**
Pool Price = $3.50						
Domestic Demand (million bu.)	147.17	145.37	145.37	145.37	145.37	145.37
Export to World (million bu.)	513.30	514.93	520.06	524.68	528.84	532.58
Export to U.S. (million bu.)	51.30	51.30	46.17	41.55	37.40	33.66
World Price ($/bu.)	3.15	3.14	3.13	3.13	3.13	3.13
Total Revenue ($ million)	2241.54	2306.07	2294.98	2294.73	2294.51	2294.31
Export Sales Revenue ($ million)	1778.49	1797.29	1786.19	1785.95	1785.73	1785.53
Domestic Sales Revenue ($ million)	463.05	508.78	508.78	508.78	508.78	508.78
Changes in Total Revenue (million $)	--	64.53	53.44	53.19	52.97	52.77
Pool Price = $3.20						
Domestic Demand (million bu.)	147.17	146.77	146.77	146.77	146.77	146.77
Export to World (million bu.)	513.30	513.53	518.66	523.28	527.44	531.18
Export to U.S. (million bu.)	51.30	51.30	46.17	41.55	37.40	33.66
World Price ($/bu.)	3.15	3.15	3.12	3.13	3.13	3.13
Total Revenue ($ million)	2241.54	2250.83	2237.59	2238.73	2239.75	2240.67
Export Sales Revenue ($ million)	1780.49	1781.18	1767.93	1769.08	1770.10	1771.02
Domestic Sales Revenue ($ million)	463.05	469.65	469.65	469.65	469.65	469.65
Changes in Total Revenue ($ million)	--	9.29	-3.95	-2.81	-1.79	-0.87

The Long-Run Effects of the Pool

Both the U.S. durum and HRS wheat industries are simulated for the 1999-2008 period to evaluate longer-term impacts of the pool operation.

The Durum Wheat Industry

The simulation for the U.S. durum wheat industry is based on the following assumptions: (1) domestic demand elasticity for durum wheat is -0.1, (2) domestic supply elasticity is 0.86, (3) world import demand elasticity is -1.2, and (4) the pool price should not exceed the world price by transportation costs from offshore exporting countries to the United States and handling charges at origin and destination ports. Transportation costs and handling charges are assumed to be $1.50 per bushel.

In this simulation, the pool starts to operate from 1999 (Table 5.7). Four alternative pool price scenarios are introduced. They assume pool price equivalent to $5.00 per bushel, $4.60 per bushel, $4.20 per bushel, and $3.80 per bushel. When the pool price is set at $5.00 per bushel, there are no changes in domestic supply of durum wheat in 1999, because it is assumed that supply is determined by the lagged price. However, supply of durum wheat increases from 97.20 million bushels in 1999 to 118.62 million bushels in 2000 and stabilizes at about 113.20 million bushels for the remaining period. On the other hand, domestic demand decreases in 1999 due to higher domestic price ($5.00) and stabilizes at 79.64 million bushels for the remaining period. U.S. exports of durum wheat increase substantially due to increases in supply and decreases in domestic demand. The increased exports result in decreases in the world price. The world price decreases from $3.50 per bushel in 1999 to $3.22 per bushel in 2000 and stabilizes at $3.27 per bushel for the remaining period. Average prices received by producers are $4.40 per bushel in 1999, decreasing to $4.12 per bushel in 2000, and stabilizing at $4.17 per bushel for the remaining period.

When the pool price is $4.60, the average price received by producers ranges between $4.16 per bushel in 1999 and $4.08 per bushel in the remaining period. For the pool price of $4.20, domestic demand and supply do not change much compared to the scenario with pool price of $4.60 per bushel. Average prices range between $3.92 per bushel in 1999 and $3.87 per bushel in the remaining period. For the pool price of $3.80 per bushel, average prices range between $3.68 per bushel in 1999 and $3.66 per bushel in the remaining period. In these scenarios, average prices received by farmers are much higher than the competitive market price ($3.50), indicating that the pool operation durum wheat is viable in the short and long run.

The Hard Red Spring Wheat Industry

Assumptions introduced in the simulation for the HRS wheat industry are different from those for the durum wheat industry because these two wheat industries have different marketing characteristics. The simulation for the U.S. HRS wheat industry is based on the following assumptions: (1) domestic demand elasticity for durum wheat is -0.15, (2) domestic supply elasticity is 0.3, (3) world import demand elasticity is -1.68, and (4) the pool price should not exceed the world price by transportation costs from offshore exporting countries to the United

States and handling charges at origin and destination ports. These transportation costs and handling charges are assumed to be $1.50 per bushel. Pool prices considered in this simulation are $3.50 and $3.20 per bushel.

Since the pool price is higher than the competitive price, supply of HRS wheat increases in 2000 and remains at the same level for the remaining period (Table 5.8). Domestic demand decreases from 281.86 million bushels in the competitive market scenario to 276.72 million bushels in 1999, and remains the same level for the remaining period. The world price is $3.15 per bushel in the competitive condition, decreasing to $3.13 per bushel in 2000. Average prices received by producers are still higher than the competitive price, ranging between $3.32 per bushel in 1999 and $3.31 per bushel in 2000.

When the pool price is set at $3.20 per bushel, changes in domestic supply and demand are similar. Average prices received by producers are higher than the competitive price, implying that the pool will provide additional revenue to producers in both the short and long run.

Table 5.7. Ten Years Simulation for the U.S. Durum Wheat Industry

	Base	Year 1 1999	Year 2 2000	Year 3 2001	Year 4 2002	Year 5 2003	Year 6 2004	Year 7 2005	Year 8 2006	Year 9 2007	Year 10 2008
Pool Price		5.00	4.72	4.80	4.77	4.77	4.77	4.77	4.78	4.77	4.77
World Price ($/bu.)	3.50	3.50	3.22	3.30	3.27	3.28	3.28	3.28	3.28	3.27	3.27
Domestic Cons. (million bu.)	82.58	78.91	79.64	79.64	79.64	79.64	79.64	79.64	79.64	79.64	79.64
Acres	2.70	2.70	3.30	3.11	3.16	3.14	3.13	3.14	3.14	3.12	3.14
Yields (bu./acre)	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00
Production (million bu.)	97.20	97.15	118.62	111.91	113.82	113.15	113.22	113.20	113.20	113.33	113.16
Exports (million bu.)	37.00	37.04	58.53	51.93	53.92	53.35	53.50	53.56	53.63	53.84	53.75
World Import (million bu.)	220.70	220.70	221.70	222.70	233.70	224.70	225.70	226.70	227.70	228.70	229.70
Average Price ($/bu.)	3.50	4.40	4.12	4.20	4.17	4.17	4.17	4.17	4.18	4.17	4.17
Pool Price = $4.60											
World Price ($/bu.)	3.50	3.50	3.29	3.32	3.31	3.31	3.31	3.31	3.31	3.31	3.31
Domestic Cons. (million bu.)	82.58	80.37	80.37	80.37	80.37	80.37	80.37	80.37	80.37	80.37	80.37
Acres	2.70	2.70	3.14	3.08	3.09	3.09	3.09	3.09	3.09	3.09	3.09
Yields (bu./acre)	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00
Production (million bu.)	97.20	97.15	112.90	110.92	111.15	111.12	111.13	111.13	111.13	111.13	111.13
Exports (million bu.)	37.00	37.02	52.77	50.79	51.02	50.99	51.00	51.00	51.00	51.00	51.00
World Import (million bu.)	220.70	220.70	221.70	222.70	223.70	224.70	225.70	226.70	227.70	228.70	229.70
Average Price ($/bu.)	3.50	4.16	4.08	4.09	4.09	4.09	4.09	4.09	4.09	4.09	4.09
Pool Price = $4.20											
World Price ($/bu.)	3.50	3.50	3.37	3.38	3.38	3.38	3.38	3.38	3.38	3.38	3.38
Domestic Cons. (million bu.)	82.58	81.84	81.84	81.84	81.84	81.84	81.84	81.84	81.84	81.84	81.84
Acres	2.70	2.70	2.98	2.94	2.95	2.95	2.95	2.95	2.95	2.95	2.95
Yields (bu./acre)		36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00
Production (million bu.)	97.20	97.15	107.17	105.91	106.06	106.05	106.05	106.05	106.05	106.05	106.05
Exports (million bu.)	37.00	36.99	47.02	45.76	45.91	45.89	45.89	45.89	45.89	45.89	45.89
World Import (million bu.)	220.70	220.70	221.70	222.70	223.70	224.70	225.70	226.70	227.70	228.70	229.70
Average Price ($/bu)	3.50	3.92	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87
Pool Price = $3.80											
World Price ($/bu.)	3.50	3.50	3.44	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45
Domestic Cons. (million bu.)	82.58	82.13	82.13	82.13	82.13	82.13	82.13	82.13	82.13	82.13	82.13
Acres	2.70	2.70	2.82	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80
Yields (bu./acre)	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00
Production (million bu.)	97.20	97.15	101.45	100.91	100.97	100.96	100.97	100.97	100.97	100.97	100.97
Exports (million bu.)	37.00	36.97	41.27	40.73	40.79	40.78	40.78	40.78	40.78	40.78	40.78
World Import (million bu.)	220.70	220.70	221.70	222.70	223.70	224.70	225.70	226.70	227.70	228.70	229.70
Average Price ($/bu.)	3.50	3.68	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66

