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# STRUCTURAL DEVELOPMENTS IN THE U.S. GRAINS SUBSECTOR

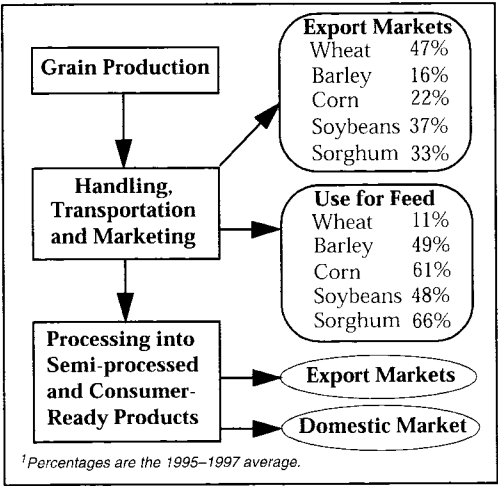
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## INTRODUCTION

The purpose of this paper is to describe major changes in the structure of the U.S. grains sector and to assess how these structural changes will affect the sector's competitiveness. Part of this assessment involves evaluating the impact of integrating the grains sector of the United States with that of Canada and Mexico, as a result of the North American Free Trade Agreement (NAFTA). This paper focuses on wheat, barley, grain sorghum, corn and soybeans, the most important grains and oilseeds in the United States. Cash receipts for these five crops were \$50 billion in 1997 and accounted for 25 percent of total farm receipts.

To assess changes in the industry it is necessary to understand its structure. Figure 1 illustrates the components of the industry and how they are linked. Bulk grains and oilseeds have three markets: export markets as primary undifferentiated products, domestic markets for further processing, and domestic feed markets. An efficient production sector alone does not ensure competitiveness as handling, transportation and marketing contribute heavily to the cost of grains. Semi-processed products include flour and oil used in the production of consumer-ready products for domestic or export markets.

Figure 1: Structure of U.S. Grains Sector<sup>1</sup>



<sup>1</sup> Percentages are the 1995-1997 average.

Given the complexity of evaluating markets for the major grains, only the most important changes will be discussed. Emphasis will be placed on evaluating the impact of changes on the ability of the U.S. grains sector to compete in both the domestic and world markets.

The first part of the paper includes an examination of recent trends in grain production. The following investigation into domestic commodity policy includes the impact on:

- supply response,
- stockholding and price variability, and
- acres retired from production under the Conservation Reserve Program (CRP).

The second part of the paper addresses changes in handling, marketing and processing including:

- the impact of NAFTA on trade flows and market integration,
- trends in food processing for grains and oilseed products, and
- implications of food and feed use of grains and oilseeds for U.S. markets.

## **GRAIN PRODUCTION**

### **Trends in North American Grain Production**

**Wheat.** U.S. wheat production was 68.7 million metric tons (mmt) in 1997, an increase of 17 percent since 1987 (see Table 1). Over the last decade wheat production increased by 54 percent in the Northern Plains, 15 percent in the Central Plains, and 28 percent in the Far West. Wheat production and yields decreased in the Corn Belt and Southern Plains. In all other regions of the U.S. wheat yields increased an average 7 percent since 1987.

The average increase in yield for the United States masks a wide variation in the realized yield of different classes of wheat. Hard red winter wheat yields declined between 1982 and 1995. Epplin (1997) investigated the impact of U.S. domestic farm programs on production of hard red winter wheat. While his empirical work was limited to Oklahoma, the results appear applicable to other states. Epplin found that domestic commodity programs provided incentives for increased grazing of winter wheat acres. Other changes in production practices, such as the variety selected and the planting date, optimized the sum of grazing and wheat production. However, these changes caused a downward trend in yield.

**Table 1: Trends in U.S. Grain Production, 1997 Production (mmt) and Percentage Change from 1987**

	Barley		Corn		Sorghum		Soybeans		Wheat	
	mmt	% chg	mmt	% chg	mmt	% chg	mmt	% chg	mmt	% chg
<b>U.S.</b>	<b>8.15</b>	<b>-7</b>	<b>237.90</b>	<b>33</b>	<b>16.59</b>	<b>2</b>	<b>74.20</b>	<b>35</b>	<b>68.77</b>	<b>17</b>
Corn Belt	0.00	0	116.70	26	1.40	3	41.50	35	6.41	-11
Central Plains	0.24	-37	42.90	39	8.64	10	6.30	48	18.26	15
Delta States	0.00	0	3.30	251	0.54	14	5.80	12	1.39	-13
Far West	2.85	-10	2.10	23	0.00	0			11.13	28
Lake States	0.71	-24	38.70	44	0.00	0	10.20	57	3.28	5
Northeast	0.27	5	6.10	24	0.00	0	1.10	19	1.07	41
Northern Plains	3.90	2	10.20	61	0.29	21	4.20	104	15.26	54
Southeast	0.18	-4	10.40	16	0.12	17	4.60	-3	3.61	7
Southern Plains	0.01	-48	7.40	50	5.61	-10	0.60	15	8.36	-8

Note: Percentage change calculated with the average of 1987-1989 and 1995-1997.

Source: See end note for region definitions.

**Barley.** U.S. barley production was 8.15 mmt in 1997, a decline of 7 percent since 1987. Production is concentrated in the Far West and Northern Plains regions, which over the last decade respectively decreased production by 10 percent and held steady. Barley production could not compete with production of wheat in the Far West. Barley yields increased an average of 25 percent in the Far West, while in the Northern Plains barley yields increased 37 percent. As provisions were introduced into commodity programs that allowed producers flexibility in their planting decisions, barley producers shifted into competing crops when possible. In the malting barley industry direct contracting between growers and brewers is common, and proprietary varieties are commonly used (Bushena, Gray and Severson, 1997).

