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Grades/Classes of Hard Wheats Exported from North America: Analysis of Demand and Trends

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Abstract

Export patterns for U.S. and Canadian hard wheats (HAD, HRS, HRW, CWRS, and CWAD) were examined. Analysis incorporated grade and non-grade factors from U.S. shipments and grades and classes of Canadian exports. Shift-share analysis was used to examine changes in market shares for classes and grades. Cluster analysis was used to group importers of U.S. wheat classes based on like grade and non-grade factors of wheat shipments.

Canada exports most of its hard wheat as No. 1, while the U.S. exports predominately No. 2 or better. Classes experiencing increased market shares include HRS, CWRS, and CWAD. U.S. HRS, HRW, and HAD all showed patterns of increasing market shares for No. 1 over lesser grades from the early 1980s to 1990s. Importer comparisons indicated that in many cases, countries imported largely No. 1 from Canada and lesser grades from the U.S. (predominately No. 2 or better). Clustering analysis indicated an increase in the number of distinct segments of wheat importers from 1986-89 to 1991-94. Composition of market segments also changed with many countries moving from one segment to another from one year to the next.

Keywords:

Wheat exports, HAD, HRS, HRW, CWRS, CWAD, grade, class, non-grade factors, protein, dockage, total defects, market patterns, cluster analysis, and shift-share analysis.

Acknowledgments

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Highlights

The purpose of this study was to analyze the composition of exports of hard wheat from the United States with comparisons to Canada. The scope of the study was limited to hard wheat which were defined to include the following: Hard Red Spring (HRS), Hard Red Winter (HRW), and Canadian Western Red Spring (CWRS). Durum wheats are also included in the analysis and are referred to as Hard Amber Durum (HAD) from the United States and Canadian Western Amber Durum (CWAD) from Canada.

The analysis used data on individual grade and non-grade factors from the United States export shipments. Similar data are not available for Canadian exports; however, exports by grade/class and protein were available by country through 1991.

These data were used to document the composition of exports by class and grade, evaluate changes through time, compare quality specifications implied in export shipments across importers, and to categorize countries with similarities in grade specifications. Results indicate differences in composition of exports exist between Canada and the U.S. While, Canada exports largely No.1, the U.S. exports largely No. 2OB. Further, there have been changes in the composition of exports by class and grade toward HRS, CWAD, CWRS, and higher grades within classes. Quality levels for factors varied substantially across importers. Finally, clustering of importers suggested an increase in the differentiation of segments within the international wheat market.

A number of implications can be discerned from these results for both the public and private sectors. First, the increase in HRS and decline in HRW indicate a shift in demand over the last decade. Second, results suggest buyers are capable of specifying contracts allowing them to get higher qualities of U.S. wheats. Third, the trend toward more exports of higher grade wheat should impact market development strategies for lower grades.

Implications for the private sector center around the increased demand and specificity of export buyers. This suggests that demands for higher quality exports may reduce the dominance of the domestic processing sector in consumption of the highest quality wheats, thus increasing premiums. Further, increased specificity and market segments may allow firms to service more niche markets, at the cost of creating more segregations that would have to be maintained throughout the marketing system. Specific results are summarized below:

- ***Composition of Exports***: Canada exports a substantially larger portion of its exports as No. 1 than does the United States. This is true for each class. The average share of exports of grade No 1. for each class from 1986-91 were HRW 3 percent; HRS 7 percent; CWRS 60 percent; U.S. HAD 5 percent; and CWAD 25 percent.

- ***Changes in the Composition of Exports (Shift Share Analysis).*** There have been some dramatic changes in the distribution among exports by grade and class which have

important implications for demand and competition. Generally, results from this study indicated

By class. From the early 1980s to the mid-1990s, wheat classes whose exports increased the fastest (measured as *net shift* from a shift-share analysis and listed rank order) were HRS, followed by Canada Other, CWRS, and CWAD. Those classes experiencing negative growth included HAD, soft and HRW (listed from least to greatest negative growth). The realized growth in Canada Other is likely related to the one-time increase in feed wheat experienced during 1993 and probably related to crop quality problems in that year.

By grade. There have also been some notable changes in the composition of exports among grades from each country. From 1986-87 to 1993-94, export volumes of HRW, HRS, and HAD have shifted from lesser amounts of lower grade wheat to greater proportions of higher grade wheat. Most notable (in percent net shift) has been the growth in No. 1 exports of HRS followed by No. 1 HRW. In each case, these represent a shift from lower grades. Similar growth has occurred in No. 1 HAD, but not as dramatic, though the reduction in No. 3s was notable. To a large extent, the shift among grades is largely a South Korean phenomenon, especially for HRS. However, Taiwan which imports almost exclusively U.S. No. 1, has also increased imports of U.S. HRS. Other countries have imported limited quantities of U.S. No. 1; however, imports are small and sporadic.

- ***Quality Levels in Shipments and Received***. The level of individual characteristics reported in shipments for individual importers of U.S. exports varied substantially.

  Quality levels by importers. There was substantial variability in dockage levels, test weights, and total defects across importers. Those specifying the tightest levels for these characteristics include Finland, New Zealand, Taiwan, Singapore, and South Korea. However, the fact that these levels vary greatly suggests differences in requirements and preferences across importers.

  Factor levels greater than specifications. In many cases, the actual level of an individual factor exceeded that of the particular grade purchased. For example, buyers frequently specify a grade level [e.g., No. 2 or No. 2 OB (or better)], but receive levels greater than the factor limit, and, in many cases, these are substantial. This observation was true for exports from all port areas, but was notable from the PNW. In many cases, exports from that port had factor levels comparable to No. 1 limits, even though the grade was No. 2 OB. Shipments from the Gulf port locations and Duluth-Superior generally had the lowest probability of No. 2 OB exports meeting specifications of No. 1.

- ***Comparison of Exports into High Quality Markets***. Exports of hard red wheats into markets identified as high quality by Kraft et al. were examined. Canadian exports to these high quality markets were largely No. 1 (83.4 percent of exports), while the U.S. exported largely No. 2OB. However, Canadian exports of No. 1 to these markets represents only 30 percent of total Canadian No. 1 exports. U.S. No. 1 HRS and HRW account for 19 and 15 percent of exports to designated high quality markets, yet they amount to 97.7 and 99.5 percent of total U.S. exports of HRS and HRW No. 1, respectively. Total Canadian exports of No. 1 have been greater than 7 times the volume of U.S. No. 1 exports.

- ***Market Segments.*** Cluster analysis was used to identify countries importing similar quality. Countries importing wheat with similar characteristics are referred to as segments, and their behavior and composition have important marketing implications. Results from this analysis indicated

  Number of segments. Over the entire period, each hard wheat class had several distinct segments. HAD had three segments, and HRS and HRW each had four segments. In general, these were distinguished by the levels of dockage, test weight, defects, and protein level.

  Changes in segment numbers over time. There were notable changes in the definition and composition of segments over the time period of the study. The number of segments existing in durum exports increased from 3 to 4, HRS increased from 2 to 5 segments, and HRW increased from 2 to 4 segments.

  Changes in segment composition. Countries included in what would be defined as the higher quality segments varied, and, in some cases, they jumped in and out of a segment. Those countries that were in the higher quality segment more than 50 percent of the time in the more recent years for durum included: Italy, Costa Rica, Japan, and Kuwait. Those in the higher quality HRS segment over 50 percent of the time were Taiwan, South Korea, Malaysia, New Zealand, and Singapore. Those in the higher quality HRW segment over 50 percent of the time included Japan, South Korea, Taiwan, Thailand, Bangladesh, Hong Kong, Malaysia, and Norway. Other countries were also categorized as being part of these segments, but were there less frequently.

- ***High Quality Demands.*** The data were used to define those countries that routinely purchase No. 1 specifications and tighter specifications of protein and dockage. These could be interpreted as those buying higher quality hard wheats. For HRS, these include largely South Korea and Taiwan. Other countries such as Belgium-Luxembourg, Hong Kong, New Zealand, and the United Kingdom have imported limited quantities of high protein, low dockage HRS.

Grades/Classes of Hard Wheats Exported from North America: Analysis of Demand and Trends

Bruce L. Dahl and William W. Wilson*

Introduction

Much of the past analysis and debate on competition and demand for wheat has focused on class (i.e., Hard Red Spring, Hard Red Winter, etc.) as the salient source of differentiation. In that context, the United States and Canada are the principal competitors in the hard wheat market. Both countries are the dominant producers of Hard Red Spring Wheat [HRS in the United States and Canadian Western Red Spring (CWRS) in Canada]; the United States is the dominant producer of Hard Red Winter (HRW); and both countries are large producers of durum (Hard Amber Durum, HAD, in the United States and Canadian Western Amber Durum, CWAD, in Canada). Due to the indigenous similarities among these wheats, the competitive environment is particularly acute.

Distinct differences exist between the U.S. and Canadian grading systems, which in turn impact trade (McLaughlin, Joint Commission on Grains). Other studies (see below) have noted the effects of the differences, mostly in terms of the results of surveys of importers and hedonic values. The principal difference is that the U.S. system, in general, relies upon specifications of characteristic limits in contracts between buyers and sellers, with reference to grade determining and non-grade determining factors and standards for measurement. As such, it is incumbent upon buyers, through their negotiations with sellers and subject to competition from other buyers, to determine the optimal level of a particular characteristic. In contrast, the Canadian system has relied more upon a regulatory approach toward grading and standards with less use of individual specifications than in the United States.

As demonstrated in this study, there are differences in the quality shipped from these two countries, and there have been some important changes that have occurred through time. Besides the differences in the grading systems, there are two particularly important phenomena that contribute to these differences. One is that the United States has a relatively large domestic market and, in recent years, has purchased up to 57 percent of the domestic wheat crop. Traditionally, the U.S. domestic milling industry has purchased primarily No. 1s and No. 2s for domestic processing. Given that typically about 75 percent and 85 percent[1] of the Hard Red Spring and Hard Red Winter wheat crop grades as No. 2 or better, a large percentage of the

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[1]Average of 1986-1995 for North Dakota, Minnesota, Montana, and South Dakota Regional Crop Quality Survey for HRS and Kansas Crop Quality Survey for HRW grading No. 2 or better (Moore et al., Tierney).

higher quality wheat is consumed domestically, leaving lesser amounts for the offshore market. In contrast, Canada consumes about 20 percent to 35 percent of its wheat crop domestically. The proportion of the crops in each country being of desirable quality for the hard wheat milling industries are likely similar. Thus, in general, Canada would have a greater proportion of exportable excess supply of higher grades than would the United States.

The second major factor affecting the dynamic changes in grades of wheat purchased is the shift toward privatization of wheat imports (Wilson, 1996). One of the important implications of privatization is a greater tendency for buyers to be more specific in their purchase contract specifications. Generally, private buyers have a greater ability to evaluate the value of higher quality and are more willing to pay premiums (and discounts) if that greater (lower) quality enhances (reduces) their profits. Importer procurement strategies, i.e., the combinations of price and quality specificity, are critical factors in the spring wheat market. Some importers use more stringent contract specifications than U.S. domestic millers. The latter are accustomed to mixing and blending and can target specific producing regions for their wheat procurement. Contract specifications have considerable strategic importance, particularly in view of competition among buyers (Johnson, Wilson, and Dierson).

In light of these changes, protein premiums and spreads between grades have become more important. The spread between No. 1 HRS and No. 2 HRS has shown an increasing trend from 1980-94 (Figure 1). Protein premiums for HRS have varied from a few dollars per metric ton in the early 1980s to $40 per metric ton in 1993 (Figure 2).[2] Therefore, changes in specifications can have dramatic monetary impacts on purchase prices for buying and selling prices for producers and grain merchandisers.

The purpose of this study was to analyze the composition of exports for hard wheat from the United States with comparisons to Canada. The scope of the study was limited to hard wheats which were defined to include the following: Hard Red Spring (HRS), Hard Red Winter (HRW), and Canadian Western Red Spring (CWRS). Durum wheats are also included in the analysis and are referred to as HAD from the United States and CWAD from Canada.

The report and analysis is organized as follows. In the first section, previous studies related to wheat quality are summarized. The second section describes the data used in the analysis.