Domestic demand elasticity = -0.1
Domestic supply elasticity = 0.86
World import demand elasticity = -1.2
Pool price is less than or equal to world price + $1.50 (ocean transportation costs plus handling charges)

Table 5.8. Ten Years Simulation for the U.S. Hard Red Spring Wheat Industry

	Base	Year 1 1999	Year 2 2000	Year 3 2001	Year 4 2002	Year 5 2003	Year 6 2004	Year 7 2005	Year 8 2006	Year 9 2007	Year 10 2008
Pool Price = $3.50											
World Price ($/bu.)	3.15	3.15	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13
Domestic Consumption (million bu.)	281.86	276.72	276.72	276.72	276.72	276.72	276.72	276.72	276.72	276.72	276.72
Acres	14.66	14.66	14.90	14.89	14.89	14.89	14.89	14.89	14.89	14.89	14.89
Yields (bu./acre)	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00
Production (million bu.)	527.38	527.67	536.46	535.95	535.98	535.98	535.98	535.98	535.98	535.98	535.98
Exports (million bu.)	283.40	283.42	292.22	291.71	291.74	291.73	291.73	291.73	291.73	291.73	291.73
World Import (million bu.)	796.80	799.40	813.79	813.79	813.79	813.79	813.79	813.79	813.79	813.79	813.79
Average Price ($/bu.)	3.15	3.32	3.31	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32
Pool Price = $3.20											
World Price ($/bu.)	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15
Domestic Consumption (million bu.)	281.86	280.39	280.39	280.39	280.39	280.39	280.39	280.39	280.39	280.39	280.39
Acres	14.66	14.66	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69
Yields (bu./acre)	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00
Production (million bu.)	527.76	527.67	528.93	528.85	528.86	528.86	528.86	528.86	528.86	528.86	528.86
Exports (million bu.)	283.40	283.32	284.59	284.52	284.52	284.52	284.52	284.52	284.52	284.52	284.52
World Import (million bu.)	796.80	799.40	801.65	801.65	801.65	801.65	801.65	801.65	801.65	801.65	801.65
Average Price ($/bu.)	3.15	3.18	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17

Domestic demand elasticity = -0.15
Domestic supply elasticity = 0.30
World import demand elasticity = -1.68
Pool price is less than or equal to world price + $1.50 (ocean transportation costs plus handling charges)

6. Management and Operational Efficiency

Thus far the analysis has focused on the market power of a wheat pool, and the potential for raising producer revenue through differential pricing in the domestic and international markets. As noted earlier, a limitation of this strategy is that the free riders also benefit from any rise in the domestic price. Free riders fall into two categories: first, North Dakota producers who remain outside of the pool; and second, producers in other states who could expand production and domestic sales in response to higher U.S. prices. These pose obvious problems for the viability of a pool and suggest the need for other sources of competitive advantage.

To elaborate briefly, consider the disincentives for participation by North Dakota producers. In general, producers will seek to market their grain independently if they believe they can earn a higher return than offered by the pool. Since the pool return represents a weighted average of domestic and export sales, producers who are able to sell at the high domestic price (while avoiding the costs of pool participation) will choose to do so. For the pool to attract a sizable base of North Dakota producers, it must offer advantages to offset this tendency. Similar concerns arise with respect to free riders in other regions. To the extent that a higher domestic price elicits an increase in production in other regions, the market power of a North Dakota pool is diminished.

This suggests that long-term viability of a pool may come to depend on operational efficiencies or competitive advantages that are not shared by other grain trading firms. Among the areas where the pool could develop competitive advantages are grain blending, logistics, and strategic quality management.

Grain Blending: Blending activities are recognized as one of the principal sources of profit for grain elevators and merchandisers. Wheat is blended for a variety of grade and non-grade factors (e.g., protein, dockage, DON), based on premium and discount schedules that vary across markets and through time. Profit opportunities are greatest when there are shortages of high-quality grain or large price spreads for particular quality characteristics—as occurred in 1993/94, for example, because of the scab outbreak.

Given the prevalence of blending in the grain industry, it is reasonable to think this could be an important activity for the North Dakota wheat pool. To the extent that this replaces grain blending by private firms, the effect would be to capture new benefits for producers. Moreover, the pool's access to wheat stocks in a wide geographic area, combined with information on qualities available by location, would ensure greater blending opportunities than are available to local elevators.

Transportation and Logistics: The pool would have additional advantages in the area of transportation and logistics. Unlike local elevators that must bid for grain, the pool could arrange for farmer deliveries at specified times and locations (shipping points) in order to meet sale commitments. With an assured supply, much of the logistical uncertainty is removed, forward sales are facilitated, and favorable shipping rates can be locked in more easily. In addition, the pool would have greater flexibility to assemble large shipments (e.g., by unit train) in response to short-term market incentives.

Strategic Quality Management: With the cooperation of producers, a pool could have unparalleled access to information on the distribution of grain quality, by location, and across a geographical growing region. This would enable the efficient matching of supplies with quality requirements of individual buyers. Strategic quality management would entail the selective targeting of market segments and, in some cases, development of long-term supply arrangements based on customer requirements for quality assurance. Arguably, the pool would be better placed to enter long-term supply arrangements than private grain trading firms.

While the net benefits of grain blending, logistical advantages, and quality management are difficult to project, it is important to recognize that such benefits may be crucial to the long-term viability of the pool. The following analysis develops these ideas more formally using concepts from game theory.

A Brief Description of A Game Theory Model for Market Efficiency

Game theory has been used extensively in the literature to analyze market efficiency. In the following analysis, game theory is used to evaluate the best strategy for producers (whether or not to join the pool) based on projected returns, and to determine the conditions under which the pool is sustained in the long run. The model provides a way to address the following efficiency issues:

(1) Can the pool generate sufficient efficiency gains to cover fixed and operating expenses?

(2) What strategies should the pool use to provide sufficient incentives for members to adhere to the pool and to discourage free riding? Expert opinion suggests that while the pool may be able to exert market power in the first year and increase domestic prices, it may be difficult to sustain high prices if it cannot control free riders.

(3) Are there quality and marketing characteristics that can provide sustainable competitive advantage for the pool? The pool needs to be operated as a business, identifying possible efficiency gains and building a reputation for quality.

Two game theory models are used to address the above issues; the Baby Folk Theorem and the Rubinstein bargaining model.

Baby Version of the Folk Theorem

In an infinitely repeated game, cooperation is the equilibrium outcome if a punishment strategy is defined so that it makes players worse-off when they deviate from the cooperative solution. The infinitely repeated game is based on three solution concepts: 1) the Nash equilibrium solution, 2) the best strategy for each player irrespective of other players, and 3) a mixed strategy outcome. The three components of this game model are the players, their strategies, and their payoffs for each strategy.

The Players: There are two players in this game: pool members and non-pool members. The objective of the pool is to provide significant incentives that make players better off by joining the pool.

The Strategies: There are two strategies for each player. The strategies for pool members are: (a) join the pool and be loyal to the pool and (b) join the pool and cheat or be free riders. Non-pool members can either: (a) cooperate with the pool or (b) decide not to cooperate with the pool.

Payoffs: There are two distinct payoffs for each player, corresponding to different strategies. The model evaluates which strategy yields the optimum revenue for pool and non-pool members.

The model also analyzes conditions under which the pool is sustained in the long run, using the three solution concepts listed earlier. Although the Baby Folk Theorem analyzes efficiency gains with punishment strategies and determines whether cooperation with the pool is beneficial in the long run, it does not explicitly evaluate the duration of contracts necessary to sustain a pool. That issue is addressed by the Rubinstein bargaining model.

The Rubinstein Bargaining Framework

This is a dynamic bargaining model that analyzes projected payoffs in a repeated game. The model incorporates dynamic interactions between prices and quantities, and is used to determine the contract length necessary to sustain the pool in the long run. The period considered is 1999 through 2003. Data for the analysis are found in Tables 5.7 and 5.8. The players and their strategies are the same as in the Baby Folk model.

The North Dakota Wheat Pool Game

Though this game can be developed in an n-player framework, we will simplify it to facilitate understanding in a two player framework (pool and non-pool members). Strategies and payoffs (*a, b, c, d, e, f, g,* and *h*) for pool and non-pool members are summarized in Table 6.1. The payoffs are derived by maximizing each player's profit function. The payoffs *a* and *e* are equal and represent pool members who are loyal to the pool, *c* and g are equal and represent pool members who are free riding, *b* and *d* are for non-pool members who want to cooperate with the pool, and *f* equals *h* for non-pool members. The presentation in Table 6.1 is used to facilitate aggregated payoffs of the pool and non-pool members for each outcome of the game and estimate efficiency gains due solely to the pool's operation. Efficiency gains are estimated from the difference in profits for pool and non-pool members, and are due mostly to quantity and quality premiums.