**Corn.** U.S. corn production reached 238 mmt in 1997, an increase of one third in the last decade. Corn is largely produced in three regions – the Corn Belt, the Central Plains and the Lake States, which increased production by 26, 39 and 44 percent respectively. Yields increased throughout the United States, with yields in the Corn Belt increasing by 16 percent over the past ten years.

**Sorghum.** U.S. sorghum production was 17 mmt in 1997, showing almost no change in the level of production or yield in the last decade. Production occurs almost completely in the Central and Southern Plains, and no change across regions has been evident.

**Soybeans.** U.S. production of soybeans increased 35 percent in the last decade, reaching 74.2 mmt in 1997. Production in the Corn Belt, the major producing region, also rose 35 percent. Yields increased by 20 percent nationwide, with little variation for the major producing regions.

**Value-Enhanced and Genetically Modified Grains.** Value-enhanced grains and oilseeds include pest and herbicide resistant crops and end-use enhanced crops. Pest resistant crops include B<sub>1</sub> corn and cotton. These crops have been genetically engineered to contain *Bacillus thuringiensis* which is toxic to many important pests of these crops. Herbicide resistant crops include Roundup ready soybeans which are resistant to the herbicides used on them. Herbicide and pest resistant crops reduce input requirements and increase yields. The importance of these crops is rapidly expanding, with 12-15 million acres estimated to be planted to herbicide-resistant soybeans (Harwood, 1997), accounting for around 18 percent of planted soybean acreage in 1997. It is expected that planted acreage of Roundup Ready soybeans will reach 60 percent in the next few years (Jacobson, 1998). These crops do not have to be kept separate in the grain handling system.

End-use enhanced crops include high oil and waxy corn. These crops have had a longer presence in U.S. agriculture and have had limited market penetration. One reason for the limited market penetration is that the identity of these products must be preserved in marketing, adding to their cost.

Total acreage planted to value-enhanced crops is estimated to be between 28-36 million acres (Harwood, 1997). U.S. cropland planted to the 15 major crops is around 300 million acres (FAPRI, 1997). This means that value-enhanced grains currently account for 9-12 percent of U.S. cropland. Issues of concern in developing the market for these crops includes labeling as genetically modified organisms, and acceptance by domestic and foreign consumers. B<sub>1</sub> corn and Roundup ready soybeans have been approved for use in the European Union's market. The quick adoption of Roundup ready soybeans indicates that U.S. producers feel it will increase revenues, at least in the short-run. As it is expected that other exporting nations will also adopt these products, their adoption in the United States is not likely to increase U.S. competitiveness for a significant period of time.

### **Implications of Domestic Policies in the U.S. Grains Sector**

Over the last several decades, U.S. grain production has been influenced by a variety of government programs. The objectives of the programs have included price and income stabilization for producers, resource conservation and environmental benefits, and increasing U.S. competitiveness. In many years, these programs were a substantial cost to the government. The mid-1980s represented the peak with annual outlays exceeding \$20 billion in fiscal years 1986 and 1987. Since that time, changes in domestic policies within the United States have generally been designed to reduce government outlays for agriculture. Along with reduced payments, these changes have also been accompanied by fewer controls and restrictions on the decisions of producers.

A significant change in farm programs and their influence on acreage decisions followed passage of the Federal Agriculture Improvement and Reform (FAIR) Act of 1996. This legislation was designed to give producers the freedom to make planting decisions based on market signals rather than government programs. In the

years leading up to the FAIR Act, government programs played a substantial, yet declining role in determining acreage decisions in the United States. The programs that controlled acreage decisions for the 1982-95 crops were defined by stringent planting restrictions, and compliance with these restrictions determined eligibility for government payments. Producers were assigned a base acreage for the program crop that depended on recent cropping history. In most years, a percentage of this base was required to be idled, and the remainder had to be planted to the program crop. Meeting these requirements qualified the producer to receive a government payment, defined as the difference between the target price and the maximum of the average market price or the announced loan rate. As a result, the acreage decisions for feed grains, wheat, cotton, and rice were largely driven by policy variables and not market signals. Though the same program structure did not exist for soybeans, acreage decisions for this crop were also affected through competition for available area.

Beginning with the Food Security Act of 1985, modifications designed to increase market orientation were introduced, but the general structure of the programs remained intact. Legislation in 1990 increased the market orientation of acreage decisions by introducing Normal and Optional Flexible Acreage (NFA and OFA, respectively). The NFA represented 15 percent of a producer's base acreage that did not receive government payments and could be planted to a crop other than the program crop. The OFA was an additional 10 percent that could also be planted to another crop but doing so would forfeit program payments on those acres. The significance of the NFA lies in the fact that acreage decisions for this portion of the base were driven by market and not government incentives.

The 1996 FAIR Act removed the acreage controls found in the earlier programs, and introduced a new era with market signals driving acreage decisions. Payments divorced from production have now replaced deficiency payments as a means of income support. With a few exceptions for specialty crops, producers are now free to plant any crop without jeopardizing government payments. Annual acreage idling requirements were also eliminated under the FAIR Act.

### **Supply Response Under the FAIR Act**

With the relaxation of acreage controls under the FAIR Act, questions concerning the supply response of U.S. grains and oilseeds include potential changes in regional acreage mixes and how acreage will respond to changes in market signals. Definitive answers to these and other questions may be elusive, but some conclusions can be drawn.

It is reasonable to assume that there will be a greater response to market signals under the FAIR Act than was observed under the previous period of acreage controls and target prices. During these periods, the response to market signals was distorted by policy planting restrictions. Historical price responses under the previous programs may be used as a proxy of a lower bound for acreage responsiveness under the FAIR Act.

Table 2 shows the elasticity estimates developed at the Food and Agricultural Policy Research Institute (FAPRI, 1997) for recent historical periods. Own- and cross-price elasticities are given for corn, wheat, and soybeans. The elasticities are derived from estimated models that incorporate the relevant policy parameters during the different periods. In general, responsiveness for the 1991-95 period was found to be larger than the previous two periods. This is not surprising given the increased market orientation of the 1990 legislation relative to the previous programs.