[2]Similar patterns for the spread between No. 1 and No. 2 and for protein premiums/discounts are present in HRW and HAD (Appendix Figures 1-3).

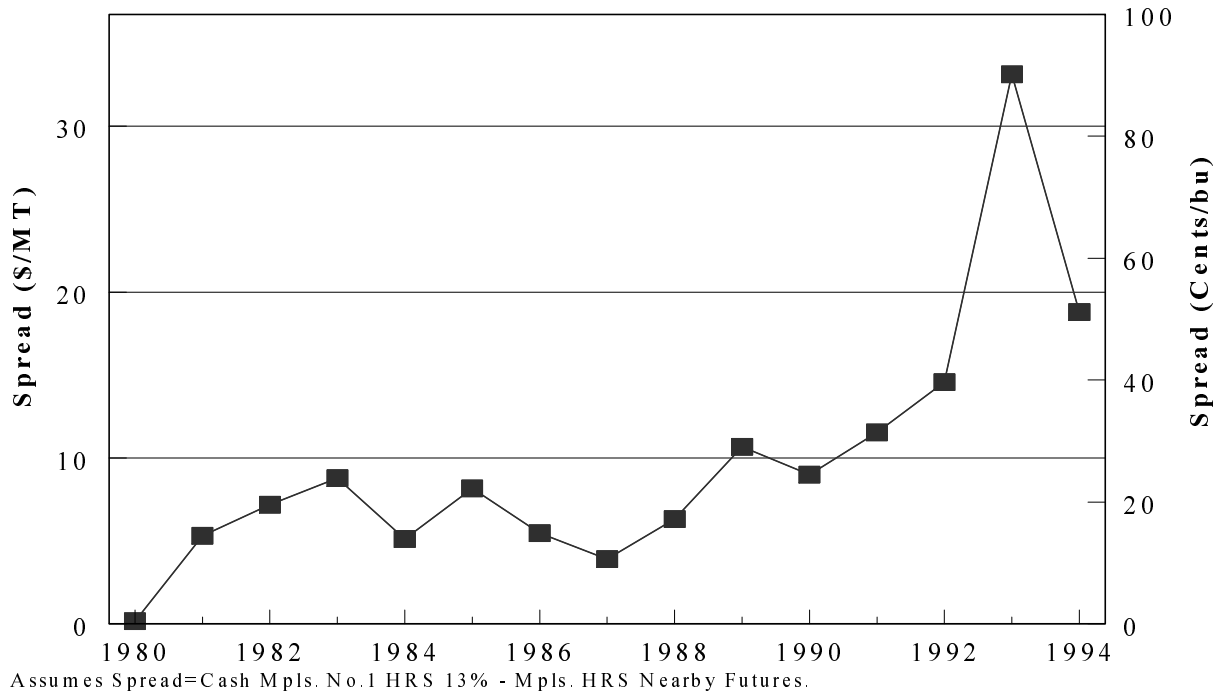

Figure 1. Average Marketing Year Spread Between No. 1 HRS and No. 2 HRS, 1980-94.

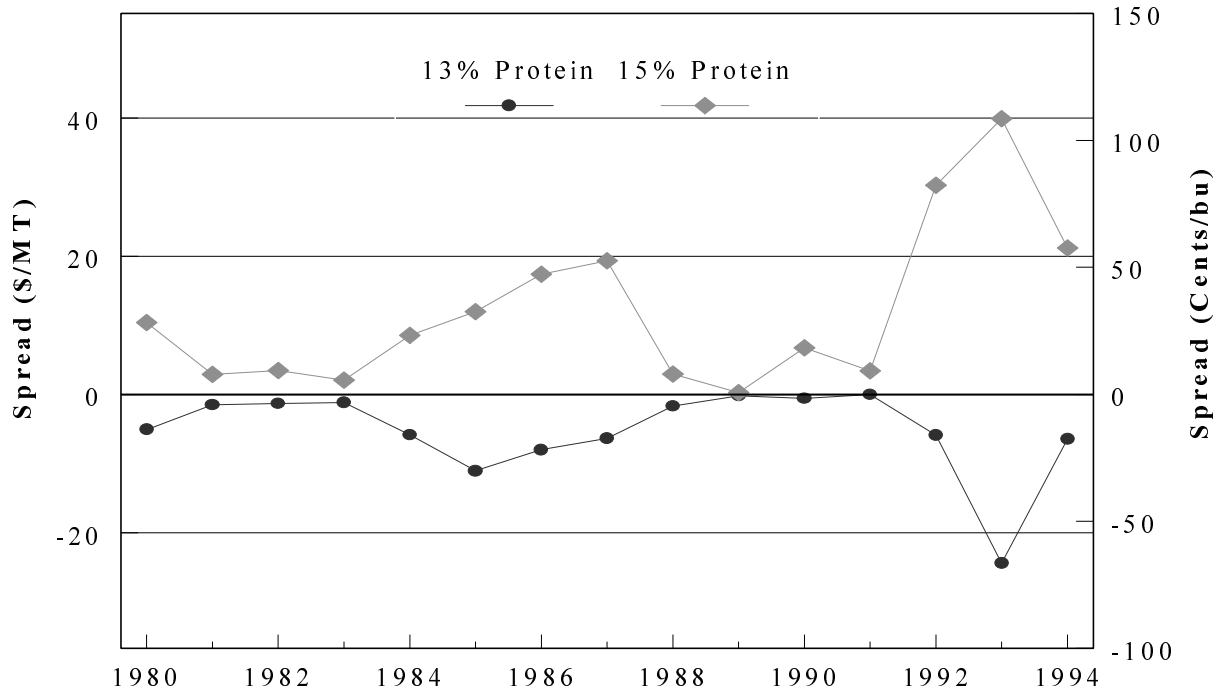

Figure 2. Average Marketing Year Protein Premium/Discount Over 14% Mpls. HRS, 1980-94.

The remaining sections analyze the composition and dynamic changes in exports. First, aggregate exports are analyzed. These are examined with respect to wheat classes, by grade for each of the classes, across exporters, and to "high quality" markets. Shift-share analysis was used to compare the observed changes over time for class and grade comparisons. Second, purchasing patterns of specific countries for durum and hard red wheats are examined across exporters by grade. Third, selected comparisons are made of quality levels received by buyers of U.S. hard wheats. Finally, cluster analysis was used to identify segments of buyers according to the grade factor specifications, and comparisons are made through time.

Previous Studies and Policy Issues

The extent and effect of differentiation in the world grain (wheat) trade has recently come to be of interest to grain market analysts. Grain trading firms and agencies have always recognized the importance of quality differences among wheat from different origins and their variability through time. However, agricultural economists have generally treated wheat as undifferentiated from an analytical perspective. In more recent years, class differences have been recognized. In the United States, at least, this could be due to the very important fact that farm policy mechanisms treat wheat (and other commodity groups) as homogenous, thereby setting a precedence of requiring modeling based upon undifferentiated commodity groupings.

Wheat has numerous end uses and indigenous characteristics and should be treated as heterogeneous. Wilson (1989) demonstrated that over time, differentiation (using the Hufbauer index) has increased. Hedonic studies generally have similar conclusions.[3] Larue also confirmed that wheat was not homogeneous.

Wilson and Gallagher, and Wilson (1989) indicated that through time, there has been a growing diversity of demands for end-use characteristics. In other words, demands have never been homogenous, and the degree of differences in preferences appears to be growing. In Asia, there were growing preferences for SRW, HRS, and CWRS relative to ASW, whereas HRW was losing.[4] In Japan, HRS and ASW were gaining relative to White.

Recent analyses have shifted to the demand for wheat classes. Agriculture Canada analyzed regional import demands for aggregated classes. Others have analyzed demand for wheat classes (Wang; Chai; Chang; Benirschka and Koo, 1995, 1996) using loosely specified

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[3]There have been numerous studies using hedonic analysis in the international wheat market. These include Wilson (1989), Veeman, and Wilson and Preszler.

[4]The following acronyms are used to designate wheat classes: HRS, HRW, SRW, and White for U.S. hard red spring, hard red winter, soft red winter, and white, respectively; ASW for Australian Standard White; and CWRS and CWAD for Canadian Western Red Spring and Amber Durum, respectively.

models with respect to functional form, relationships among elasticities, and, in some cases, variables included.

Wilson (July 1994) used a translog function to estimate wheat class demands for Pacific Rim countries. Results indicated substantial differences among underlying demand parameters for different wheat classes as well as across countries. In addition, the expenditure level has important impacts on the distribution of imported wheat classes; and preferences have shifted significantly through time, generally toward higher protein wheats. The only country in which ASW had a significant shift in preference was Indonesia.

The results indicated 1) positive shifts in preference for CWRS in two of the four countries importing this class; 2) positive and significant shifts in demand for HRS in three of the five countries (Japan, Korea, and Philippines), and 3) positive and significant shifts in Korea for each class, except for negative shifts in preference of White.

Countries have numerous mechanisms that influence grain quality and that have very important implications for their evaluation. If the market does not reflect quality differentials, the need to provide mechanisms for differentiation may be minimal. However, as price differentials increase, the importance of being capable of differentiation increases. Thus, given the nature of competition since the 1980s, mechanisms that allow differentiation have become an important component of international competition. In the United States, two major studies addressed these issues.

The first was undertaken by the Office of Technology Assessment (OTA) (U.S. Congress Office of Technology Assessment). The USDA (Mercier) conducted a comprehensive analysis of issues related to grain quality. The OTA surveyed overseas millers about their feelings toward U.S. wheat. Several major points gleaned from this survey were 1) assuming price and transport costs are the same, U.S. wheats were nearly always the least preferred relative to competitor wheats; 2) wheat class is not a good indicator of end-use quality; 3) important criteria in approximate ranking include protein quality, pesticide residue, insects (hidden, dead), and mycotoxin; 4) overseas millers wanted more information on dough handling properties; and 5) a major concern of survey respondents was an apparent increase in lack of uniformity in end-use quality, baking absorption, and dough-handling properties.

Since each country has a multitude of institutions and mechanisms that influence quality, the OTA study suggested a paradigm for evaluating issues related to grain quality. The concept was that a highly interdependent “system” impacts the quality of grain offered for export. This is comprised of variety development and release mechanisms, agronomic conditions, trading practices, grading and standards, and farm policies. The important point of the paradigm is that the institutions and policies which impact the quality of grain exported is more complex than simply looking at issues related to grades and standards. This, of course, has been the traditional area of debate in the United States.

The purpose of variety release and control mechanisms is to provide a means to regulate quality for characteristics not capable of being easily measured in the market system. A prerequisite for market regulation (premiums and discounts) is the ability to easily measure the characteristic. Another implicit effect of these mechanisms is that they provide a means to reduce the extent of lack of uniformity in end-use, an increasing complaint of domestic and export millers.

The U.S. grading system typically only measures physical (not chemical) characteristics, and these are the mechanisms upon which the establishment of quality measures for premiums and discounts rely. Trading practices cover a range of issues, but are crucial in making cross-country comparisons. These include the mechanisms by which premiums and discounts develop, whether by marketing boards or through a market system; local competitive environment; trading practices with respect to indigenous and extraneous quality characteristics; regulations regarding cleanliness and hygiene (e.g., infestation); and the extent that variety is used in the marketing system.

Farm policies typically are avoided in any discussion of grain quality. However, these have an important impact on the quality of grain in a number of dimensions, including yield-inducing incentives and, therefore, disincentives for quality improvement and marketing incentives related to cleanliness/hygiene and storage.

The 1990 Farm Bill urged the FGIS to establish or amend grade standards to match levels of "cleanliness" offered by competing countries. As part of that initiative, the USDA conducted a study to evaluate the "economically and commercially practical levels of cleanliness." The study included two major components: 1) economic-engineering studies of the cost of wheat cleaning in the United States and estimates of domestic benefits from cleaning and 2) a series of in-country interviews of buyers in major wheat-importing countries to determine the effects of cleaner U.S. wheat on sales in these markets.[5]

The U.S. system with respect to wheat cleaning, which was the primary motive of these analyses, operates differently from other countries. Both Canada and Australia include wheat cleaning either in terms of restrictive factor limits or as a regulation to force cleaning on a large portion of wheat entering the market system. In contrast, in the United States, this is a non-grade determining factor. As such, it is a contractual term, the level of which is determined through negotiation and buyer-seller competition. The upshot is that wheat is cleaned extensively in the United States, but only for those competitive conditions in which buyers and sellers specify the limit contractually.