Table 6.1. Strategies and Payoffs of Pool and Non-pool Members and Free Riders

Pool Members(1)/Non-pool Members(2)	Join Pool (J)	Join Pool but be Free Rider (JF)
Cooperate with Pool (C)	*a, b*	*c, d*
Don't Cooperate (DC)	*e, f*	*g, h*

Quantity Premium: If pool costs are maintained constant and the volume of grains handled by the pool increases, then the pool will enjoy scale advantages. These justify the use of quantity incentives to attract larger amounts of grain from producers. The annual cost of running the pool is a function of volume:

$$C_m = f(Q) \tag{28}$$

where C_m is cost of running the pool and Q is the quantity supplied to the pool.

In the case of durum wheat, suppose the pool has a 50 percent market share; this corresponds to 1.131 million metric tons or 41.47 million bushels. The pool's fixed and operating expenses (charged to producers) are five cents per bushel, or $2.07 million. Therefore with estimated pool costs of $1.186 million per annum, pool members who provide greater quantities could receive quantity premiums totaling $0.884 million. For HRS, fixed and operating expenses (charged to producers) at five cents per bushel are $4.22 million (assuming 30 percent market share), and estimated pool costs are $2.484 million. This leaves $1.74 million that can be used for quantity premiums.

The quantity premium serves two goals: 1) attract greater volumes to the pool and limit free rider problems and 2) create a pool that compensates loyal participants who commit large acreage to the pool. Not all pool members will receive the same price per bushel; pool members who supply greater quantities would earn a higher price.

Quality Premium: Elevators, merchandisers, and processors routinely blend grains for these quality characteristics in order to enhance their margins.[3] The efficiency or game theory model developed in this study internalizes benefits that are otherwise captured by grain companies or processors and uses these benefits as incentives for pool members and punishment strategies for free riders.

Questions that arise are: how long can the pool sustain the higher pool price to cover its expenses (with just quantity premiums); and how will free riders who produce limited volumes react to quantity premiums? Success of the pool will depend on the ability of the pool to provide quality and quantity premiums to pool members in a rational way.

[3]For example, premiums for zero vomitoxin can go as high as 22 cents per bushel. For some grain quality characteristics, elevators and processing firms charge discounts equivalent to 10 percent of the price. Based on assumptions about returns to blending and other logistical advantages, the pool can internalize these benefits. To be conservative, we assume potential benefits equivalent to 5 percent of grain value.

Estimation of Efficiency Gains and Sustainability

The quantities used are based on total durum supply in the United States, assuming the pool controls 50 percent, 65 percent, and 90 percent of the domestic market. An average market price in Tables 5.1 and 5.2 was used. Pool participants contribute 5 cents per bushel for the cost of running the pool. Quality premiums were set at 5 percent of total revenue for pool quantities. We assume that 40 percent of the grain is blended, and costs of blending are 8 cents per bushel. The quality premiums were estimated to be $7.36 million for the members who are loyal to the pool.

Efficiency Gains

In Table 6.2, efficiency gains were estimated for each player based on average price, plus quantity and quality premiums, less the cost for running the pool. The average market price of $4.40 per bushel was used if the pool controls 50 percent market share. This price, estimated earlier, is based on the average quality proportions produced by U.S. farmers (Tables 5.1 and 5.2). Pool participants contribute 5 cents per bushel for the cost of running the pool. Quality premiums were set at 5 percent of total pool revenue (a conservative estimate), less 8 cents per bushel for blending costs. The quantity premium for durum wheat totals $0.884 million for pool members who cooperate. The premium is zero for producers who do not join the pool, and members who free-ride are punished with lower returns because they incur membership costs while gaining only half of the premium.

The total revenue for each strategy is simply the quantity multiplied by the price plus premiums and less the cost of running the pool. The extra revenue resulting from the pool's operation is the total revenue when all producers join the pool less the total revenue when producers do not join the pool. As the pool's market share increases from 50 percent to 90 percent, producers receive efficiency gains ranging from $0.165 to $0.284 per bushel for durum wheat and $0.074 to $0.09 per bushel for HRS (Table 6.3).

Table 6.2 Efficiency Gains for the Durum Wheat Pool

	Pool Members Loyal (a & e)	Non-members Cooperate (b & d)	Pool Members Free Ride (c & g)	Non-members Don't Cooperate (f & h)
50% Market Share				
Quantity (mbu)	41.47	41.47	41.47	41.47
Price ($/bu)	4.35	4.35	4.375	4.4
Total Revenue (m$)	180.3945	180.3945	181.4313	182.468
Quantity Premium (m$)	0.2135	0.2135	-1.34163	0
Quality Premium (m$)	7.360925	7.360925	3.706381	0
Total Profit ($/bu)	4.482648	4.482648	4.419523	4.4
Pool Cost ($0.05/bu, m$)	2.0735	2.0735	0.518375	0
Blending Cost ($0.08/bu, m$)	1.6588	1.6588	0.8294	0
Efficiency Gains ($/bu)	**0.165297**			
65% Market Share				
Quantity (mbu)	53.58	28.85	53.58	28.85
Price ($/bu)	5.33	5.33	5.355	5.38
Total Revenue (m$)	285.5814	153.7705	286.9209	155.213
Quantity Premium (m$)	0.819	-0.4175	-1.19025	0
Quality Premium (m$)	12.13587	6.534525	6.101423	0
Total Profit($/bu)	5.521786	5.492029	5.434161	5.38
Pool Cost ($0.05/bu, m$)	2.679	1.4425	0.66975	0
Blending Cost ($0.08/bu, m$)	2.1432	1.154	1.0716	0
Efficiency Gains ($/bu)	**0.276**			
90% Market Share				
Quantity (mbu)	74.5	8.28	74.5	8.28
Price ($/bu)	5.06	5.06	5.085	5.11
Total Revenue (m$)	376.97	41.8968	378.8325	42.3108
Quantity Premium (m$)	1.865	-1.446	-0.92875	0
Quality Premium (m$)	15.8685	1.76364	7.980813	0
Total Profit ($/bu)	5.248034	5.048362	5.167159	5.11
Pool Cost ($0.05/bu, m$)	3.725	0.414	0.93125	0
Blending Cost ($0.08/bu, m$)	2.98	0.3312	1.49	0
Efficiency Gains ($/bu)	**0.284**			

Table 6.3. Efficiency Gains for the Hard Red Spring Wheat Pool

	Pool Members Loyal (a & e)	Non- members Cooperate (b & d)	Pool Members Free Ride (c & g)	Non-members Don't Cooperate (f & h)
30% Market Share				
Quantity (mbu)	84.41	196.95	84.41	196.95
Price ($/bu)	3.13	3.13	3.155	3.18
Total Revenue (m$)	264.2033	616.4535	266.3136	626.301
Quantity Premium (m$)	1.7365	7.3635	-1.42888	0
Quality Premium (m$)	9.833765	22.94468	4.969639	0
Total Profit ($/bu)	3.217072	3.233888	3.184447	3.18
Pool Cost ($0.05/bu, m$)	4.2205	9.8475	1.055125	0
Blending Cost ($0.08/bu, m$)	3.3764	7.878	1.6882	0
Efficiency Gains ($/bu)	**0.074144**			
35% Market Share				
Quantity (mbu)	98.72	183.34	98.72	183.34
Price ($/bu)	3.14	3.14	3.165	3.19
Total Revenue (m$)	309.9808	575.6876	312.4488	584.8546
Quantity Premium (m$)	2.452	6.683	-1.25	0
Quality Premium (m$)	11.55024	21.45078	5.83682	0
Total Profit ($/bu)	3.231838	3.243451	3.198963	3.19
Pool Cost ($0.05/bu, m$)	4.936	9.167	1.234	0
Blending Cost ($0.08/bu, m$)	3.9488	7.3336	1.9744	0
Efficiency Gains ($/bu)	**0.083676**			
40% Market Share				
Quantity (mbu)	112.67	169.01	112.67	169.01
Price ($/bu)	3.15	3.15	3.175	3.2
Total Revenue (m$)	354.9105	532.3815	357.7273	540.832
Quantity Premium (m$)	3.1495	5.9665	-1.07563	0
Quality Premium (m$)	13.23873	19.85868	6.689781	0
Total Profit ($/bu)	3.245453	3.252803	3.212328	3.2
Pool Cost ($0.05/bu, m$)	5.6335	8.4505	1.408375	0
Blending Cost ($0.08/bu, m$)	4.5068	6.7604	2.2534	0
Efficiency Gains ($/bu)	**0.090907**			

Conditions for Sustainability

Payoffs for all strategies are presented in Table 6.4. Estimates of the three solution concepts from the Baby Folk Theorem are as follows:

(1) The Nash equilibrium outcome for the game is to join the pool or cooperate with the pool. Payoffs are $4.48 per bushel for each player.

(2) The best strategy for either member independently is to join the pool or cooperate with the pool. Payoffs are $4.48 per bushel.

(3) The dominant mixed strategy profile for each player is $4.48 per bushel also.[4]

Using these solution concepts, we derive conditions under which the pool will be sustained in the long run. If producers believe their pool will last indefinitely, they will cooperate with the above punishment strategy and join the pool without free riding. The same conclusion was reached for the 65 percent and 90 percent market shares.

Table 6.4. Strategies and Payoffs ($/bu) of Pool and Non-pool Members and Free Riders (50% Share)

Non-pool Members/Pool Members	Join Pool (J)	Join Pool but Free Ride (JF)
Cooperate with Pool (C)	4.48 , 4.48	4.41 , 4.48
Don't Join Pool (DC)	4.48 , 4.40	4.41 , 4.40

Based on results in Table 6.5, the minimum required contract length for the North Dakota pool would be four or five years. That is the time required for payoffs to stabilize, based on supply response assumptions in the analysis.