As mentioned earlier, the NFA provisions introduced with the Omnibus Budget Reconciliation Act (OBRA) of 1990 provide a glimpse of acreage decisions based on market signals. This program was in place in 1991-95, and data were published based on the crop planted on the flexible acreage. These data were aggregated into the major production regions, and the cross-section data were pooled with the time-series observations for estimation purposes (Willott, Adams, Young, and Womack, 1996). The amounts flexed into the different uses were estimated based on expected market returns. The resulting acreage elasticities are also given in the Table 2. As expected, the price elasticities are substantially larger than was estimated under the previous programs.

**Table 2: U.S. Acreage Elasticities**

	1982-1985	1986-1990	1991-1995	Flex
<b>Corn Acreage</b>				
Corn Price	0.219	0.207	0.235	0.670
Cotton Price	-0.032	-0.030	-0.026	-0.023
Sorghum Price	-0.004	-0.003	-0.002	-0.015
Soybean Price	-0.115	-0.099	-0.114	-0.350
Wheat Price	-0.025	-0.022	-0.024	-0.065
<b>Wheat Acreage</b>				
Wheat Price	0.339	0.336	0.410	1.025
Barley Price	-0.091	-0.080	-0.078	-0.105
Corn Price	-0.038	-0.030	-0.041	-0.104
Cotton Price	-0.029	-0.028	-0.029	-0.088
Sorghum Price	-0.078	-0.058	-0.067	-0.092
Soybean Price	-0.002	-0.002	-0.007	-0.100
<b>Soybean Acreage</b>				
Soybean Price	0.268	0.237	0.271	0.994
Barley Price			-0.002	-0.029
Corn Price	-0.182	-0.172	-0.230	-0.803
Cotton Price	-0.045	-0.044	-0.040	-0.021
Oats Price			-0.002	-0.016
Rice Price			-0.002	-0.020
Sorghum Price	-0.005	-0.004	-0.009	-0.075
Wheat Price	0.008	0.007	-0.007	-0.170

Source: FAPRI 1997.

As an illustration of the impact of the range in elasticities, assume corn acreage under a baseline set of prices is 80 million acres. If the corn price increases by 10 percent with all other prices constant, corn acreage would increase by 1.9 million acres using the 1991-95 elasticities and by 5.4 million acres using the flex elasticities. However, these estimates should be viewed with some caution. It would not be reasonable to assume that producer decisions regarding acreage under the FAIR Act would respond in the same way. There are likely to be agronomic factors and rotational considerations which will dampen the response to market signals.

The second issue deals with potential shifts in acreage mix as producers compare relative returns from the market. Under the previous legislation, returns from the program coupled with penalties for leaving the program to produce another crop played a large role in determining the acreage mix. Producers were reluctant to abandon the program to plant other crops since this reduced base acreage in subsequent years. In the absence of such restrictions, certain commodities will not be competitive on the basis of market returns. Table 3 shows the net returns above variable costs for selected commodities in a few of the major production regions of the U.S. Historical data for prices, yields and costs of production come from various USDA publications. Projections for the 1998-2000 period are based on projections from the FAPRI January 1998 baseline.

**Table 3: Regional Returns Above Variable Costs of Production**

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	(Dollars per Acre)										
<b>Corn Belt</b>											
Corn	133	110	157	134	181	222	179	152	147	147	156
Soybeans	140	121	151	162	163	174	199	189	158	165	167
Wheat	47	6	73	36	87	109	62	90	59	62	67
<b>Central Plains</b>											
Corn	157	118	108	91	131	152	162	122	114	115	124
Soybeans	95	82	140	132	145	117	197	166	135	140	143
Wheat	46	44	52	56	59	68	66	76	49	50	54
Sorghum	63	54	71	64	79	89	97	87	78	78	83
<b>Northern Plains</b>											
Soybeans	81	71	68	53	110	108	132	120	92	96	97
Wheat	28	46	63	70	55	83	58	26	37	39	42
Barley	45	44	52	36	39	70	58	35	34	35	39
<b>Far West</b>											
Wheat	56	91	93	98	112	175	156	110	94	98	106
Barley	53	64	46	54	32	93	62	56	43	45	50

Source: FAPRI 1998.

For the Corn Belt and Central Plains, corn and soybeans yield substantially higher returns than competing crops in those regions. In addition, soybean returns are \$10-\$15 higher than corn returns. Sorghum returns exceed wheat returns by an average of \$20 per acre between 1990 and 2000 in the Central Plains. Barley and wheat are competitive with each other in the Northern Plains, but wheat returns substantially exceed barley returns in the Far West.

These relative returns suggest that the acreage mix will likely change under the FAIR Act. When compared to most other crops, corn and soybeans show a definite advantage. Over the last decade, there has been a modest west and northward shift in corn and soybean acreage. As new varieties become available that can better tolerate cooler and drier climates, the shift may become more pronounced. Certainly barley, and perhaps wheat, are likely to lose acreage to corn and soybeans.

### **Stockholding Under the FAIR Act**

With the elimination of the Farmer-Owned Reserve (FOR) program, the FAIR Act officially removed the government from the stockholding business. From a practical standpoint, this is nothing new to the U.S. grains sector since the FOR had not been used since 1994. With marketing loans in place for the major crops, producers will not forfeit grain placed under loan to the government, assuring that there will be virtually no government stocks held in the coming years. With these changes, stockholding will now become the responsibility of the private sector. This has important implications for price volatility when there are unanticipated shocks to the market. With increased responsiveness to market forces, planted acreage will be more sensitive to price volatility.

The potential for increased variability in production, consumption, and prices has been examined by Ray, Richardson, De La Torre Ugarte, and Tiller (1998). In the study, the authors used the FAPRI November 1997 baseline to determine the projected supply, demand, and price of U.S. commodities. A stochastic analysis was conducted by introducing variability through random yield and export shocks for 100 iterations over the 1998-2006 period. The resulting variability from the multiple draws was compared to observed historical variabilities.