The second part was a survey of importers to identify factors influencing choice of supplier country. These included the role of quality factors in import purchases and importers'

[5]See Mercier for a summary analysis and Hyberg, et al. for an overview of the implications.

perception of wheat purchased from their suppliers, details of preferences as revealed by contract specifications, level of dockage in import shipments and the cost of removal, and, finally, sensitivity of import purchases to cleanliness and the willingness of importers to pay a premium for a cleaner wheat from the United States.

These countries were classified in three groups based on the role of the state in importing: 1) state-controlled operations, 2) mix of state and private operations, and 3) imports operated by private sector. Perceptions regarding sensitivity to prices and quality of wheat appeared to vary in these different groups of countries. The survey suggested that in countries where imports are state regulated, the choice of source of imports was influenced by factors, such as credit availability, domestic supply, and prices. The emphasis on quality was limited to the minimum standard requirements stipulated by the importing agency in the contract. In the majority of importing countries, where imports are state regulated, the United States seemed to maintain a stable market share, and wheat from the United States was preferred. One miller indicated the possibility of compromising on prices for better quality wheat should wheat imports be privatized.

On the other hand, where import functions were privatized, the choice of supplier was influenced by both quality and prices. The United States seems to be losing its market share to Canada and Australia in countries where wheat imports have been privatized, not in government-regulated wheat importing countries.

Instances were identified where private importers were willing to pay premiums for cleaner wheat. This was revealed and confirmed in trade practices and export realizations of wheat cleanliness. Numerous importing countries specified limits on wheat cleanliness. In some cases, explicit premiums for cleaned wheat were embedded in contract terms (Wilson, Scherping, Johnson, and Cobia, p. 20-21). In addition, the average level of dockage in wheat exported has declined.[6]

Other countries are going through related debates and policy analysis. The Grains Council of Australia conducted a series of studies on the international market and implications for organization of the domestic market (Grains Council of Australia). Some of the more interesting conclusions indicated a large portion of the variability in prices received by the Australian Wheat Board were due to variability in quality characteristics. Further, it suggested that Canada and Australia were thought to be "quality suppliers" and the United States, along with the EU, Saudi Arabia, and Argentina, were price suppliers. An important outcome of the study was the recognition that the strategy for quality control in Australia results in higher costs throughout the entire system, even though premiums are only achieved on a portion of the sales.

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[6]For example, dockage content in exports to Japan declined from an average of about .90 percent during 1980-84 to .73 percent and .61 percent in 1989 and 1990, respectively. The average level in DNS imports to Taiwan has decreased from .88 percent in 1985 to an average of .65 percent during 1986 to 1990.

Another interesting and important debate is evolving in Canada. While it has always been claimed that Canadian wheat has certain characteristics preferred by importers, mostly related to cleanliness and uniformity, the value of that in terms of higher sales prices has always been a mystery. The recent study by Kraft, Furtan, and Tyrchniewicz analyzed prices and differentials for sales of Canadian wheat from 1980 to 1994. Results indicated that the average premium received for Canadian wheat relative to its benchmark was $C13.35/mt (29 U.S. cents/bu). However, as Carter and Loyns indicate, the additional costs imposed on the Canadian system necessary to achieve these premiums were about $C21-28/mt.

Data

Data on exports by class and grade for U.S. HRS, HRW, HAD, and Canadian CWAD, and CWRS were obtained from two sources. Data for U.S. exports were obtained from the Export Grain Inspection System (EGIS) wheat database (USDA-FGIS). Data were by shipment and included information on wheat class, grade, quantity, importer, and characteristics for most grade parameters, protein, and dockage from January 1986 to August of 1995. Data on Canadian exports by grade and class were obtained from the Canada Grains Council's 'GRAINBASE' database. Information included import grades and quantities for each importer for 1977-1991 for classes of Canadian wheat and durum. Canadian data were aggregated by crop marketing year, class, and grade for respective countries. To allow for cross comparisons, U.S. data were aggregated by crop marketing years (June 1 to May 31) for class and grade by country.

Data on aggregate U.S. exports of wheat by class prior to 1986 were not available. Data on aggregate U.S. wheat export volumes by class were obtained from the USDA Wheat Situation and Outlook. Data on aggregate Canadian wheat exports, by class and grade after 1991, were not available.[7] Aggregate Canadian exports by class were available after 1991 from several sources (Canada Grains Council (various years), Canadian Wheat Board).

Aggregate Exports to All Markets

Exports of U.S. and Canadian hard red and durum wheats were compared at different levels of aggregation to identify trends and changes in trends. In the next sections, aggregate U.S. and Canadian exports of each class were examined by grade within classes and finally by source. Comparisons focus on export volumes, market shares, and changes over time using shift-share analysis.

All Hard Wheat Classes to All Destinations

Comparison of Aggregate U.S. and Canadian Exports

[7]Prior to 1991, Canadian wheat export data were reported by country, grade, class, and protein. Beginning in 1992, this changed to only report class of wheat exported.

Aggregate exports to all markets were compared for hard wheats (U.S. HRS, U.S. HRW, CWRS, U.S. HAD, and CWAD) from 1980-93 (Figure 3). Total exports of U.S. and Canadian hard wheats in the early 1980s averaged 40 to 45 million metric tons. In the middle 1980s to 1990, wheat exports were lower than early 1980s levels (about 30 to 35 million metric tons); however, they had a one-year peak of 55 million metric tons in 1987. Exports increased again in 1991, but fell back to 35 million metric tons in 1993.

Market shares[8] for each of the classes have varied from 1980-93 (Figure 4). U.S. HRS has gained market share, increasing from 12.8 percent in 1980 to 21.5 percent in 1993. Canadian CWAD also gained market share, increasing from 5 percent in 1980 to 8 percent in 1993. U.S. HRW lost market share decreasing from 47.6 percent of U.S. and Canadian hard wheat exports to 37.2 percent in 1993. Market share for CWRS has fluctuated around 30 percent for the entire period. U.S. HAD has averaged 4 percent of U.S. and Canadian hard wheat exports.

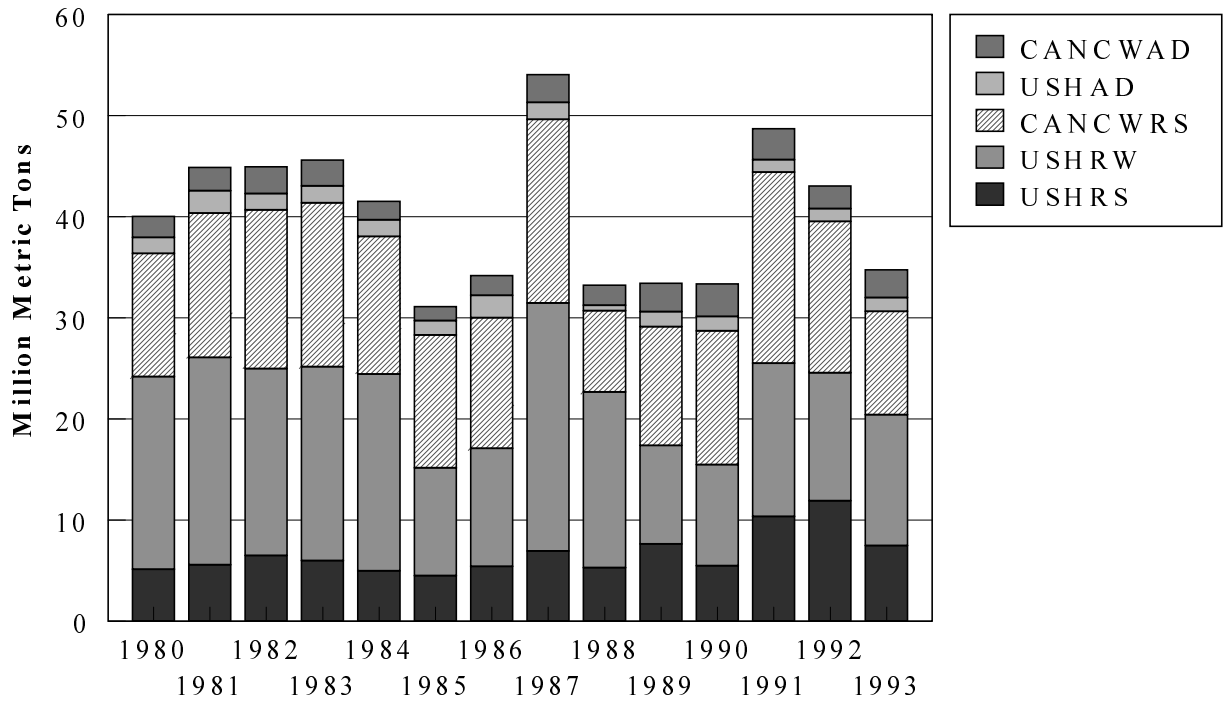

Figure 3. U.S. and Canadian Hard Wheat Exports, by Class, 1980-93.

[8]Defined as the share of wheat exported among these classes.

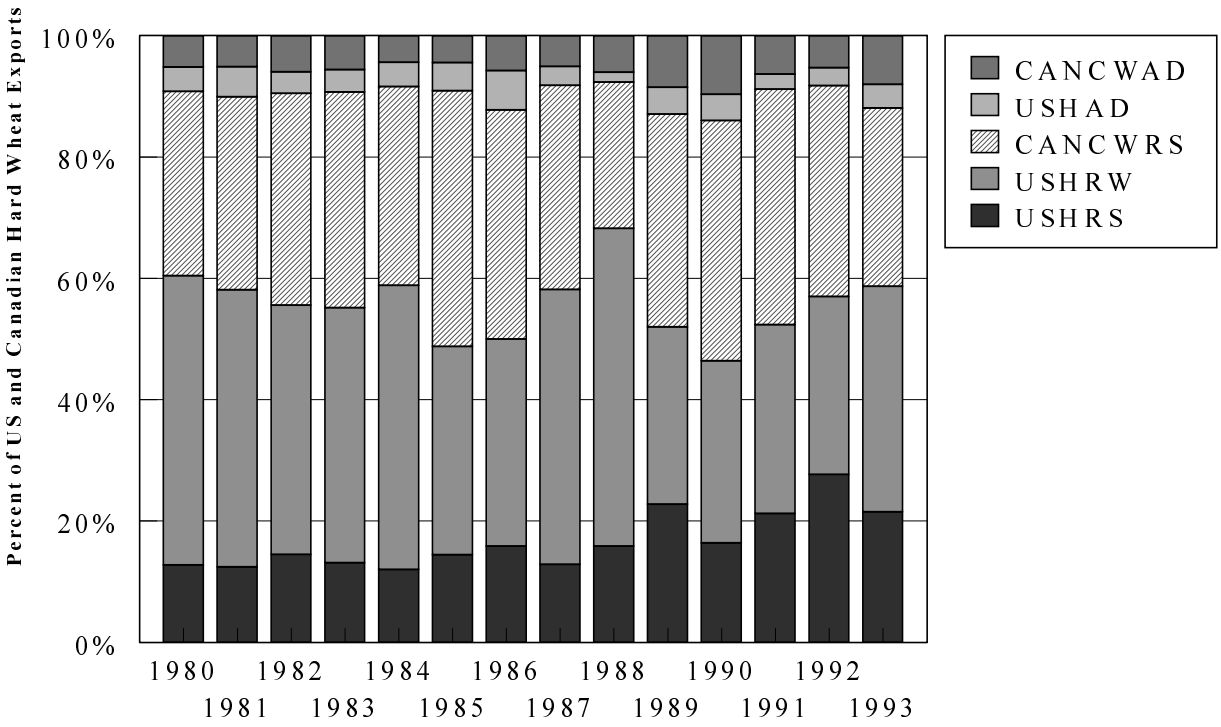

Figure 4. Percent of U.S. and Canadian Hard Wheat Exports, by Class, 1980-93.