[4]Details of the game theory models are in a forthcoming technical report.

Table 6.5. Forecast of Durum Supply for the U.S. from 1998-2002 and Revenue for Joining the Pool

Pool	Year 1 1999	Year 2 2000	Year 3 2001	Year 4 2002	Year 5 2003
Pool Price ($/ton)	183.00	168.00	173.00	171.00	171.00
World Price ($/ton)	125.98	113.03	118.26	116.31	116.31
Domestic Consumption (mm tons)	2.15	2.18	2.18	2.18	2.17
Production (mm tons)	2.63	3.20	2.95	3.04	3.00
Exports (mm tons)	1.09	1.63	1.39	1.48	1.44
Avg. Price ($/ton)	160.19	146.01	151.10	149.13	150.02
Change in Domestic Cons. (mm tons)	0.10	-0.03	0.01	-0.00	0.00
Quantity Premium ($/ton)	3.70	4.74	4.29	4.45	4.39
Quality Premium ($/ton)	9.42	9.07	9.17	9.13	9.16
Blending Cost ($/ton)	3.86	4.69	4.32	4.46	4.41
Total Revenue (m$)	531.26	550.46	539.77	543.37	542.44
Pool Revenue (m$)	272.19	282.13	276.61	278.47	277.99
Non-pool Revenue (m$)	265.63	275.23	275.88	277.28	277.62

7. Market Strategies and Payment Schedule

Marketing Strategies

The goal of the pool is to provide consistent quality wheat for domestic and foreign customers through careful handling, cleaning, blending, and storage. The pool also will attempt to establish long-term sale contracts with domestic and foreign customers through customized wheat quality. Quality premiums will be paid to producers to meet stated goals of the pool. The pool will control large volumes, and enjoy informational and logistical advantages not shared by other grain trading companies; this will facilitate strategic marketing and quality management, and allow the pool to build a long-term positive relationship with buyers.

The pool will also use quantity premiums to attract greater volumes to the pool and limit the free rider problem. Not all pool members will receive the same price per bushel; pool members who supply greater quantities should earn a higher price. It is proposed that a 3 cent per bushel premium be offered to producers who supply more than 10,000 bushels of wheat, and a 6 cent per bushel premium for wheat exceeding 20,000 bushels.

The pool will provide efficient risk management for its members, both intra- and inter-year. Intra-year price risk is the risk that producers face during a marketing year. Price fluctuations in some years can amount to 40-50 percent in just a few months. With its sales spread throughout the year, the pool provides a means to protect producers from these intra-year price fluctuations.

Inter-year price risk is the risk that producers face between marketing years. Forces of supply and demand can change commodity prices drastically from one year to the next. The pool can help stabilize the effects of these fluctuations in several ways: first, by establishing long-term contracts with food processors; second, by developing a positive reputation for high quality service and product; and third, by developing market power to help offset periods of low commodity prices.

Figure 7.1 shows the strategies and organizational structure of the North Dakota Wheat Pool. The pool collects wheat from member producers utilizing authorized local grain elevators. The grain elevators will be contracted with the pool to maintain variety segregation and the level of quality control required by the pool. Wheat is delivered by member producers according to their delivery commitments, arranged at the time of sign up. Wheat is either cleaned and blended at the local elevator or shipped to larger regional elevators for cleaning and/or blending to meet or exceed quality factors which are determined by the pool and its customers, with input from technical experts in the market. After wheat is blended and graded, it will be sold to either the domestic or foreign markets, depending on the quality standards required by those markets. A portion of wheat may be processed into semolina for durum wheat or flour for spring wheat by the pool and sold to domestic and foreign food processors. The pool will direct ship wheat from local elevators to domestic processors and contract with grain companies to ship durum wheat to the international markets.

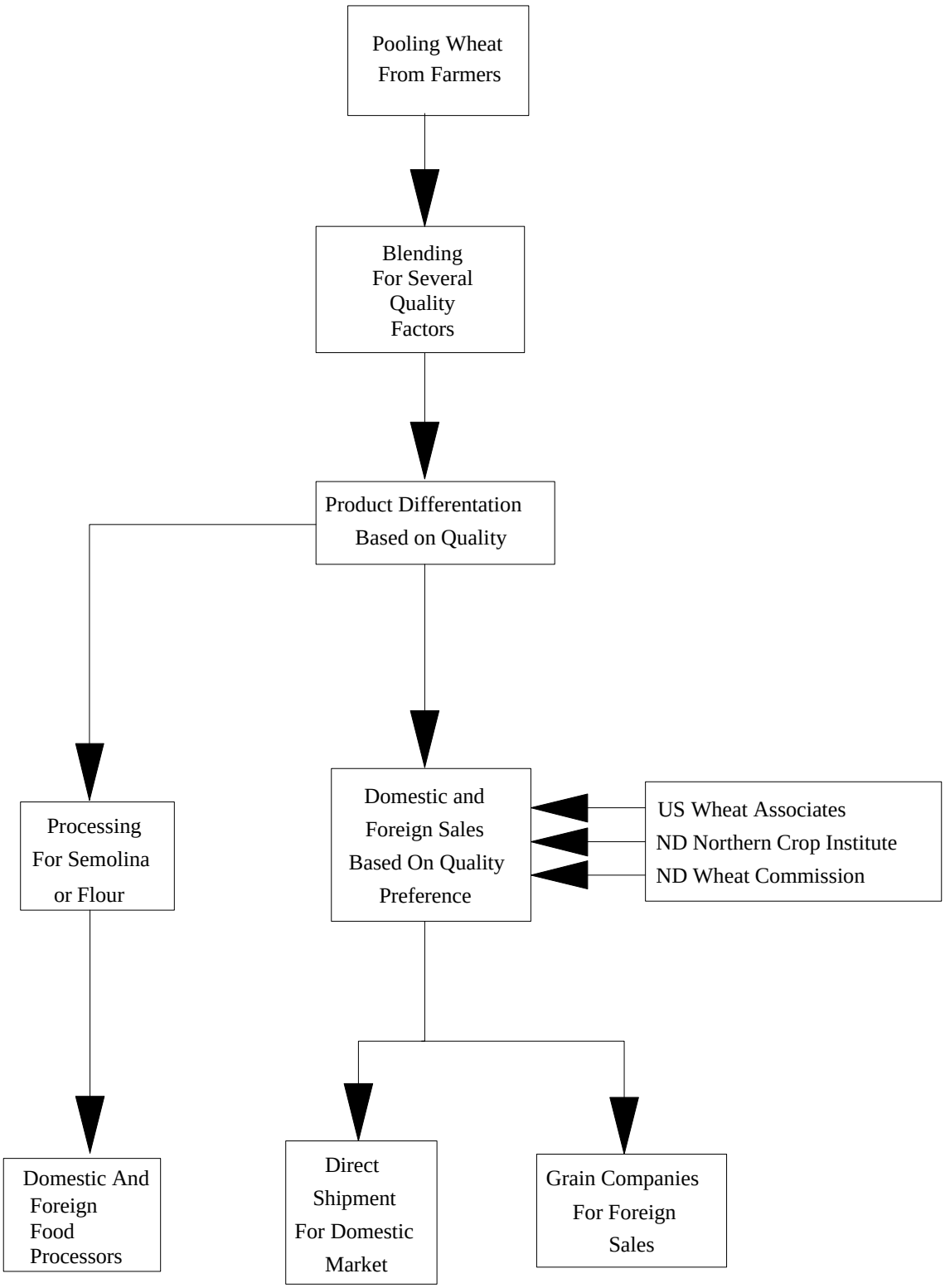


Figure 7.1. Strategies/Marketing Structure of the North Dakota Wheat Pool

Payment Schedule

Incentive and Scheduled Payments

The incentive payment is used to attract producers to the pool operation. In general, higher incentive payments will attract more participants to the pool. It has been suggested that $1.00 per bushel be given to producers at sign up. A concern is how to finance the incentive payment. The payment could come from either state government as a form of subsidy or from the state bank or commercial bank as a loan. A state government subsidy might violate the WTO agreement, and would require approval of the North Dakota legislature.

If the incentive payment is to be subsidy neutral, it must be financed by a bank and the pool would be responsible for the repayment of the loan. In this case, the pool would have to arrange multi-year contract with its members. Otherwise, members would exit after receiving the incentive payment.

For instance, assume that the incentive payment is $1.00 per bushel to those who participate in the pool and that the pool finances this payment with a bank loan at an 8 percent interest rate. The pool's annual payment to the bank would be 38.8 cents per bushel per year with a 3-year contract and 25.0 cents per bushel per year with a 5-year contract.

The initial payment would be paid to producers upon delivery of wheat to the local elevator. The initial payment would equal a percentage of current market price or the CCC loan rate for wheat in that county. The delivery of wheat would be spread out over the marketing year to ease the transportation of wheat. The interim payment may be made to producers after the committed volume of wheat is sold. The final payment would be made in April or May after the marketing activities of the pool are finished.