As reported by Ray et al., the means, standard deviations, and coefficients of variation for corn, soybeans, and wheat are given in Table 4. For all commodities, the variability, as indicated by the coefficient of variation, increases in the projection period relative to history. Across the three commodities, corn shows the greatest increase in price variability with the coefficient of variation increasing from 0.133 to 0.242. This suggests that corn prices will be 82 percent more variable over the projection period. To put it another way, over the simulation period, corn prices had a mean of \$2.65 per bushel with a standard deviation of \$0.64 per bushel. This compares to a mean of \$2.34 per bushel and a standard deviation of \$0.31 per bushel over the historical period 1986-96. Wheat prices were found to be 40 percent more variable than was observed in the historical period.

**Table 4: Summary of Historical and Simulation Results for Crop Variables**

	Corn		Wheat		Soybeans	
	1986-1996	1997-2006	1986-1996	1997-2006	1986-1996	1997-2006
<b>Planted Acreage</b>						
Mean (Million Acres)	74.1	82.3	71.5	69.6	60.3	68.0
Standard Deviation	3.9	7.7	3.8	6.2	1.4	6.2
Coefficient of Variation	0.053	0.094	0.053	0.089	0.023	0.091
<b>Ending Stocks</b>						
Mean (Million Bushels)	1,897	1,271	1,735	683	265	310
Standard Deviation	877	684	276	192	72	147
Coefficient of Variation	0.462	0.538	0.375	0.281	0.270	0.473
<b>Farm Price</b>						
Mean (\$/Bushel)	2.34	2.65	3.35	3.55	6.06	6.43
Standard Deviation	0.31	0.64	0.49	0.71	0.75	1.00
Coefficient of Variation	0.133	0.242	0.146	0.200	0.124	0.156

Source: Ray et al., 1998.

In the absence of planting restrictions under the FAIR Act, price variability is transmitted through to planted acreage. Variability increases for the planted acreage of all three crops. The greatest increase is found in soybeans, where acreage variability rises by 296 percent from the historical period. Corn and wheat acreage variability increase by 77 and 68 percent, respectively.

The authors are quick to note that it is difficult to determine how much of the increased variability can be attributed directly to the 1996 farm bill. Reduced stock levels are most likely the greatest factor, and they were already low before the FAIR Act was in place. There is historical evidence that stocks dampen price volatility. In 1988, the U.S. corn crop fell to 4.9 billion bushels, yet the season average corn price rose to the relatively modest level of \$2.54 per bushel. The shortfall in production was offset by beginning stocks of 4 billion bushels. In 1990, a study by FAPRI looked at the implications of the 1988 drought in the absence of such large stock holdings. Assuming a beginning stock level of approximately 2 billion bushels, season average corn prices rose to \$3.59 per bushel in 1988, a 41 percent increase above the observed level of \$2.54.

The current environment of reduced stocks suggests that there is more upside potential in prices when a shortfall in production occurs. This in fact occurred in the latter part of 1995 and the first few months of 1996. Increased price and production variability has important implications for producers, distributors, and end users of U.S. grains and oilseeds. The U.S. grains sector is on a year-to-year basis in terms of production and consumption. Shortfalls in production cannot be met by grain reserves, and price will be used to ration demand to meet the available production.

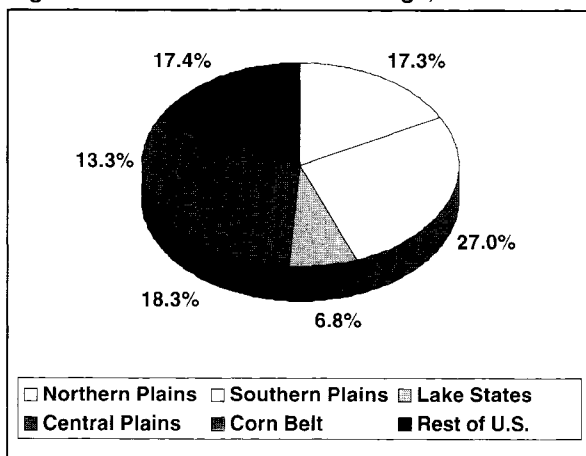
With a higher elasticity of demand, U.S. export quantities will absorb more of the shortfall than the domestic uses. Importers of U.S. corn are the most at risk since there are relatively few reliable exporters in world markets. Importers of soybeans will be somewhat less susceptible because of the export presence of Brazil and Argentina. In the wheat market, there are a number of other suppliers that stand ready to meet the import demand.

The increased price volatility associated with the current environment should also be reflected in the options markets through higher premiums. The premium of an option is the sum of its intrinsic value and time value. A number of factors influence the time value of the option, one of which being the underlying volatility of the market or futures prices. As price volatility increases, the range of possible prices also increases. Hence, option writers require larger premiums to cover the potential losses that might occur.

### The Conservation Reserve Program

Long-term acreage idling under the FAIR Act was maintained through a number of programs designed to provide environmental benefits. The most prominent of these is the highly-popular Conservation Reserve Program (CRP). The FAIR Act authorized the continued use of CRP with much of the operation left to the discretion of the Secretary. A cap of 36.4 million acres is in place from now through 2002. Recent signups suggest that the CRP will remain at relatively large levels in coming years. In 1997, two signups were held to replace the 21.4 million acres that expired in October of that year. As a result of recent signups, the CRP will total 29.9 million acres on October 1, 1998.

**Figure 2: Distribution of CRP Acreage, 1998**



The USDA has indicated that future enrollments will push total acreage towards the legislated maximum. At that level, CRP will affect U.S. and regional crop production. The greatest impact will likely be on wheat production since a majority of CRP acres are located in the Plains. Recent signups have increased the concentration in the Plains states. In 1993, the Plains states accounted for 57 percent of enrolled acreage. By October 1998, that percentage will have

risen to 63 percent (Figure 2). While the trade-off between CRP and planted acreage is not one-for-one, enrollment at this level reduces acreage and production below what they would have been in the absence of the program.