Shift-Share Analysis of Aggregate Wheat Exports

Exports of North American wheats were compared for two periods (1980-83 and 1990-93) to quantify the shifts in exports of wheat classes by source. Total exports for each time period were averaged for each class of wheat (U.S. HRS, U.S. HRW, U.S. HAD, U.S. Soft Wheat,[9] CWRS, CWAD, and Other Canadian Wheat[10]) exported from the United States and Canada. Then, comparisons of average exports were made between periods using three different measures of changes (actual change, percent change, and percentage net shift).

Exports for wheat declined from 60 MMT per year during the 1980-83 period to an average of 52.9 MMT from 1990-93 (Table 1). Average exports declined for most of the classes of wheat from the United States except U.S. HRS. Exports for two of the Canadian classes (CWAD and Canadian Other Wheat) increased, while exports of CWRS declined. The largest decline came in U.S. HRW which exported 6.6 MMT per year less in 1990-93 than in 1980-83. The U.S. HRS showed the largest increase at 3.0 MMT more in exports than during the earlier period.

[9]U.S. soft red winter wheat and U.S. white wheat were combined to form a U.S. soft wheat class.

[10]Other Canadian wheat includes Canadian Feed and Canadian Eastern Wheats.

Changes in actual volume when averaged over many individual markets tend to overstate changes in larger markets. One alternative is simply the percent change. This indicates that Canadian Other Wheat increased most from 1980-83 to 1990-93 (Table 1 and Figure 5). U.S. HRS had the second largest increase in exports per year increasing 51.9 percent from 1980-83 to 1990-93. Similar to the actual change measure, the percent change also indicates that U.S. HRW is the class that declined the most. Average exports of U.S. HRW decreased 34.4 percent from 1980-83 to 1990-93. Use of the percent change measure results in a different ranking than the actual change measure. Further, use of this measure overstates changes in small markets.

Table 1. Average Exports and Measures of Changes in Exports, By Class, North America, 1980-83, 1990-93

Class	Exports		Measures of Change		
	1980-83 (tmt)	1990-93 (tmt)	Actual (tmt)	Percent (%)	Net Percent Shift (%)
U.S. HAD	1,783	1,327	-456	-25.6	-3.3
U.S. HRW	19,309	12,682	-6,627	-34.3	-58.1
U.S. HRS	5,796	8,804	3,008	51.9	49.6
U.S. Soft Wheat	15,431	10,709	-4,722	-30.6	-38.7
CWAD	2,405	2,839	435	18.1	9.7
CWRS	14,593	14,332	-261	-1.8	19.8
Canadian Other Wheat*	787	2,251	1,463	185.8	20.9
Total	60,105	52,945	-7,160	-11.9	-NA-

*Canadian Other Wheat includes wheat from the Canadian Feed Wheat and Canadian Eastern Wheat classes.

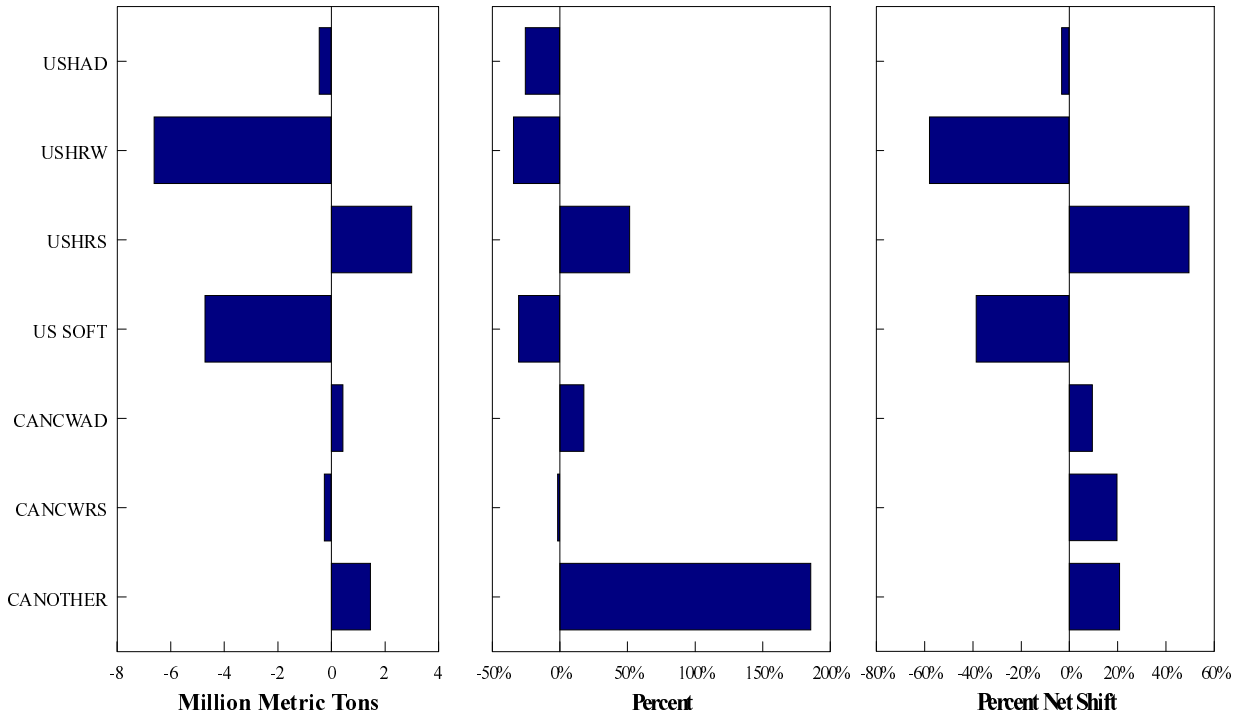

Figure 5. Actual, Percent, and Percent Net Shift in Exports, by Class, 1980-83 to 1990-93.

An alternative is the net percent shift and provides another measure for ranking growth in exports. This measure estimates the percent of deviations from the average growth rate captured by each class. This method provides perspective on the rate of growth for each class in relation to the market as a whole and provides a more apparent method of ranking growth among classes.[11] Using this measure, U.S. HRS is the market with the highest growth. U.S. HRS captured 49.6 percent of the variability in growth from 1980-83 to 1990-93. CWRS, which declined in average exports from 1980-83 to 1990-93, captured 19.8 percent of the variability in growth between the two periods. This indicates that CWRS, which declined in average exports between the two periods, declined at a slower rate than the market as a whole.

Comparison of results for the three measures shows that all three ranked the largest losers as U.S. HRW (7th in growth), U.S. Soft Wheat (6th in growth), and U.S. HAD (5th in growth). The actual difference and percent change methods also ranked the 3rd and 4th highest growth classes as CWAD and CWRS, respectively. The percent net shift reversed the order of these two classes ranking CWRS higher than CWAD. The highest growth classes were ranked No. 1 U.S. HRS and No. 2 Canadian Other Wheat by both the actual and net percent shift methods.

[11]For a more in-depth discussion of shift-share analysis, see the Appendix and Huff and Sherr.

However, the percent method reversed the order of these two classes ranking Canadian Other Wheat higher than U.S. HRS.

These comparisons indicate growth in HRS, CWAD, and Canadian Other Wheat exports. The growth in Canadian Other Wheat appears to be largely a function of exceptionally large exports of Canadian feed wheat in 1993 (4.6 MMT). Feed exports in most years are usually less than 1.0 MMT. This also occurred in 1986 where exports of feed wheat were 4.0 MMT. Thus, the growth comparisons for Canadian Other Wheat reflect a one-year phenomenon rather than a longer term trend. Meanwhile, growth in both HRS and CWAD appear to be longer term trends. Another notable result is the decline in HRW exports. This also appears to be a longer term trend and is in part due to reductions in HRW production.

Exports by Grade

Exports of U.S. and Canadian hard wheats were examined on the basis of individual classes. Aggregate exports of U.S. HAD, U.S. HRS, U.S. HRW, CWRS, and CWAD to all importers were examined to determine shifts in the amount and/or market shares of exports of grades within each of these classes. Aggregate exports and export market shares were derived, and shift-share analysis of changes in exports by grade was conducted for each class of wheat by source. Results for each class are presented in the following sections. Due to data availability, the analysis was conducted for United States 1980-1994/95; and Canada 1968-91.

HAD Exports to All Destinations

U.S. HAD wheat exports have experienced a continued decline from 1986 to 1994 except for the extremely short drought year of 1988 when sales were off dramatically from prior years (Figure 6). Most HAD is exported as U.S. No. 1, U.S. No.2 or better, or U.S. No. 3 or better (Figure 7). Limited amounts of other grades have been exported. In 1992-93, more of the durum exported went out as U.S. No. 1, which was more than in the years from 1986-94. Decreases in export volumes from 1986 to 1994 have largely come from exports of U.S. No. 3 or better.

Aggregate protein levels for U.S. HAD exports have varied widely from 1986 to 1994 (Figure 8).[12] In 1989 and 1991, over 90 percent of U.S. durum exports were shipped with protein levels from 15-15.9 and 14 percent to 14.9 percent protein, respectively. During the 1992-94 marketing years, exports have been largely 13.9 percent protein or less. This probably reflects, to a large extent, variability in crop quality across years.

[12]Protein levels by shipment were reported on a 12 percent moisture basis.

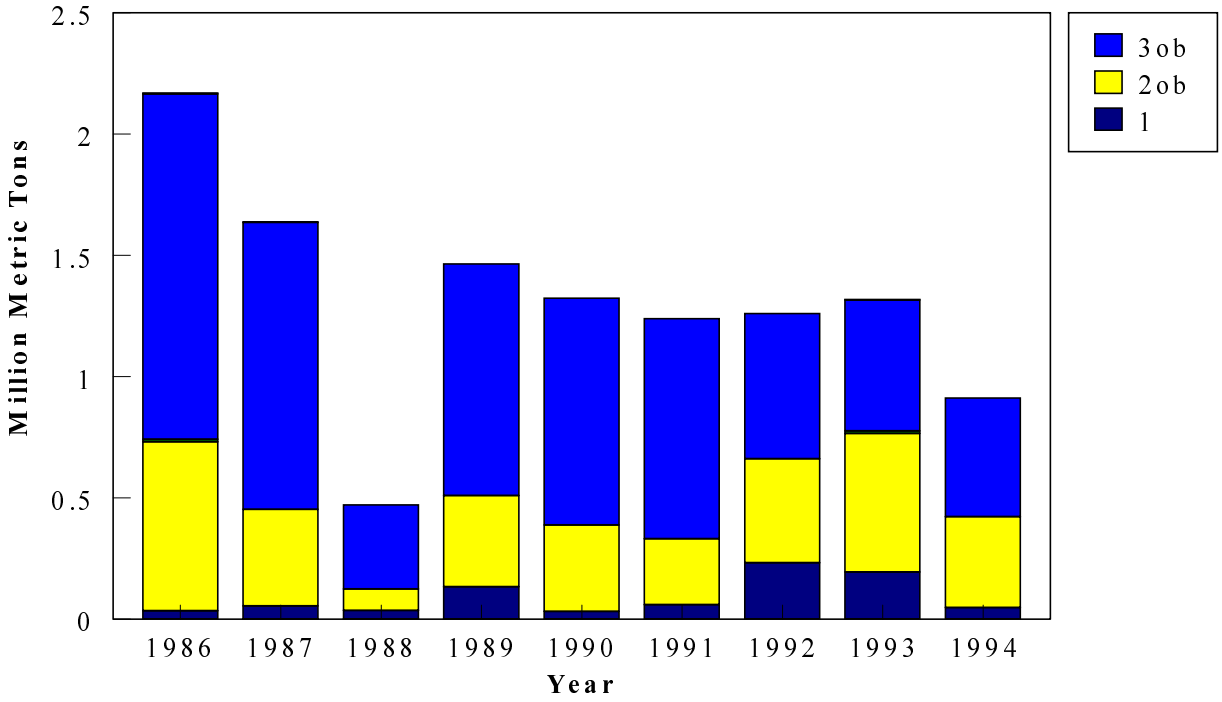

Figure 6. U.S. HAD Exports, by Grade, 1986-94.