The provisions of the Commodity Credit Corporation loan program permit qualified cooperatives to obtain loans on wheat on behalf of their member producers. To qualify for a support loan, the cooperative must meet specific requirements of a bonafide cooperative, including having a market agreement with producers and operating a system of pooling. This "cooperative provision" of the price support loan programs permits cooperatives to obtain loans for member producers. Funds from these loans may be used to make advance payments to members after they deliver their products.

Payment Examples for the Pool Members

The following example demonstrates how payments to pool members may be determined. Assume that there are three members producing durum wheat of three grades (Table 7.1). Each grade is treated as a sub-pool for the purpose of calculating payments. It is assumed that producer A commits 2,000 acres, producer B also commits 2,000 acres, and producer C commits 1,000 acres. With an average yield of 30 bushels per acre, producers A and B deliver 60,000 bushels each and producer C delivers 30,000 bushels. It is assumed that the local elevator charges $0.10 per bushel for cleaning and handling and that the pool charges $0.05 per bushel as management expenses. A quantity premium is made based on the number of bushels delivered to the pool. For example, a $0.06 per bushel premium is paid to producers who deliver over 20,000 bushels and $0.03 per bushel premium is paid to the producer who delivers between 10,000 and 20,000 bushels. Efficiency gains through blending, cleaning, and storage are assumed to be $0.28 per bushel for durum wheat.

Table 7.1 Payment Examples for Durum Wheat Under the Joint Pool

Farm	Acres	Grade 1	Grade 2	Grade 3 and 4	Total
	acres	---bushels---			
A	2,000	20,000	20,000	20,000	60,000
B	2,000	10,000	20,000	30,000	60,000
C	1,000	10,000	15,000	5,000	30,000
		---$/bu---			
Pool Price		5.00	4.80	3.28	
Efficiency Gain		0.28	0.28	0.00	
Initial Payment		3.25	3.25	2.75	
Interim Payment		1.00	1.00	0.40	
Operating Exp		0.05	0.05	0.03	
Handling and Cleaning Cost		0.10	0.10	0.10	
Final Payment		0.88	0.68	0.00	
Average Payment Received by Pool		5.13	4.93	3.15	
Quantity Premium		bushels	$/bu		$
First		10,000	0.00		
Next		10,000	0.03		
Greater		20,000	0.06		
Producer A					
Initial Payment		20,000	3.25		65,000
		20,000	3.25		65,000
		20,000	2.75		55,000
Interim Payment		20,000	1.00		20,000
		20,000	1.00		20,000
		20,000	0.40		8,000
Quantity Payment					2,700
Final Payment		20,000	0.88		17,600
		20,000	0.68		13,600
Total Payment					266,900
Average					$4.45
Producer B					
Initial Payment		10,000	3.25		32,500
		20,000	3.25		65,000
		30,000	2.75		82,500
Interim Payment		10,000	1.00		10,000
		20,000	1.00		20,000
		30,000	0.40		12,000
Quantity Payment					2,700
Final Payment		10,000	0.88		8,800
		20,000	0.68		13,600
Total Payment					247,100
Average					$4.12
Producer C					
Initial Payment		10,000	3.25		32,500
		15,000	3.25		48,750
		5,000	2.75		13,750
Interim Payment		10,000	1.00		10,000
		15,000	1.00		15,000
		5,000	0.40		2,000
Quantity Payment					900
Final Payment		10,000	0.88		8,800
		15,000	0.68		10,200
Total Payment					141,900
Average					$4.73

Upon delivery, it is assumed that the producers receive an initial payment of $3.25 for grades 1 and 2, and $2.75 for grades 3 and 4 because grades 3 and 4 will be exported into the world market. During the year the producers are assumed to be paid an interim payment of $1.00 for grades 1 and 2, and $0.40 for grades 3 and 4. The final payment will be made when the marketing year is finished and all of the contents of the pool are sold and all expenses are paid.

Each producer will receive a different average price paid per bushel because of the different grades delivered and different quantities committed. The average price for Producer A is $4.45 per bushel, while that for producer B is $4.12 per bushel because producer A delivers more grade 1 durum and less grade 3 and 4 durum than producer B. Producer C averages $4.73 per bushel even though he commits less durum wheat, because he delivers a higher proportion of grades 1 and 2.

Table 7.2 shows the same example for spring wheat. The three producers commit the same acreage as in the previous example. The main difference is that 50 percent of the spring wheat is assumed to be sold to domestic processors at $4.00 and 50 percent is sold to overseas markets at $3.15. Efficiency gains are $0.09 per bushel. Other expenses are the same as those for durum wheat. An initial payment of $3.00 is paid upon delivery and an interim payment of $0.50 is made for the domestic sales portion. The average price for producers A and B is $3.52 and that for producer C is $3.50. The producers receive similar average prices because a fixed proportion is sold domestically and overseas.

Sensitivity of Payments

The total producer payment is sensitive to several factors. These include the length of the contract, the ratio of domestic sales to foreign sales, and whether the incentive payment is a subsidy or a loan. Table 7-3 shows the total payment when these three factors are varied. It is assumed that the pool handles 50 million bushels of durum wheat, and spends $1.21 million dollars for its operation. Domestic sales are made at $5.00 per bushel, and foreign sales are made at $3.50 per bushel. The incentive payment of $1.00 per bushel is paid at sign up time, the initial payment of $2.75 is paid at delivery to the local elevator, and the final payment is made in April or May the following year when the marketing activities of the pool are finished.

For a 3-year contract, if the pool sells one-half of the durum wheat domestically and pays back the incentive payment, the producers receives $3.89 per bushel plus the $1.00 incentive payment. If one-half of the incentive payment is not paid back, the producer receives $4.06 per bushel. If the pool sells 60 percent of the durum wheat domestically and pays back the incentive payment, the producers receive $4.04. If one-half of the incentive payment is not paid back, the producer receives $4.21 per bushel. The returns for a 5-year contract are higher because the incentive payment can be paid back over a longer period of time.

Table 7.2. Payment Examples for Spring Wheat Under the Joint Pool

Farm	Acres	Domestic	Export	Total
	acres	----------bushels----------		
A	2,000	30,000	30,000	60,000
B	2,000	30,000	30,000	60,000
C	1,000	15,000	15,000	30,000
		----------$/bu----------		
Pool Price		4.00	3.15	
Efficiency Gain		0.09	0.00	
Initial Payment		3.00	3.00	
Intern Payment		0.50	0.00	
Operating Exp.		0.05	0.05	
Handling and Cleaning Cost		0.10	0.10	
Final Payment		0.44	0.00	
Average Payment Received by Pool		3.94	3.00	
Quantity Premium		bushels	$/bu	
First		10,000	0.00	
Next		10,000	0.03	
Greater		20,000	0.06	
Producer A		bushels	$/bu	$
Initial Payment		30,000	3.00	90,000
		30,000	3.00	90,000
Interim Payment		30,000	0.50	15,000
		30,000	0.00	0
Quantity Payment				2,700
Final Payment		30,000	0.44	13,200
		30,000	0.00	
Total Payment				210,900
Average				$3.52
Producer B				
Initial Payment		30,000	3.00	90,000
		30,000	3.00	90,000
Interim Payment		30,000	0.50	15,000
		30,000	0.00	0
Quantity Payment				2,700
Final Payment		30,000	0.44	13,200
		30,000	0.00	
Total Payment				210,900
Average				$3.52
Producer C				
Initial Payment		15,000	3.00	45,000
		15,000	3.00	45,000
Interim Payment		15,000	0.50	7,500
		15,000	0.00	0
Quantity Payment				900
Final Payment		15,000	0.44	6,600
		15,000	0.00	
Total Payment				105,000
Average				$3.50

Table 7.3. Sensitivity of Producer Member's Return to Contract Length, Ratio of Domestic Sales to Foreign Sales, and Pay-back Schedule of Incentive Payment

Contract Length	Domestic Sale	Foreign Sale	Incentive Payback	Initial Payment	Final Payment	Total Payment
Year	----------Percent----------			----------$/bu----------		
3	50	50	100	2.75	1.14	3.89
3	50	50	50	2.75	1.31	4.06
3	60	40	100	2.75	1.29	4.04
3	60	40	50	2.75	1.46	4.21
3	40	60	100	2.75	0.99	3.74
3	40	60	50	2.75	1.16	3.91
5	50	50	100	2.75	1.28	4.03
5	50	50	50	2.75	1.38	4.13
5	60	40	100	2.75	1.43	4.18
5	60	40	50	2.75	1.53	4.28
5	40	60	100	2.75	1.13	3.88
5	40	60	50	2.75	1.23	3.98

8. Organizational Structure and Handling Mechanism

Organizational Structure for the North Dakota Wheat Pool

Figure 8.1 shows the organizational structure for the North Dakota Wheat Pool. The pool is organized as a cooperative with an elected board of directors. The manager is responsible for the day-to-day operation of the pool and answers to the board of directors. The pool is divided into five divisions; Sales and Marketing, Membership Promotions, Accounting, Transportation, and Research. The Sales and Marketing division is responsible for sales of durum wheat in both domestic and overseas markets. It is also responsible for the promotion and advertising of the products of the pool. The Membership Promotion division is responsible for the education of growers, membership organization, and information transfer between the pool and its members. The Accounting division is responsible for all financial records, bookkeeping requirements, and operational records. The Transportation division is responsible for all logistics needs of the pool, transportation from local elevators to the domestic market, and transportation from local elevators to seaports for overseas sales. The Research division is responsible for production research, consumption characteristics, and price trends in both domestic and overseas markets.