## Implications for U.S. Grain Production

Relaxed acreage controls and increased reliance on market signals are likely to accentuate recent production trends. Over the last decade, corn and soybean production has increased in the traditional production regions and expanded into new areas of the United States. This is consistent with relative returns in the different regions. As U.S. producers adjust to increased flexibility under the FAIR Act, the cost advantages in the different regions will become more important. In the past, it was sufficient to maintain variable production costs below the target price. Now, producers must give greater consideration to where they stand relative to the market price. The FAIR Act also gives producers the ability to better take advantage of certain market opportunities. In 1997, U.S. soybean acreage increased by 10 percent in response to strong market signals. Fewer acres were planted to winter wheat in the fall of 1997, and it is anticipated that those acres will be planted to corn and soybeans in the spring of 1998. Such a response would have not been possible under previous acreage controls.

## THE U.S. GRAINS HANDLING, MARKETING AND PROCESSING SECTOR

### NAFTA

Trade has increased since the reduction of trade barriers between Canada, the United States and Mexico. However, changes in trade flows are only one consequence of the integration of the grains sectors of these three countries.

**Trade Flows.** Trade has increased between Canada and the U.S., and between the U.S. and Mexico over the past ten years (see Table 5). In 1987, the U.S. had a negative trade balance for grains and feeds of 1.1 mmt with Canada. By 1996, the net trade deficit for grains and feeds increased to 3.4 mmt. For oilseeds, over the last ten years the United States switched from being a net exporter to Canada of .5 mmt of oilseeds and products, to being a net importer of 1.1 mmt. This is largely due to an increase in imports of canola oil. However, new crushing facilities in the United States are expected to reduce imports of canola and canola oil (USDA, ERS, 1997). In 1996 the United States produced 62 mmt of wheat, 236 mmt of corn, and 65 mmt of soybeans. While U.S. imports of these commodities have increased, import levels are still small compared to the size of the U.S. market, and are not a major factor in price determination.

**Table 5: U.S. Trade with Canada and Mexico, 1987 and 1996 (mt)**

	1987		1996	
	US to CA	CA to US	US to CA	CA to US
Wheat and Flour	2,286	311,251	22,193	1,284,516
Barley	1,460	200,103	NA	788,937
Corn	181,501	NA	875,044	333,515
Grains and Feeds	606,707	1,722,996	2,206,739	5,597,080
Oilseeds and Products	1,020,547	458,085	1,157,911	2,232,331
	US to ME	ME to US	US to ME	ME to US
Wheat and Flour	113,860	NA	1,616,205	NA
Barley	NA	NA	269,610	NA
Corn	3,333,022		6,314,387	2,774
Grains and Feeds	4,213,725	16,004	11,291,304	114,501
Oilseeds and Products	1,407,430	36,199	3,432,808	39,446

Source: Foreign Agricultural Trade of the U.S.

The United States is a net exporter of grains and oilseed products to Mexico. Exports of corn have doubled since 1987, reaching 6.3 mmt in 1996. United States exports of grains and feeds increased by 266 percent, and oilseeds by 247 percent since 1987. Mexico accounted for 5 percent of U.S. wheat exports, and 13 percent of U.S. corn exports in 1996.

U.S. exports of sorghum to Mexico declined to 1.97 mmt in 1996, from a high of 4.9 mmt in 1992. This decline is attributed to increased Mexican sorghum production as their support prices for corn have been reduced.

**Impact of NAFTA.** While trade flows have increased, a recent report by the USDA/Economic Research Service (1997) shows that only a small part of the increase, usually between 3 and 10 percent, is due to trade reform with the implementation of the Canada-U.S. Free Trade Agreement (CFTA) and NAFTA. NAFTA had the greatest impact on U.S. exports of vegetable oils to Canada and Mexico and U.S. exports of corn to Mexico. This empirical analysis can only take into account the changes in tariffs and non-tariff barriers that have occurred with NAFTA. It does not include the pivotal role that securing passage of NAFTA played in policy reforms in Mexico that enhanced trade, nor does it account for the role that NAFTA played in preventing the implementation of protectionist policies with the severe devaluation of the Mexican peso.

### **Integration of the U.S. and Canadian Grain Handling and Processing Sectors**

Integration of the U.S. and Canadian grain handling, processing and milling sectors is occurring due to substantial investments made by U.S. multinational companies in Canada. U.S. companies have invested heavily in the Canadian malting industry (Bushena, Gray and Severson 1998), with purchases by Archer Daniels Midland (ADM)

of Dominion Malting in 1990, Cargill and Ladish entering a joint venture in 1991, and ConAgra acquiring 70 percent of Canada Malt in 1996. Between 1994–1996, ADM purchased around 51 percent of total Canadian milling capacity (Weisensel, Milling and Baking News). Investments have been made or announced in high volume terminals by ConAgra, Cargill and Louis Dreyfuss, and by ADM in process elevators. Cargill intends to build a terminal facility on the west coast with the Alberta Wheat Pool, and has long-standing investments in the canola industry. Finally, ADM bought 40 percent of ownership of United Grain Growers.

Several factors have contributed to this investment. With the implementation of CFTA in 1989, investors were granted 'national treatment'. This means that U.S. investors must be treated the same as Canadian investors in Canada, and vice-versa. NAFTA retained and built on these provisions by expanding the coverage from direct foreign investments to a wide variety of investments. NAFTA also deepened investment security by improving dispute settlement procedures (Globerman and Walker, 1993).

While CFTA created a favorable investment climate for U.S. companies, the impetus for investment was provided by Canadian government policy changes, including the removal of the Western Grain Transportation Act and the reduction of government involvement and regulation of the rail industry. Companies are also seeking to position themselves in the event that the Canadian Wheat Board loses its monopoly right to export wheat and barley.