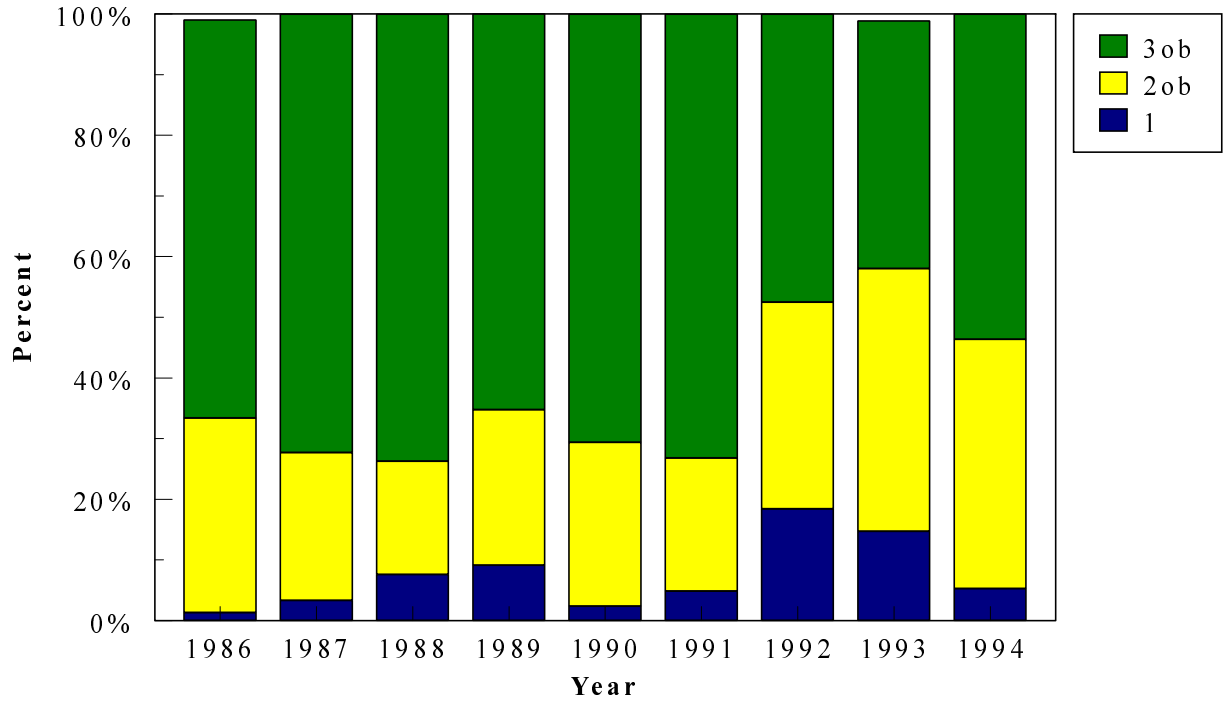

Figure 7. Percent of U.S. HAD Wheat Exports, by Grade, 1986-94.

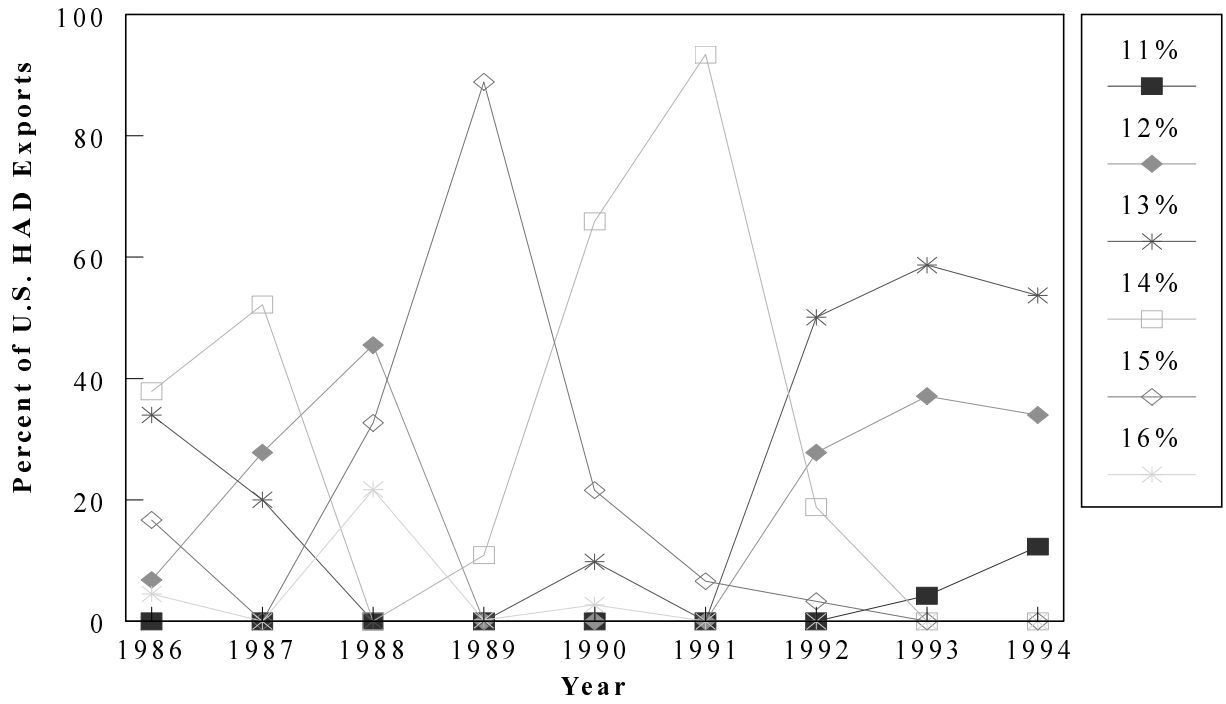

Figure 8. Exports of U.S. HAD, by Protein Level, 1986-94.

Shift-share analysis was used to compare the grade distribution of U.S. HAD exports from an average of exports for 1986-87 to 1993-94 (Table 2). U.S. durum exports declined 787 *tmt* from 1986-87 to 1993-94, representing a 41 percent loss. Exports of U.S. No. 3 OB HAD declined by 789 *tmt*, while U.S. No. 1 HAD exports increased 76 *tmt* and U.S. No. 2 OB declined 73 *tmt*. Comparison of changes from 1986-87 to 1993-94 using the net percent shift indicate that exports of U.S. No. 2 OB declined slower than the average decline for U.S. HAD exports and, as such, were able to capture 61 percent of the variability in growth for the market. U.S. No. 1 HAD exports, which increased in export volume, were able to capture 34 percent of the variation from average growth in U.S. durum exports. This further indicates that from 1986 to 1994, exports of U.S. HAD have tended toward exports of higher quality U.S. No. 1 and U.S. No. 2 OB at the expense of U.S. No. 3 OB.

Table 2. Average Exports and Measures of Changes in Exports, for U.S. HAD Wheat, by Grade, 1986-87, 1993-94.

Grade	Exports		Measures of Change		
	1986-87 (tmt)	1993-94 (tmt)	Actual (tmt)	Percent (%)	Net Percent Shift (%)
U.S. No. 1		121.3	76.6	171	38
U.S. No. 2 OB	44.7	473.2	-73.9	-14	61
U.S. No. 2	5.7	5.0	-0.6	-11	1
U.S. No. 3 OB	1,303.3	514.0	-789.3	-61	-100
U.S. No. 3	1.6	0.0	-1.6	-100	0
U.S. No. 4 OB	0.0	1.8	1.8	>100	1
U.S. No. 4	0.3	0.0	-0.3	-100	0
U.S. No. 5 OB	0.0	0.0	0.0	0	0
U.S. No. 5	0.0	0.0	0.0	0	0
U.S. SG OB	0.0	0.0	0.0	0	0
U.S. SG	0.0	0.0	0.0	0	0
TOTAL	1,902.7	1,115.4	-787.2	-41	-NA-

* Numbers may not sum due to rounding.

** OB refers to Shippers Preference. Ex. U.S. No. 2 OB allows for shipment of grain equivalent to either U.S. No. 2 or U.S. No. 1.

HRS Exports to All Destinations

Exports of HRS wheat increased from 5 MMT in 1986 to 8 MMT in 1994 (Figure 9). Most of the HRS wheat was exported as U.S. No. 1 and U.S. No. 2 or better. Export quantities of HRS that have been sold as U.S. No. 1 have steadily increased from 1986 to 1994. Exports of U.S. No. 1 increased from 320,000 MT in 1986 to over 980,000 MT in 1994. This amounts to a doubling of market share for U.S. No. 1 (Figure 10). The percent of HRS wheat exported as U.S. No. 1 has increased from 7 percent in 1986 to 14 percent in 1994. Exports of U.S. HRS wheat grades, other than U.S. No. 1 or U.S. No. 2 or better, have been limited.

Exports of U.S. HRS wheat have largely been shipped with 13 percent to 15.9 percent protein from 1986 to 1994 (Figure 11). During this period, 67 percent of the U.S. HRS wheat was exported with 14 percent to 14.9 percent protein, 19 percent with 13 percent to 13.9 percent protein, and 10 percent with 15 percent to 15.9 percent protein.

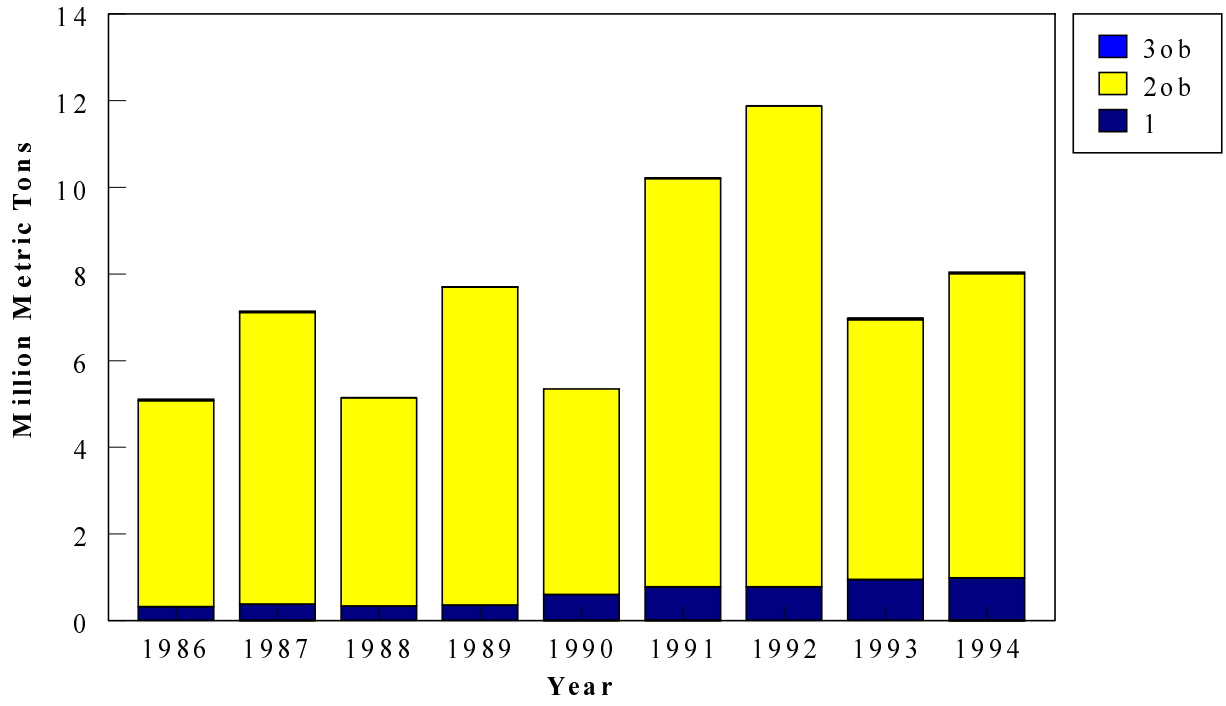

Figure 9. U.S. HRS Exports, by Grade, 1986-94.