The organizational structure for the North Dakota HRS Wheat Pool is the same as that for the North Dakota Durum Wheat Pool. More personnel are involved in the five divisions in the North Dakota HRS Wheat Pool; seven people in sales/marketing, four people in promotion, six people in accounting, four people in transportation, two people in research, and eight people in the secretarial pool.

Estimated Operating Expenses for the North Dakota Durum Wheat Pool

Table 8.1 shows the estimated operating expenses for the North Dakota Durum Wheat Pool. It is assumed that the pool handles 50 million bushels of durum. The manager earns $120,000 per year and others in the organization earn between $40,000 and $50,000 per year. Benefits, including health insurance and retirement plans, are assumed to be 30 percent of salary. The other operating expenses include office rent and operation, communications and computer expense, other office equipment, utilities, legal fees, travel, and advertising. Estimated office space required for 11 offices with a secretarial pool, meeting room, reception area, and storage area is about 1800 sq. feet. The pool requires 16 computers networked with 5 printers and fax machine. A telephone system can be rented from AT&T. A copy machine can also be rented from the manufacturer. Other office equipment including desks, chairs, file cabinets, and storage shelves can be purchased from local office supply retailers. The useful life for computers is three years. Other electronic equipment is assumed to have a useful life of 5 years. Office equipment is assumed to have a useful life of 10 years. Total estimated operating expense is $1,186,000 or about 2.37 cents per bushel.

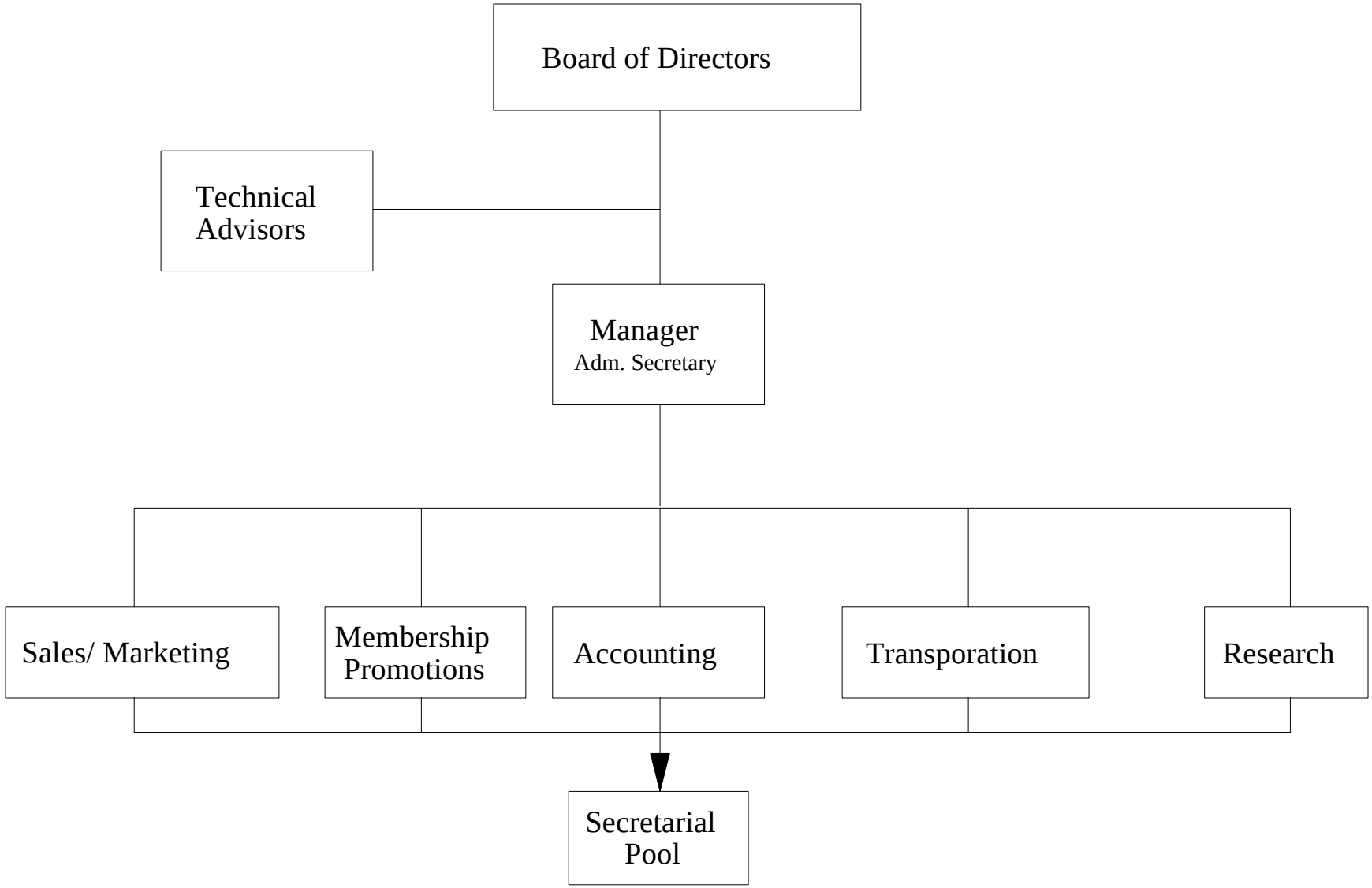


Figure 8.1. Organizational Structure for the North Dakota Wheat Pool

Table 8.1. Operating Expenses for the North Dakota Durum Wheat Pool

Human Resources, Salaries	Salary	Total
Manager (1)	120,000	120,000
Sales/Marketing (3)	50,000	150,000
Promotions (2)	40,000	80,000
Accounting (2)	40,000	80,000
Transportation (2)	50,000	100,000
Research (1)	45,000	45,000
Secretarial (4)		85,000
Benefits (30%)		198,000
Salary Total		858,000
Other Operating		
Communications and Information[a]		27,000
Office and Equipment[b]		80,000
Utilities		15,000
Repair and Supplies		36,000
Bonds and Insurance		5,000
Legal and Audit Fees		25,000
Consulting		20,000
Promotions and Advertising		50,000
Travel and Transportation		70,000
Total		$1,186,000

[a]Includes computer system, telephone, fax machine, printers, software.
[b]Includes office rent of other office equipment.

Estimated Operating Expenses for the North Dakota Hard Red Spring Wheat Pool

Table 8.2 shows the estimated operating expenses for the North Dakota Spring Wheat Pool. It is assumed that the pool markets 50 percent of the North Dakota spring wheat crop or 136 million bushels. The manager earns $120,000 per year and others in the organization earn between $40,000 and $50,000 per year. Benefits including health insurance and retirement plans, are assumed to be 30 percent of the salary. The other operating expenses include office rent and operation, communications and computer expense, other office equipment, utilities, legal fees, travel, and advertising. Estimated office space required for 24 offices with secretarial pool, meeting room, reception area, and storage area is about 4200 sq. feet. The pool requires 35 computers networked with 10 printers and Fax machine. A telephone system can be rented from AT&T. A copy machine can also be rented from the manufacturer. Other office equipment, including desks, chairs, file cabinets, and storage shelves, can be purchased from local office supply retailers. The useful life for computers is three years. Other electronic equipment is assumed to have a useful life of 5 years. Other office equipment is assumed to have a useful life of 10 years. Total estimated operating expense is $2,484,000 or about 1.83 cents per bushel.

Table 8.2. Operating Expenses for the North Dakota Hard Red Spring Wheat Pool

Human Resources, Salaries	Salary	Total
Manager (1)	120,000	120,000
Sales/Marketing (7)	50,000	350,000
Promotions (4)	40,000	160,000
Accounting (6)	40,000	240,000
Transportation (4)	50,000	200,000
Research (2)	45,000	90,000
Secretarial (8)		170,000
Benefits (30%)		399,000
Salary Total		1,729,000
Other operating		
Communications and information[a]		62,000
Office and equipment[b]		184,000
Utilities		34,000
Repair and supplies		83,000
Bonds and insurance		12,000
Legal and audit fees		58,000
Consulting		46,000
Promotions and advertising		115,000
Travel and transportation		161,000
Total		$2,484,000

[a] Includes computer system, telephone, fax machine, printers, software.
[b] Includes office rent of other office equipment.

Components in the Pooling Agreement

The pooling agreement is a legal document, signed by the producer member and a pool representative outlining the rights and responsibilities of both parties. Most pooling agreements should contain the following elements (Dunn, Thurston and Famis):

1. Producer Commitment

The pooling agreement will outline the extent of a member's commitment to deliver wheat to the pool. This commitment may be in terms of the production of a specified number of acres. Occasionally grade or variety specification are made, as are limitations of acceptable forms of on-farm storage.

2. Cooperative Commitment

With the pooling agreement, the cooperative commits itself to seeking the highest possible average price for its members' products while keeping per unit administration costs to a minimum. To aid the cooperative in fulfilling its responsibilities, the pooling agreement usually grants the pool's management the authority to establish grading, classification, handling, storage, financing, testing, and selling practices.