Bushena, Gray and Severson (1998) argue that cost reductions in the malting barley industry are possible due to the mergers that have occurred. They cite the ability of companies to source their supply and to direct output over a wider base, to reduce transportation costs, to reallocate production across plants, and to exploit economies of scale as factors that may contribute to cost savings. They estimate that malt production will increase in Canada and decrease in the United States, that barley producers' surplus will increase a little, and that malting firms surplus will increase nearly 25 percent due to the combination of free trade and firm mergers.

Investments in grain handling have been made as part of the move towards larger and more efficient primary and transfer terminals. Variable costs may be reduced in new facilities due to investment in larger and more efficient terminals. In addition, the ability of companies to source their grain was given as one motivation for their investments. Investments by ConAgra in the Canadian milling industry allow it to source Canadian grain of a particular quality for its clients in the U.S.

Investment by U.S. companies in Mexico's grains sector is occurring, but to a lesser extent than in Canada. Two joint ventures were reported between U.S. and Mexican firms in 1997 (Milling and Baking News). Investment by U.S. companies accounts for 65 percent of foreign direct investment in Mexico's agriculture. Most U.S. investment is occurring in the vegetable and flower industries, and only a small proportion of total investments has occurred in the grains industry (Ávila and López López 1998).

Investments by U.S. companies in the Canadian industry and mergers between U.S. and Canadian firms indicate that integration is occurring between the grain sectors of the two countries. Competitiveness is a concept about the ability of national sectors to compete. This concept is now undermined by the rise of multinational companies, whose management and profit goals are not limited by national boundaries. Eventually, further integration of the industry may necessitate a concept of competitiveness based on the performance of the industries in both countries.

### **Possible Elimination of the Canadian Wheat Board's Export Monopoly**

Since the CFTA there has been increased pressure to reform the Canadian Wheat Board (CWB). The CWB has the monopoly right to export Canadian wheat and barley to the United States and other destinations on terms decided by the Board. The status of the CWB is the subject of great controversy in Canada and has figured prominently in two forms of producer votes, recent court cases and a federal investigation. This debate was initiated by Canadian producers wanting choice in marketing wheat and barley including free access to the U.S. market. The Wheat Board has also been a source of friction in trade relations with the United States, making increased discipline of state trading enterprises a U.S. priority in the next round of multilateral trade negotiations under the World Trade Organization. Part of the tension is due to the increase in the level of exports and part is due to differences in the U.S. and Canadian grain marketing systems.

Unfortunately, empirical analyses focused on barley have reached different conclusions on the impact of removing the CWB. Schmitz, Gray, Schmitz and Storey (1997) estimate that export sales of feed barley by Canada will decrease by an average of .5 mmt, and that Canadian feed barley consumption will, on average, slightly increase.

Both Carter (1993) and Johnson and Wilson (1995) conclude that exports of feed barley from Canada to the United States will increase if the authority of the CWB to control exports is removed. Their estimates of barley exports to the U.S. range from 0.5 to 2.7 mmt.

While the lack of consistent empirical findings is unfortunate, the size of the impact of removing CWB single desk seller status must be kept in mind. For the U.S. industry, the impact on prices of imports of feed wheat and barley between 0.5 to 3 mmt would be extremely small, as it is a fraction of the total 1996-97 U.S. production of feed grains of 267 mmt.

No public empirical studies have evaluated the impact of removing the Canadian Wheat Board on exports of wheat from Canada to the United States. One reason that Canadian producers wish to export to the U.S. market is the difference between prevailing prices in the U.S. spot market and the annual pooled price of wheat offered by the CWB. With the elimination of CWB pooling, this incentive would also be removed.

Alston, Gray and Sumner (1994) investigated the impact of Canadian wheat exports on the U.S. market using a simulation model of the U.S., Canadian and world markets for durum, milling and feed wheat. They analyze the impact of reducing U.S. imports of Canadian milling wheat from 2.5 to 1.25 mmt, and estimate that an increase of one-half cent a bushel results.

Technically speaking, Alston, Gray and Sumner's results should not be used to evaluate much larger U.S. imports. However, their results suggest that flows of wheat to the U.S. market in the magnitude of 2-3 mmt will decrease prices by one to two cents a bushel.

**Implications of Integration.** The main consequences of NAFTA for grains and oilseeds may be within the industries which now consider the three countries to be a single market. While open borders increase the options available to industry, it limits the choices open to policymakers who wish to achieve domestic policy objectives. For Canada, the cost of continuing the CWB's single desk seller status appears to be trade friction with the United States and dissatisfaction on the part of Canadian farmers who want open access to the U.S. market. For the United States, careful attention must be paid to the consequences of using export subsidies and land retirement programs. To the extent that these programs reduce the supply of grains on the U.S. domestic market, they create an incentive for Canadian exports to the United States.

### **The Seed Market for Grains and Oilseeds**

Significant changes are occurring in the products offered by, and the structure of, the seed industry. As discussed in the section on trends in U.S. production, value-enhanced crops already account for 9-12 percent of U.S. cropland. Many new genetically engineered products are likely to be introduced in the near future, including crops that are resistant to drought, cold, herbicides or that contain other characteristics such as higher protein content.

The development of these products is occurring largely in the private sector, concurrent with a structural change in the seed industry. Previously, seed companies bought varieties developed by public institutions, and these companies multiplied and marketed the seeds. The market was characterized by many small firms (Cook, 1994). Currently, new products are being developed by a few companies, such as Pioneer Hi-Bred, or Monsanto, who have made significant investments in research and development of genetically engineered crops. As these products are demanded by producers, it is likely that the trend of industry concentration will continue. In some cases, issues of potential market power may be important. For example, Monsanto recently acquired AgriPro wheat germplasm, giving them the entire market for wheat hybrids (Engelke, 1997).