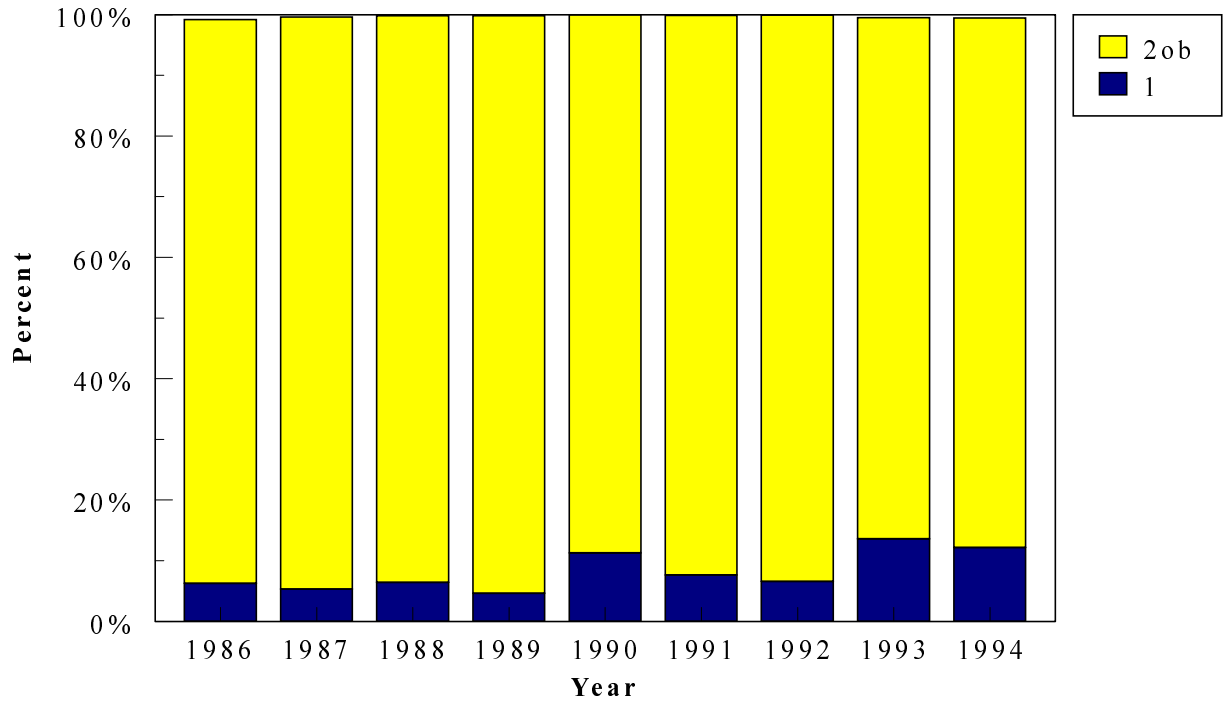

Figure 10. Percent of U.S. HRS Wheat Exports, by Grade, 1986-94.

Shift-share analysis was used to compare the change in grade distribution for U.S. HRS

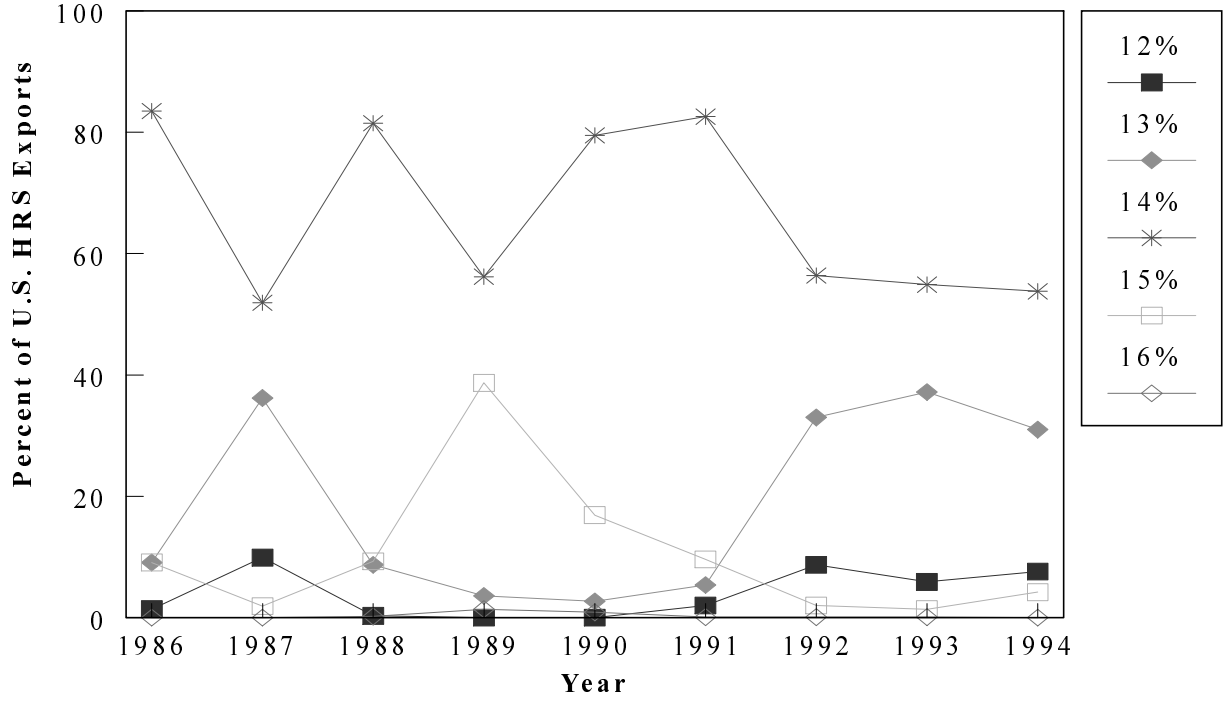

Figure 11. Exports of U.S. HRS, by Protein Level, 1986-94.

from 1986-87 to 1993-94. From 1986-87 to 1993-94, exports of U.S. HRS increased 23 percent, exports of U.S. HRS No. 1 increased 613 *tmt*, and U.S. HRS No. 2 OB increased 764 *tmt* (Table 3). Comparison of net percent shifts indicated that exports of U.S. HRS No. 1 grew faster than exports of U.S. HRS No. 2 OB. This indicates that like U.S. HAD, U.S. HRS exports of higher quality wheat in the late 1980s and early 1990s increased in importance.

Table 3. Average Exports and Measures of Changes in Exports, for U.S. HRS Wheat, by Grade, 1986-87, 1993-94

Grade	Exports		Measures of Change		
	1986-87 (tmt)	1993-94 (tmt)	Actual (tmt)	Percent (%)	Net Percent Shift (%)
U.S. No. 1	349.7	963.5	613.9	176	99
U.S. No. 2 OB	5,747.3	6,511.9	764.5	13	-99
U.S. No. 2	5.7	4.5	-1.3	-22	0
U.S. No. 3 OB	28.3	29.4	1.1	4	-1
U.S. No. 3	0.3	3.2	2.9	1020	1
U.S. No. 4 OB	0.0	1.7	1.7	>100	0
U.S. No. 4	0.0	0.0	0.0	0	0
U.S. No. 5 OB	0.0	0.0	0.0	0	0
U.S. No. 5	0.0	0.0	0.0	0	0
U.S. SG OB	0.0	0.0	0.0	0	0
U.S. SG	0.0	0.0	0.0	0	0
TOTAL	6,131.4	7,514.2	1,382.8	23	-NA-

HRW Exports to All Destinations

Exports of U.S. HRW wheat averaged 10-15 MMT from 1986-94 except for 1987 and 1988 when exports were dramatically higher (Figure 12). The grade distribution pattern of exports for U.S. HRW wheat is similar to U.S. HRS. Most of the U.S. HRW wheat is exported as U.S. No. 1 or U.S. No. 2 or better with the largest share going out as U.S. No. 2 or better (Figure 13). The total volume of HRW wheat that is exported as U.S. No. 1 has also increased from 352 *tmt* in 1986 to 761 *tmt* in 1994.

Exports of U.S. HRW wheat were compared to assess protein content of exports by volume. The largest share of U.S. HRW wheat is exported with 11 percent to 11.9 percent and 12 percent to 12.9 percent protein (Figure 14). Throughout 1986 to 1994, an average of 49 percent of the U.S. HRW wheat was exported with protein of 12 percent to 12.9 percent, 38 percent with 11 percent to 11.9 percent protein, and 15 percent with 13 percent to 13.9 percent protein.

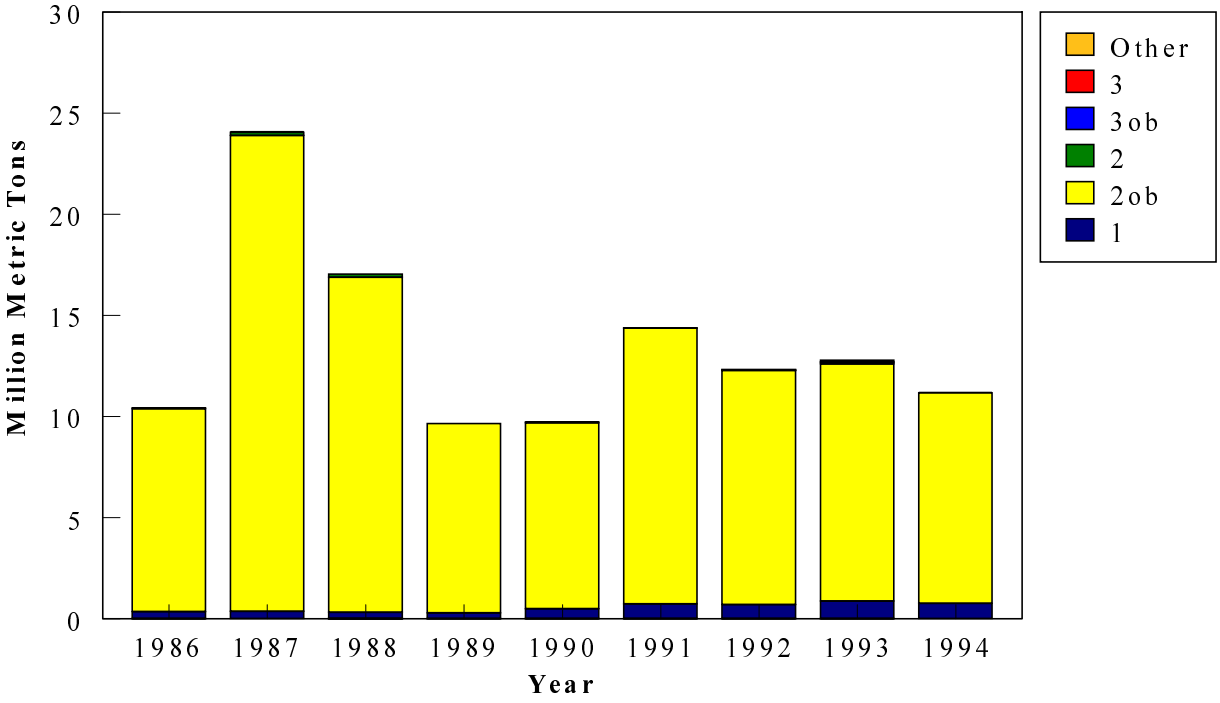

Figure 12. U.S. HRW Exports, by Grade, 1986-94.