3. Duration of the Agreement

The pooling agreement will state the period for which the agreement is in force. Special circumstances under which early termination of the agreement is allowed may be stated. The time period of specific pools may be included. Provisions are generally made for the way in which pool carryover, the crop remaining unsold at the end of the pool period, will be disposed.

4. Qualifications for Membership

The agreement may state specific qualifications that a producer must meet to become a pool member. Such qualifications may deal with type of operation or location.

5. Payments to Producers

The pooling agreement may outline the payment procedures to members. Typically, provisions are made for advance, progress, and final payments. A specific method of determining the size of the advance payment may be included. The pool may be given the right to obtain funds for advance payments by using the pool's contents as collateral for some type of loan.

6. Financing the Pool

The pooling agreement usually contains provisions for financing the pool. A method of allocating expenses among members and deducting for expenses is often specified. A maximum amount to be withheld as capital retention is frequently stated on a per unit basis.

7. Other Provisions

The pooling agreement may contain a number of other provisions covering a variety of topics. These include penalties for breach of agreement by either party, identification of creditors and claims, conditions for renewal of the agreement, and limitations of the agreement.

9. Summary and Conclusions

North Dakota Farmers Union has proposed marketing pools for durum and HRS wheat. The main purpose of the pools would be to enhance net farm income for wheat producers in North Dakota. In principle, pools could accomplish this through improved marketing efficiency, or by exerting market power. The overall objective of this study is to evaluate the economic feasibility of proposed pools for durum and HRS wheat produced in this region.

North Dakota produces about 80 percent of the durum wheat produced in the United States and about 50 percent of the HRS wheat. North Dakota's market share for durum wheat is about 60 percent of U.S. consumption. The United States imports about 24 million bushels (0.67 million metric tons) of durum wheat, mainly from Canada and also exports about 45 million bushels (1.23 million metric tons) of durum wheat. North Dakota's market share of HRS wheat is about 40 percent of U.S. consumption. The United States imports about 45 million bushels (1.23 million metric tons) of HRS wheat, mainly from Canada, and exports about 239 million bushels (6.8 million metric tons). Unlike durum wheat, HRS wheat is substitutable with hard red winter wheat. HRS wheat represents about 30 percent of the U.S. hard wheat production. Domestic demand for HRS wheat is very sensitive to the price of HRS wheat (price-elastic), while demand for durum wheat is much less sensitive to the price of durum (price-inelastic). On the supply side, however, supply of HRS wheat is less price sensitive than the supply of durum wheat.

The total benefits of the Canadian Wheat Board, including single-desk selling, pool account deficit transfers, guaranteed borrowing, and risk management, sum to $23.23/tonne for the 1980/81 to 1993/94 period. This amount is based on conservative estimates for each source of benefit. The total costs sum to $13.59. Subtracting the costs from the benefits leaves a net benefit of $9.64/tonne (or $0.26 per bushel). These benefits are largely attributed to the mandatory nature of pooling in Canada and special features of the Canadian system.

The proposed pools would be based on voluntary participation. Previous studies have pointed to problems with voluntary pooling. While a voluntary pool can offer improved marketing efficiency (relative to independent selling by producers), its ability to raise domestic prices by exercising market power is limited. Under a voluntary pool, non-members become 'free-riders' and weaken its market power. A feasible option is to have a multi-year contract with pool participants. The optimal contract period is estimated to be 4 to 5 years. The CWB claims to be effective in generating additional revenue for producers, but participation is mandatary for wheat and barley growers in western Canada.

The success of the pool depends upon its market share in the United States and the extent of potential cooperation with the CWB. Without full cooperation from the CWB, the proposed ND Wheat Pool may not be able to raise domestic prices substantially. Millers in the United States will buy wheat from Canada if the pool attempts to raise its domestic price without such cooperation. In general, the pool is unlikely to exert much market power if its market share is less than 50 percent.

If North Dakota forms a voluntary pool for durum wheat and operates independently without CWB cooperation, increases in total revenue, relative to the competitive scenario, would be $46.29 million, given a 60 percent market share. The domestic durum price could be $1.48 per bushel higher than under competitive marketing. With decreased market shares, the potential increases in revenue are smaller. Since Canada can increase its exports to the United States in response to a price increase, the pool's market share may shrink in absence of some form of cooperation with Canada.

If the ND Durum Wheat Pool operates with full cooperation of the CWB, the pool would be capable of raising domestic prices substantially under three alternative pooling scenarios. With a combined market share of 80 percent, increases in total revenue, relative to the competitive scenario, could reach $134.5 million, with a domestic price of $7.46 per bushel under the unlimited quantity restriction scenario. Gains are somewhat smaller if the pool's supply reductions are limited to 10 or 15 percent. Pool prices would be much higher than the competitive market price of $3.50/bushel.

The ND Wheat Pool would have less capacity to raise the price of HRS wheat. That is because (1) HRS and winter wheats are highly substitutable; and (2) the pool's market share in the U.S. hard wheat market is too small to provide effective market power. Because of these characteristics, potential increases in total revenue would be quite small, even if the pool could secure full cooperation from the CWB.

A concern is the pool may not be able to sustain the inflated domestic price of wheat in the long run mainly because the pool price will increase supply of wheat substantially. Supply elasticities are estimated to be 0.86 for durum wheat and 0.3 for hard red spring wheat. However, this study indicates that the pool is still viable in the long run and could provide additional revenue for members. This is especially true for the durum wheat pool with full cooperation of the CWB.

The ND pools for durum wheat and hard red spring wheat could seek to raise producer returns through improved marketing efficiency, marketing strategies (e.g., contract sales), and risk management. The efficiency gains through the pool operation are estimated to be $0.16-$0.28/bushel for durum wheat and $0.07-$0.09/bushel for hard red spring wheat. In addition, pooling would reduce the level of price risk now faced by many wheat producers.

Annual operating costs would be $1.19 million for the durum wheat pool. Assuming it handles about 50 million bushels of durum wheat annually, this is equivalent $0.023/bushel. Operating costs for the HRS wheat pool would be $2.48 million with annual volume of 136 million bushels, which is equivalent to $0.018/bushel.

In conclusion, the ND Durum Wheat Pool may provide additional revenue to durum wheat producers by raising the domestic prices jointly with the CWB in the North American market. If such cooperation were feasible, the domestic price could be driven substantially higher than the world equilibrium price, which would work to the mutual benefit of U.S. and Canadian producers. On the other hand, the ND Spring Wheat Pool is less likely to provide additional revenue to spring wheat producers in the state by raising domestic prices, even with full cooperation from the CWB. HRS wheat is highly substitutable with hard red winter wheat and the pool may not have enough market power in the North American market.

10. Major Issues and Concerns

Incentive Payments and Contracts

The pool can offer incentive payments to those who participate in the pool. The purpose of this incentive payment is to attract producers to the pool operation. In general, higher incentive payments will attract more participants to the pool. The concern is how to finance the incentive payment. The payment could come from either the state government as a form of subsidy or from the state bank or commercial banks as a loan. A state government subsidy might violate the WTO agreement and would require approval of the North Dakota legislature.

If the incentive payment is subsidy-neutral, it must be financed by a bank and the pool would be responsible for the repayment of the loan. In this case, the pool would have to arrange multi-year contracts with its members; otherwise, members would exit after receiving the incentive payment. The magnitude of the incentive payment, therefore, should depend upon the contract period and expected additional revenue from the pool operation.

For instance, assume that the incentive payment is 80 cents per bushel to those who participate in the durum wheat pool, with a five-year contract, and that the pool finances this payment with a bank loan. Then the pool must repay the principal and interest during the contract period. The pool's annual payment to the bank would be 20 cents per bushel per year (with an 8 percent interest rate) from its revenue.

Payments to Producers

Payments to producers will be lower than the domestic price of wheat set by the pool. The reason is that only part of the pool's wheat is sold at the high domestic price; the remainder is sold at a lower price in the world market. In addition, the pool will have operating expenses which should be paid from the pool's revenue. For example, if the pool sold 20 million bushels at $6.00 in the domestic market and 10 million bushels at $4.50 in the world market, the average price would be $5.50 per bushel. The final payment to producers would be the average price minus the pool's operating cost per bushel (5 cents per bushel). The total payment to the member, therefore, is lower than the domestic price. Because of this difference, members could seek to exit the pool in order to receive the higher domestic price. These free riders would weaken the market power of the pool.

Supply Response

The supply of durum wheat is very elastic in some regions in the United States. For instance, the price elasticity of supply of durum wheat is 2.0 in the desert region and 0.98 in other regions. The price elasticity of supply is 0.86 in North Dakota. This implies that a 10 percent increase in the price of durum wheat would induce about the same percentage increase in supply. If the pool were to raise the domestic price of durum by 30 percent (e.g., from $4.00 per bushel to $5.20 per bushel), the domestic supply of durum wheat would increase by 30 percent. To the extent that additional production is supplied by free riders, this will weaken the market power of the pool.

An alternative would be to form a U.S. durum wheat pool by including producers in all durum wheat producing states, mainly Montana, Minnesota, California, and Arizona.