### **The Market for Processed Foods Derived from Grains and Oilseeds**

Value is added in the food sector through the activities of primary production, processing, transportation, wholesale and retail trade, and food service. The value added through food processing is greater than that of primary production, and in

1994, food processing accounted for 25 percent of the total value added in the U.S. food sector. In the same year, the total value of food and kindred products (defined as products that have undergone some processing), was \$430 billion dollars (Sheldon, 1998), with products from grains and oilseeds accounting for \$96 billion.

Processed foods exceed the value of primary products in the international market place as well. In 1993 trade in processed food and beverages was twice the value of trade in agricultural products and commodities, and the relative importance of processed food and beverage trade is expected to continue to increase (Henderson, Handy and Neff, 1996).

Exports of products derived from grains and oilseeds increased from \$3.7 to \$6.9 billion between 1989 and 1997. In 1995, exports accounted for 18 percent of the value of U.S. production of soybean oil, 19 percent of wet corn milling, and 60 percent of 'other' vegetable oils. For most other grains and oilseed products, exports of processed products play a much smaller role, accounting for 1 to 6 percent of value of domestic shipments.

Economists have noted that the United States has not kept pace with other developed nations in the expanding global market for processed foods.

In the United States, however, processed food exports account for approximately 40 percent of total food trade as compared to an average of 75 percent for leading European exporters. Why does the U.S. export relatively less processed food as a share of total food and agricultural exports than other developed countries?...Without a debate over what "competitiveness" means, alternately it could be argued that the United State's competitive advantage, and hence its "competitiveness" lies in producing and exporting bulk commodities rather than processed food products...Most large food manufacturers rely much more on investing in overseas markets than they do on exporting...By 1995, sales from these (U.S.) foreign affiliates had grown by 189 percent since 1982 and were estimated to be at \$113 billion, almost four times U.S. processed food exports of \$29.39 billion in 1995. (Sheldon, 1998, pp. 65-66).

Many U.S. multinational firms use foreign direct investment instead of direct exports as a way to penetrate foreign markets. Economists have advanced a number of explanations for this including:

- exploiting a management advantage when located within the market;
- acquiring precise behaviour on consumer preferences; and
- exploiting economies of scale when the market is large (Reed, 1996).

However, these explanations do not address why foreign direct investment is used more by U.S. firms than firms in other developed nations.

The consequences of increased exports of processed food from the United States include an increase in the demand for agricultural inputs and the processing activity, which may or may not be profitable. The consequences of foreign direct investment in food processing are not straightforward, but are not as positive for the agricultural sector as direct exports. Some key ingredients may come from the U.S., but others may come from local markets (Sheldon). Connor and Schiek (1997) question if the exports would have occurred without the existence of the foreign affiliate.

The domestic and export market for processed foods are clearly of growing importance for U.S. grains and oilseeds. However, the importance of foreign direct investment as a strategy used by U.S. firms makes conclusions about the competitiveness of the U.S. sector difficult. Data on imports and exports, and on the resulting net trade balance, do not tell the whole story.

### **Relationship Between Food and Feed Uses of U.S. Grains and Oilseeds**

U.S. grains and oilseeds provide a basic input into the production of meat and grain based products destined for both the domestic and international markets. There have been changes in the relative importance of food versus feed uses and domestic consumption versus exports. Changes in the structure and growth of end-use industries have important implications for the grain and oilseed sectors.

Food and industrial uses of grains have grown steadily in recent years. For wheat, food usage continues to be the major domestic disappearance category. Since 1987, U.S. per person annual consumption increased an average of 1.4 percent. Over that same period, feed use and exports of wheat showed no or little growth. For corn, food and industrial uses represented a surging demand during the 1980s, increasing from 13 to 23 percent of total domestic disappearance over the decade. The emergence of the high-fructose corn syrup and ethanol industries is a primary driver of growth. Since 1990, growth in these industries has slowed and their shares of total consumption has stabilized. Future expansion in those industries depends on both market forces and policy developments. The ethanol industry relies on federal excise tax exemptions and tax benefits in some states. Ethanol production recently demonstrated a high degree of sensitivity to increases in the corn price. In 1995 and 1996, when corn prices showed substantial upward movement, corn used for ethanol showed the largest percentage decline of any of the demand categories.

While food usage represents a steadily growing demand for grains and oilseeds, the primary use of these commodities is the production of livestock. Over the past ten years, 63 percent of U.S. corn and around 50 percent of soybean production has been used in the domestic livestock industry. Changes and growth in the U.S. livestock industry are critical in determining the future of the grain and oilseed sectors.

While the U.S. livestock sector as a whole has experienced growth, different sectors have diverged in recent years. The biggest growth area has been and continues to be the poultry industry, led by broilers. Since 1987, broiler production has grown an average of 6 percent a year. At the same time pork and beef production

increased an average of 1.9 and 0.8 percent, respectively. Fueled by strong growth, broilers recently surpassed beef in terms of total production. With broilers and pork representing the strongest growth areas, feed demands are changing. On the positive side, these sectors are much more dependent on a corn-soybean meal ration than beef. However, broiler and pork production are more efficient in terms of pounds of feed necessary for a pound of meat than beef production. In a recent study, White (1997) assumed 1.9 pounds of feed were necessary to produce one pound of broilers, compared to 3.2 pounds of feed for a pound of pork (both on a live weight basis).

The sources of demand for the livestock sector also have implications for the grains sector. Recent domestic demand for the three major meats has been mixed. Over the last decade, per person beef consumption has declined by an annual rate of 1.1 percent and pork has declined by 0.1 percent. In stark contrast, U.S. per person broiler consumption has grown an average of 2.6 percent per year. The export markets for all three commodities have shown substantial growth in recent years. Since 1987, combined exports of beef, pork, and broilers have increased 434 percent. Currently, 8 percent of beef and 17 percent of broiler production are exported. Assuming feed conversion ratios for the different livestock categories, White (1997) estimated that approximately 300 million bushels of corn and 100 million bushels of soybeans are exported as meat. Applying White's methodology to U.S. meat export projections by FAPRI suggests that the amount of corn exported as meat will grow to 450 million bushels by 2006.