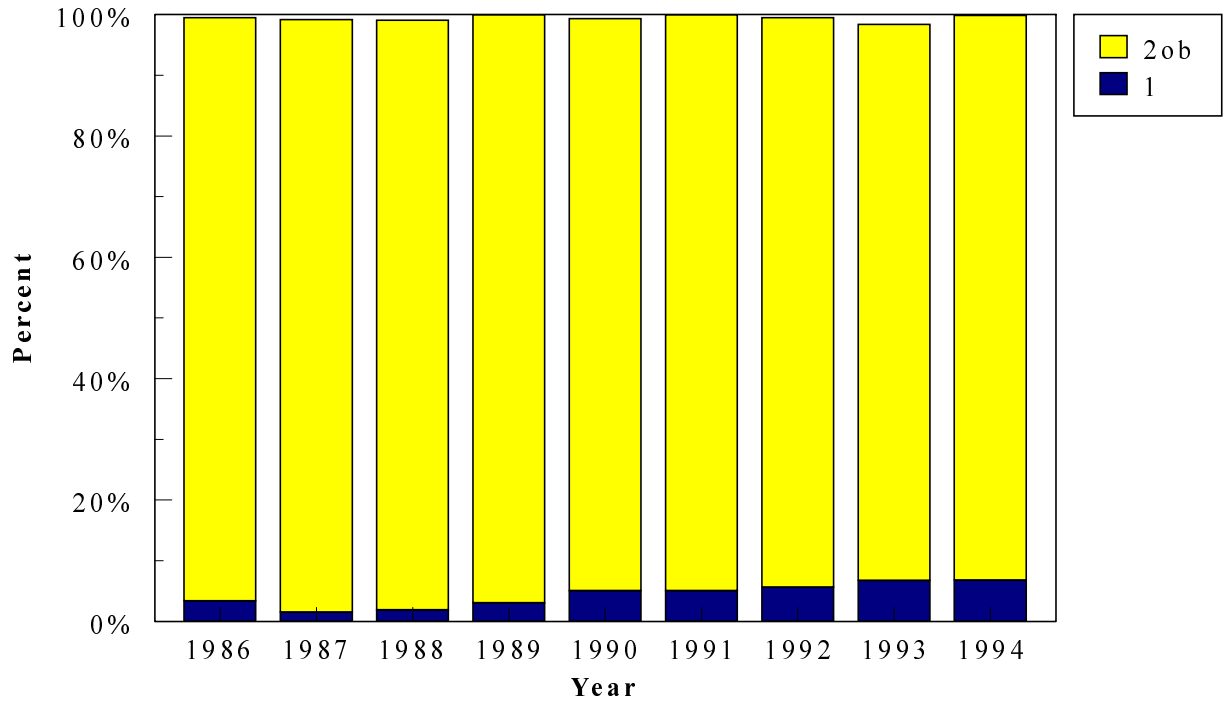

Figure 13. Percent of U.S. HRW Wheat Exports, by Grade, 1986-94.

Comparisons of average exports by grade for U.S. HRW were completed for 1986-87 to

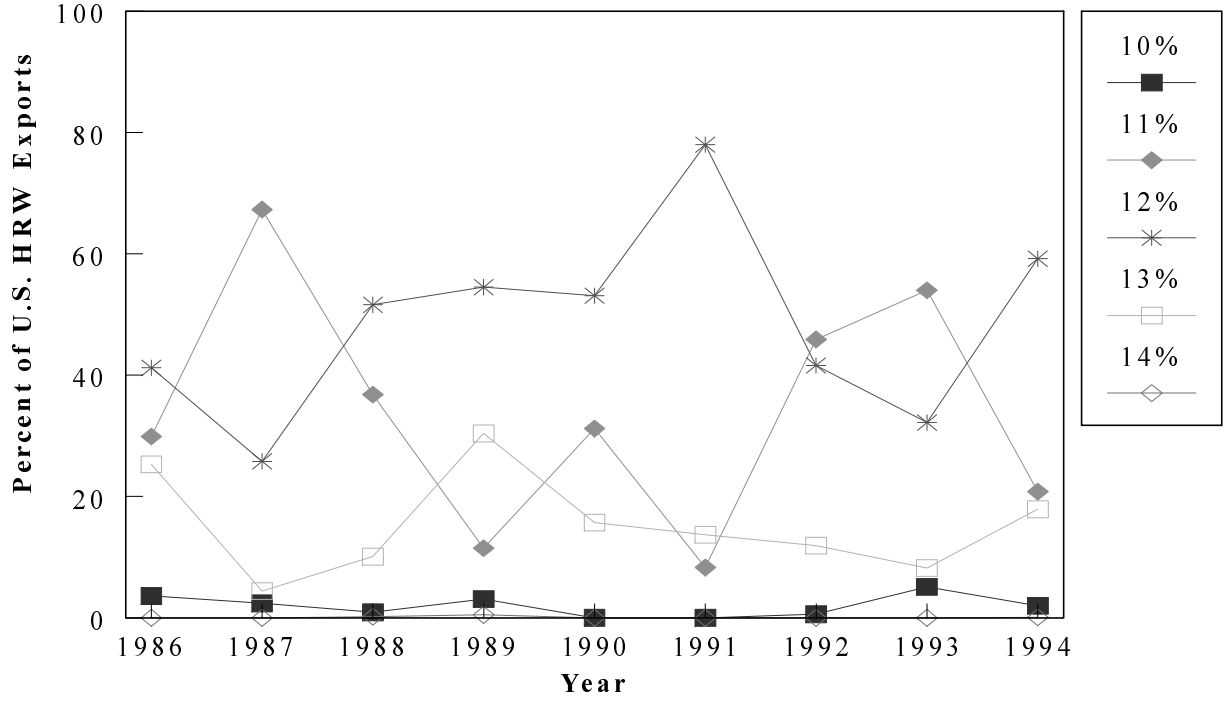

Figure 14. Exports of U.S. HRW, by Protein Level, 1986-94.

1993-94. Average exports of U.S. HRW declined 31 percent from 1986-87 to 1993-94 (Table 4). Exports of U.S. HRW No. 1 increased by 456 *tmt* while exports of U.S. HRW No. 2 OB declined by 5,710 *tmt*. Exports of U.S. HRW No. 2 and U.S. HRW No. 3 also declined, while exports of U.S. HRW No. 3 OB and U.S. HRW SG showed increases. These changes suggest a shift away from straight grades toward seller's option (No. 3 OB) and an increase in exports of minimal amounts of lower quality HRW in 1993-94. Comparisons of net percent shifts for U.S. HRW shows the same pattern of growth in exports of higher quality wheats at the expense of lower grades as in U.S. durum and U.S. HRS.

Table 4. Average Exports and Measures of Changes in Exports, for U.S. HRW Wheat, by Grade, 1986-87, 1993-94

Grade	Exports		Measures of Change		
	1986-87 (tmt)	1993-94 (tmt)	Actual (tmt)	Percent (%)	Net Percent Shift (%)
U.S. No. 1	355.5	812.3	456.8	129	91
U.S. No. 2 OB	16,785.3	11,074.9	-5,710.4	-34	-94
U.S. No. 2	108.7	41.8	-66.8	-62	-5
U.S. No. 3 OB	10.3	23.4	13.1	128	3
U.S. No. 3	3.4	0.1	-3.4	-99	0
U.S. No. 4 OB	0.0	0.0	0.0	0	0
U.S. No. 4	0.0	0.4	0.4	>100	0
U.S. No. 5 OB	0.0	0.0	0.0	0	0
U.S. No. 5	0.0	4.5	4.5	>100	1
U.S. SG OB	0.0	0.0	0.0	0	0
U.S. SG	0.0	37.2	37.2	>100	6
TOTAL	17,263.2	11,994.6	-5,268.6	-31	-NA-

Canadian CWAD Exports to All Destinations

Exports of Canadian CWAD increased from 1.5 MMT in 1986 to 3.9 MMT in 1994 (Figure 15). Market shares for each of the grades of CWAD have varied widely (Figure 16). Market shares for CWAD No. 4 and Other Canadian Durum have declined from 1986 to 1991.[13] Market shares for CWAD No. 2 and CWAD No. 3 increased from 1986 and have since declined. However, market shares for CWAD No. 2 were higher in 1991 than in 1986, while market shares for CWAD No. 3 were lower in 1991 than in 1986. Market shares for CWAD No. 1 exhibit the opposite pattern of CWAD No. 3. CWAD No. 1 lost market share from 26 percent in 1986 to 8 percent of exports in 1987. Since 1987, market shares for CWAD No. 1 rose to over 50 percent of CWAD exports in 1991. The trend in exports of CWAD from 1986 to 1991 is toward higher exports of higher quality durums.

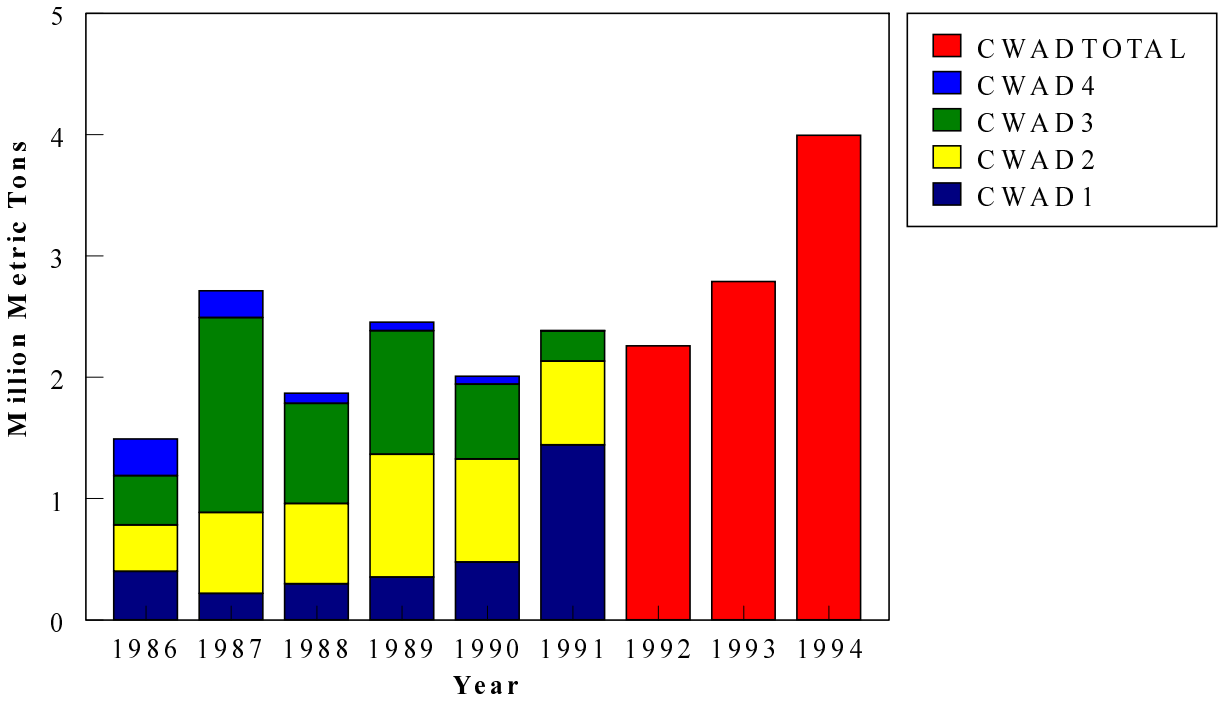

Figure 15. Exports of Canadian Western Amber Durum Wheat, by Grade, 1986-94.

[13]Data for individual grades for Canadian Exports of durum and CWRS were not available after 1991. Therefore, shift-share and market share comparisons are only reported up to 1991.