Cooperation with the Canadian Wheat Board

For effective exercise of market power, the durum wheat pool would require cooperation from the CWB. The CWB is capable of supplying large amounts of durum wheat to millers in the United States as long as the U.S. domestic price of durum wheat is higher than alternative markets, net of shipping costs. However, if the ND Wheat Pool and the CWB cooperate with each other, the two parties can jointly determine a minimum price of durum wheat, which would be much higher than the competitive price in the North American market. This cooperation would entail the CWB restricting its durum wheat exports to the United States to an agreed level. As long as the ND Wheat Pool and the CWB continue to honor the agreement, producers in the two countries could earn additional revenue. However, the legality of such cooperation (if based on an explicit agreement) would have to be determined. In absence of an explicit market-sharing and pricing agreement, cooperation would have to be implicit, based on recognition of mutual interests.

On-farm Storage

The carry-over stock at the end of the 1997-98 marketing year was about 23 million bushels for durum wheat and 228 million bushels for hard red spring wheat. The pool may have to absorb a major portion of these stocks to effectively exercise its market power, and some of the remaining stocks could be supplied to the domestic market by non-members. Large current carry-over stocks, therefore, may reduce the pool's effective market share and weaken its market power.

References

Armington, Paul S. *A Theory of Demand for Products Distinguished by Place of Production*, IMF Staff Papers 16. 1969.

Benirschka, Martin, and W. Koo. *World Wheat Policy Simulation Model: Description and Computer Program Documentation*, Ag. Econ. Rpt. #340, Dept. of Ag. Econ., NDSU, Fargo, December 1995.

Canadian Wheat Board (CWB), *Grain Matters*, September 1998.

Carter, Colin, and R.M.A. Loyns, *The Economics of Single Desk Selling of Western Canadian Grain*, March 1996.

Dahl, Bruce L., and Wilson, W. William. *Consistency of Quality Characteristics in Hard Red Spring Wheats*, Ag. Econ. Rpt. # 393-S, Dept. of Ag. Econ., NDSU, Fargo, 1998.

Dunn John R., Stanley Thurston, and William Farris. *Some Answers to Questions About Commodity Marketing Pools*, EC-509, U.S. Department of Agriculture, Washington, DC..

Fulton, Murray, and James Vercammen. *Dual Marketing and the Decisions Facing Western Canadian Farmers for Wheat and Barley Marketing: A Brief to the Western Grain Marketing Panel*, Centre for the Study of Co-operatives, University of Saskatchewan, Saskatoon, 1996.

International Grains Council. *World Grains Statistics*, London, England, 1996/97.

Kraft, Daryl, W. H. Furtan, and E. Tyrchniewicz. *Performance Evaluation of the Canadian Wheat Board*, January 1996.

Kreps, M. David. *A Course in Microeconomic Theory*, Princeton University Press, 41 William Street, Princeton, NJ, 1990.

Kreps, D., P. Milgrom, and R. Wilson. 1982. "Rational Cooperation in th Finitely Repeated Prisoners' Dilemma." *Journal of Economic Theory* 27:245-79, 1982.

Nash, J. "The Bargaining Problem." *Econometrica* 18:155-62, 1950.

Nash, J. "Two-Person Cooperative Games." *Econometrica* 21:128-40, 1953.

National Agricultural Statistics Service. *Historical Data*. Http://www.usda.gov/Nass/sso-rpts.html.

Rubinstein, A. "A Perfect Equilibrium in Bargaining Models." *Econometrica* 50:97-109, 1982.

Schmitz, Andrew, R. Gray, T. Schmitz, and G. Storey. *The CWB and Barley Marketing: Price Pooling and Single-Desk Selling*, January 1997.

Schmitz, Troy, and W. Koo. *An Economic Analysis of International Feed and Malting Barley Markets: An Econometric Spatial Oligopolistic Approach*, Ag. Econ. Report #357, Dept. of Ag. Econ., NDSU, Fargo, September 1996.

Schmitz, Andrew, A. McCalla, D. Mitchell, and C. Carter. *Grain Export Cartels*, Ballinger Publishing Co., Cambridge, MT, 1981.

Simonot, David. *The Economics of State Trading in Wheat*, July 1997.

Statistics Canada, CANSIM. *Wheat Production*. Http://www.statcan.ca/english/CANSIM/index.html

USDA Economics and Statistics System. *Field Crops/Wheat*. Http://usda.mannlib.cornell.edu/usda/usda.html.

APPENDIX

Economic Impact of Pooling Alternatives

F. Larry Leistritz[5]

The statewide economic impact of the various pooling alternatives was analyzed using the North Dakota Input-Output Model, which consists of interdependence coefficients or multipliers that measure the level of business activity generated in each economic sector from an additional dollar of expenditures in a given sector. (A sector is a group of similar economic units, e.g., the firms engaged in retail trade make up the retail trade sector.) For a complete description of the input-output model, see Coon and Leistritz (1989). The increased gross business volumes are used to estimate secondary employment and tax revenues based on historic relationships.

In analyzing the impacts of the pooling alternatives, the effects of pooling on North Dakota producers' net revenue (i.e., changes in total revenue from marketings plus gains in efficiency) were assumed to constitute the **direct impacts** of pooling and were assumed to represent an equivalent increase in the net income of farm households. These direct impacts (direct effects) were taken to represent increases in revenues of the *Households* sector within the input-output model. The model's interdependence coefficients or multipliers were then applied to estimate the total (direct plus secondary) impacts of each alternative.

The economic impacts of the durum pooling options are summarized in Table A. The North Dakota pool assumes a market share of 0.5, and impacts are evaluated for the unlimited quantity reduction scenario (high scenario-- see Table 5.1), the 10 percent quantity reduction scenario (low scenario), and the average of the two. Similarly, the joint pool assumes a market share of 0.8, and impacts are assessed for the high and low scenarios (Table 5.2), as well as for an average of these two outcomes. For the North Dakota pool, the high scenario results in a direct economic impact of $29.8 million (Table A). When the input-output interdependence coefficients are applied, the total impacts were estimated to be about $91.7 million, implying that secondary impacts across all sectors of the state economy were about $61.9 million. The total economic impact for this scenario includes additional retail sales of $22.2 million and personal income of $46.3 million (i.e., the direct effect of $29.8 million plus a secondary impact of $16.5 million). The gross business volume generated in the various sectors of the state economy would be sufficient to support 911 secondary jobs (i.e., 911 full-time equivalent [FTE] employment opportunities). The added gross business volumes also would result in added revenues from selected state taxes: sales and use tax -- $1.0 million, personal income tax -- $0.60 million, and corporate income tax -- $0.12 million. The interpretation of the other scenarios is similar.

The economic impacts of spring wheat pooling alternatives are summarized in Table B. Because the results from the different scenarios of the North Dakota pool were quite similar, impacts were estimated for an average of the high and low alternatives. The same procedure was followed for the joint pool.

References

Coon, R. C., and F. L. Leistritz. 1989. *The North Dakota Economy in 1988: Historic Economic Base, Recent Changes, and Projected Future Trends.* Agr. Econ. Stat. Series No. 45. Fargo: North Dakota State University.

---

[5]Leistritz is a professor of Agricultural Economics, North Dakota State University.

Table A. Economic Impacts of Durum Pooling Alternatives

Impact Measure	Unit	Alternative: North Dakota Pool[1] High	North Dakota Pool[1] Low	North Dakota Pool[1] Average	Joint Pool[1] High	Joint Pool[1] Low	Joint Pool[1] Average
Direct Economic Impact	($ million)	29.8	6.9	23.3	145.4	69.8	107.6
Total Economic Impact:							
Personal income	(“)	46.3	26.2	36.2	225.7	108.4	167.0
Retail sales	(“)	22.2	12.6	17.4	108.3	52.0	80.1
Gross business volume, all sectors	(“)	91.7	52.0	71.7	447.6	214.9	331.2
Secondary employment	(FTE jobs)	911.0	513.0	712.0	4,474.0	2,142.0	3,308.0
Revenue from selected state taxes:							
Personal income tax	($ 000)	601.4	341.1	470.2	2,934.3	1,408.7	2,171.5
Sales and use tax	(“)	1,027.5	582.7	803.4	5,013.3	2,406.7	3,710.0
Corporate income tax	(“)	122.3	69.2	95.4	595.3	285.8	440.5
Total	(“)	1,751.2	993.0	1,369.0	8,542.9	4,101.2	6,322.0

[1] North Dakota pool assumes 0.5 market share; joint pool assumes 0.8 market share.

Table B. Economic Impacts of Hard Red Spring Wheat (HRS) Pooling Alternatives

Impact Measure	Units	Alternative	
		North Dakota (ave.)[1]	Joint Pool (ave.)[1]
Direct Economic Impact	($ million)	14.0	21.9
Total Economic Impact:			
Personal income	(“)	21.7	34.0
Retail sales	(“)	10.4	16.3
Gross business volume, all sectors	(“)	43.2	67.4
Secondary employment	(FTE jobs)	426	667
Revenue from selected state taxes:			
Personal income tax	($000)	282.9	442.0
Sales and use tax	(“)	483.4	755.1
Corporate income tax	(“)	57.4	89.7
Total	(“)	823.7	1,286.8

[1] North Dakota pool assumes 0.4 market share; joint pool assumes 0.6 market share.