U.S. meat exports have benefitted from robust growth in global meat demand. Developing economies have experienced several years of strong income growth which has translated into additional meat in their diets. Most projections suggest that the global growth in meat consumption will continue. For the grain and oilseed sectors, where additional meat is produced becomes important.

Currently, only 10 percent of world broiler and beef production is traded. For pork, just 3 percent of world production is traded. While global meat trade is projected to expand, it will still remain relatively small in comparison to total production. Hayes (1998) argues that the cost of transporting meat from the interior of the United States to Asian markets is as little as \$0.14 per pound. A pound of boneless-boxed pork or beef contains 8 to 16 pounds of grain, which costs \$0.06 per pound to transport to Asian producers. Hayes concludes that the cost of transportation implies that the U.S. may export meat, not grain, to meet growing Asian demand.

## **CONCLUSIONS**

Evidence presented in this analysis suggests that the production of corn and soybeans is likely to increase, both within the areas that have historically produced them and in the Northern Plains. The increase in production will be driven by higher relative returns as producers now have the flexibility to respond to changes in the net returns between crops. Forecasts of greater returns for corn and soybeans are par-

tially due to anticipation of continued increases in exports of meat and feed. A shift in the U.S. crop mix towards soybeans means that interactions in the domestic and international market with canola will become increasingly important.

The production of wheat is expected to remain relatively flat and to shift to the Northern Plains. Domestic consumption of grain products has increased on a per person basis and further growth will be largely due to population growth. Exports are expected to grow slowly due to moderate anticipated growth in world markets, and continued competition from Canada, Australia and the European Union.

End-use enhanced crops and malting barley are grown on contract with companies. In addition, some wheat and other grains may be grown on contract in order to meet the quality attributes required by the buyer. However, unlike the hog, broilers, fruits and vegetable industries the extent of vertical integration in the grains sector is limited. When it becomes more pervasive there may be consequences for price discovery and for producer welfare.

For the production sector, cost minimization is the essential strategy for competing in the production of grains, when they are produced as a primary undifferentiated product (Bedahl, Abbott and Reed, 1994). The United States has a long history of investment in research by the public sector to achieve that goal. It is well documented that many production technologies will cross national boundaries (Alston, Norton and Pardy, 1995). This means that in many cases it will be more difficult to justify government involvement in research on the basis that it will confer a national advantage to its producers over the long run. Certainly technology developed by the private sector may be actively transferred to other countries where market opportunities exist. The mobility of technology makes investment in human capital and infrastructure increasingly important components of cost minimization strategies.

Integration of the grains and oilseeds sectors within North America is occurring, particularly in the United States and Canada. Investments by multinational companies, primarily U.S. multinationals in the Canadian grain handling, processing and milling industries is occurring in response to business opportunities created by policy reform in Canada. To the extent that these companies can operate within a single North American market they should also be able to reduce costs through increased specialization and flexibility in their sourcing and marketing decisions. However, the importance of multinational companies makes it difficult to assess the national competitiveness of these industry sectors, as the net trade balance maintained by a country will not be a reliable indicator.

The presence of multinational companies in the food processing industry has similar ramifications on U.S. competitiveness. U.S. food processing firms have followed a strategy of direct foreign investment in the food processing industries located in other countries, again making it difficult to assess the competitiveness of the sector. The impact of foreign direct investment on the part of U.S. food processing firms on the grains and oilseeds sector are difficult to evaluate.

Price volatility is expected to increase due to policy changes under the FAIR Act. For the three commodities examined, the increase in price volatility was estimated to be substantial, with an increases of price volatility of 82, 40 and 25 percent for corn, wheat and soybeans, respectively. One consequence of increased volatility is that the price peaks could attract additional imports of wheat from Canada.

The future of U.S. farm commodity policy and policy responses to increased price volatility are important policy questions. The existence of relatively open borders, and U.S. commitments under the Uruguay Round Agreement, place real constraints on the options available to U.S. policymakers. Rodrik (1997) argues that global integration is occurring rapidly with negative consequences for social cohesion. This integration is occurring at the same time that the government provision of safety nets has been drastically reduced. Rodrik fears that the combination of increased integration and lack of broad (not sector-specific) government programs to address the needs of the losers from integration will lead to a backlash against trade, and ultimately to protectionist policies that are welfare-reducing. The scope of Rodrik's analysis is trade in general, however, it is applicable to agriculture. The U.S. grains sector is facing global integration without the buffer previously provided by government commodity programs. Rodrik's prescription is that economists should not minimize the negative consequences of global integration but should seriously consider the impacts and become active participants in the design of appropriate safety nets. His prescription seems appropriate for this forum.

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**END NOTES**

1. U.S. crop regions used throughout the paper are as follows:

<b>Corn Belt:</b>	<i>Illinois, Indiana, Missouri, Ohio</i>
<b>Central Plains:</b>	<i>Colorado, Kansas, Nebraska</i>
<b>Delta States:</b>	<i>Arkansas, Louisiana, Mississippi</i>
<b>Far West:</b>	<i>Arizona, California, Idaho, Nevada, Oregon, Utah, Washington</i>
<b>Lake States:</b>	<i>Michigan, Minnesota, Wisconsin</i>
<b>Northeast:</b>	<i>Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, West Virginia</i>
<b>Northern Plains:</b>	<i>Montana, North Dakota, South Dakota, Wyoming</i>
<b>Southeast:</b>	<i>Alabama, Florida, Georgia, Kentucky, North Carolina, South Carolina, Tennessee, Virginia</i>
<b>Southern Plains:</b>	<i>New Mexico, Oklahoma, Texas</i>