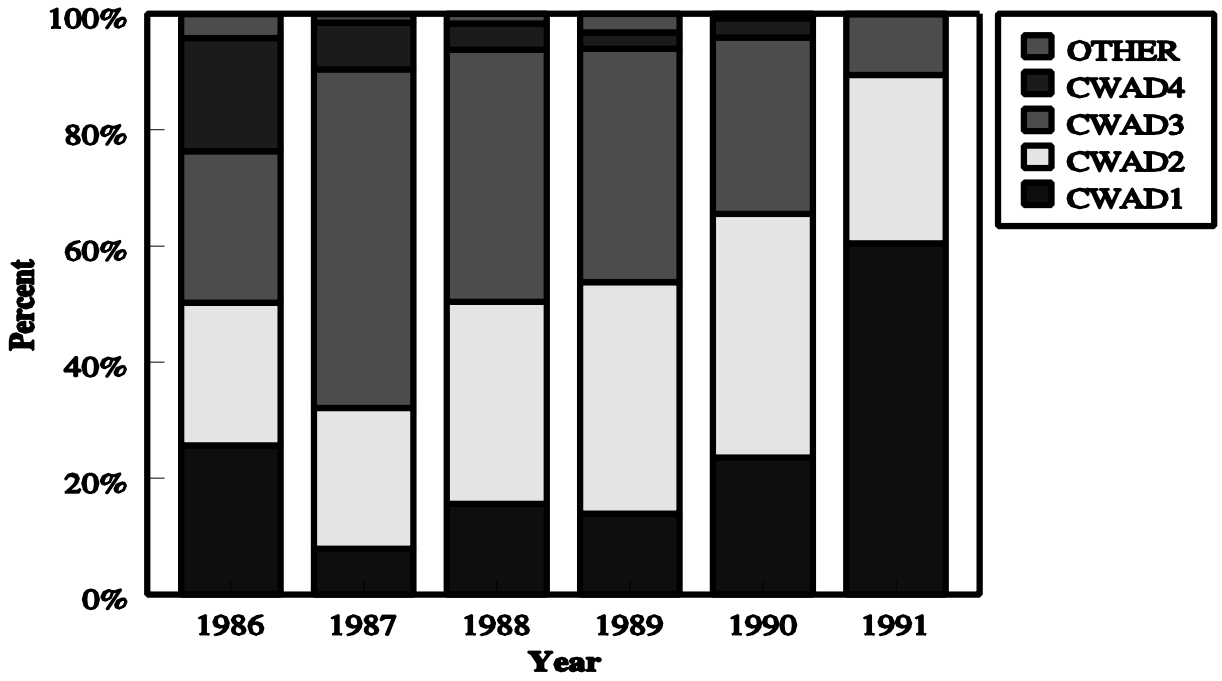

Figure 16. Percent of Canadian Western Amber Durum Exports, by Grade, 1986-91.

Shift-share analysis of exports of Canadian CWAD indicates that CWAD No. 1 and CWAD No. 2 were able to capture losses by other classes of CWAD from 1986-87 to 1990-91 (Table 5). CWAD No. 3 was the class that lost the most exports in both actual tons and for the net percent shift measures. CWAD No. 4 and Other CWAD had the highest percentage declines in exports across the time periods. These measures of changes in exports support previous results indicating that exports of Canadian durum are increasing for higher quality durums.

Table 5. Average Exports and Measures of Changes in Exports, for CWAD Wheat, by Grade, 1986-87, 1990-91

Grade	Exports		Measures of Change		
	1986-87 (tmt)	1990-91 (tmt)	Actual (tmt)	Percent (%)	Net Percent Shift (%)
CWAD No. 1	309.2	960.0	650.8	210	74
CWAD No. 2	524.3	769.9	245.6	47	27
CWAD No. 3	1,006.3	432.7	-573.6	-56	-68
CWAD No. 4	263.4	33.7	-229.7	-87	-27
Other CWAD	52.7	7.9	-44.8	-85	-5
TOTAL	2,155.7	2,204.2	48.5	2	-NA-

Canadian CWRS Exports to All Destinations

Exports of Canadian CWRS have varied widely from year to year from 1986 to 1993. Exports of CWRS have varied from a low of 9.2 MMT in 1988 to a high of 18.9 MMT in 1991 (Figure 17). Exports of CWRS No. 1 increased steadily from 6.7 MMT in 1986 to a high of 16.9 MMT in 1991. Exports of CWRS No. 1 fell from highs in 1991 to levels in 1993 equivalent to those experienced in 1986. Market shares for CWRS No. 1 also increased from 39 percent in 1986 to 89 percent of CWRS exports in 1991 and have since fallen back to 41 percent in 1993 (Figure 18). Market shares for CWRS No. 2 and CWRS No. 3 varied widely from year to year although shares for both were dramatically lower in 1991 than in 1986. Therefore, in 1990 and 1991, exports of CWRS tended toward higher exports of higher quality CWRS and have since fallen back to levels in 1992 and 1993 that are only slightly higher than those in 1986 to 1987.

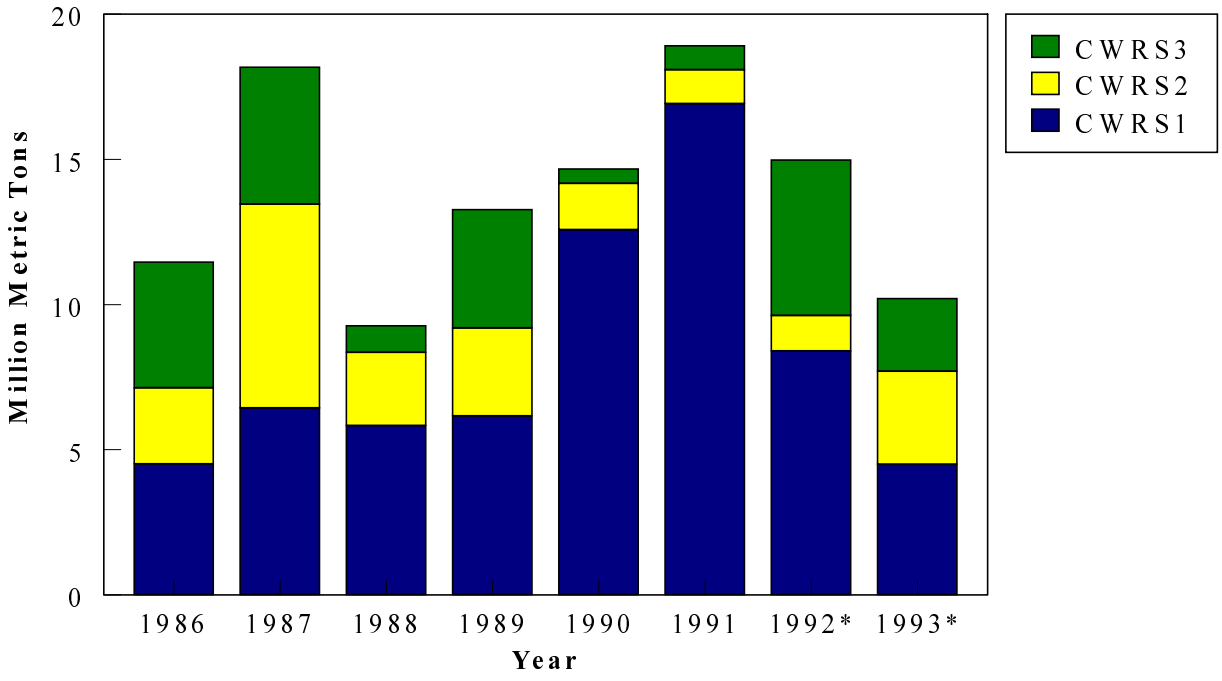

Figure 17. Exports of Canadian Western Red Spring Wheat, by Grade, 1986-93.

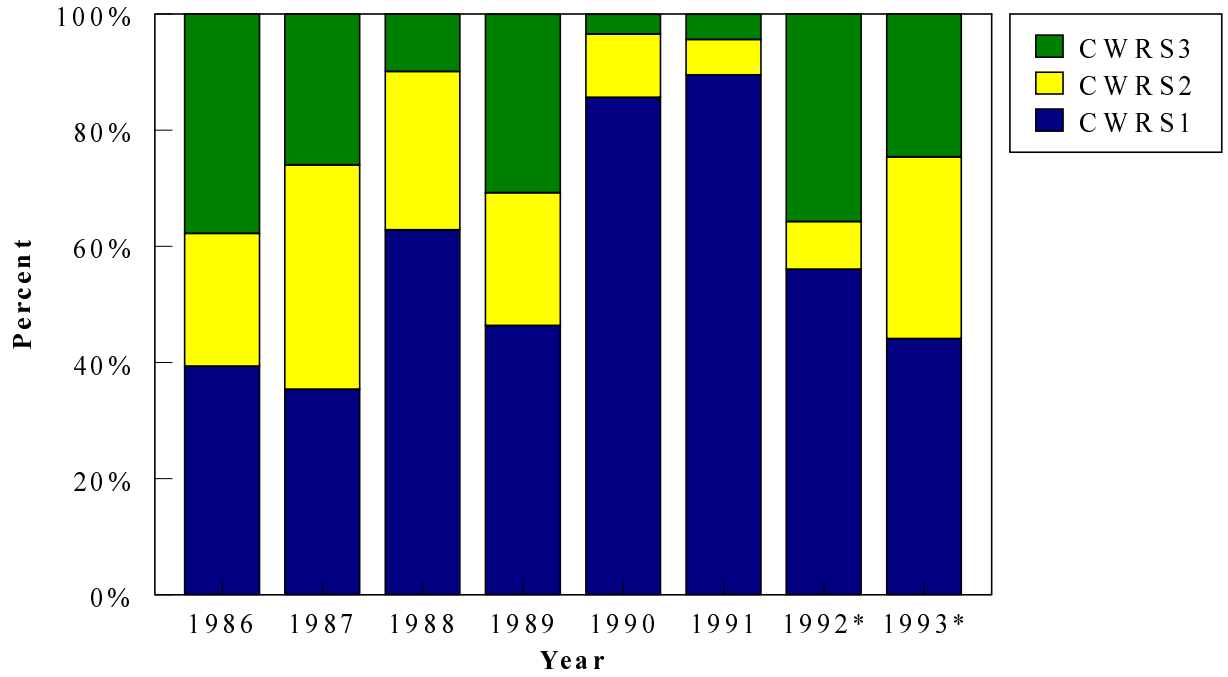

Figure 18. Percent of Canadian Western Red Spring Exports, by Grade, 1986-93.

Shift-share analysis of Canadian CWRS exports indicates an increase in CWRS No. 1 exports from 1986-87 to 1992-93 (Table 6). Exports of CWRS No. 1 rose by 979 *tmt* from 1986-87 to 1992-93. Exports of both CWRS No. 2 and CWRS3 declined by 2,607 and 592 *tmt*, respectively. Percent changes also indicate large declines for exports of lower grades and increase in exports of CWRS No. 1. However, the net percent shift method indicates that CWRS No. 3 captured 5 percent of the variability in growth. Thus, there has been a shift toward increased exports of higher quality CWRS wheats up to 1993 with most of the declines coming from reduced exports of CWRS No. 2.

Table 6. Average Exports and Measures of Changes in Exports, for CWRS Wheat, by Grade, 1986-87, 1992-93

Grade	Exports		Measures of Change		
	1986-87 (tmt)	1992-93 (tmt)	Actual (tmt)	Percent (%)	Net Percent Shift (%)
CWRS No. 1	5,471.8	6,451.1	979.3	18	95
CWRS No. 2	4,822.7	2,214.7	-2,607.0	-54	-100
CWRS No. 3	4,527.5	3,935.6	-591.9	-13	5
Other CWRS	0.0	0.0	0.0	0	0
TOTAL	14,822.0	12,601.5	-2,220.5	-15	-NA-

Comparison of Aggregate U.S. and Canadian Exports to All Destinations

Exports of U.S. and Canadian durums and hard wheats (CWRS, HRS, HRW) are compared in this section to determine changes in volumes and market shares of the two wheat classes between export sources. Aggregate exports to all destinations are compared, and market shares are examined by crop marketing year.

Exports of U.S. and Canadian durum wheat from 1986 to 1994 have generally been between 3.5 and 4.5 million metric tons except for the drought year 1988. From 1986 to 1994, U.S. durum exports have generally declined, while Canadian exports have increased (Figure 19). In 1986, the United States exported 58 percent of the North American durum exports. However, the market share for U.S. durum exports has declined, while Canadian market share has increased (Figure 20). From 1989 to 1993, the U.S. market share for North American durum exports ranged from 32 to 40 percent; however, in 1994, the U.S. market share dropped to less than 18 percent.

Exports of hard red wheats have ranged from 27 MMT in 1986 to 49 MMT in 1987. Total hard red wheat exports declined from 1991 to 1993 (Figure 21). During these three years, Canadian CWRS lost market shares declining from 43 percent in 1991 to 34 percent in 1993 (Figure 22). U.S. HRS increased market shares from 1991 to 1992 and then returned to 1991 levels in 1993. U.S. HRW increased market shares from 33 percent in 1991 to 43 percent in 1993.

Canadian CWRS has shown an interesting pattern of decreasing market shares from 1986 to 1988. Market shares then increased to a high of 49 percent in 1990 and have fallen since. U.S. HRW mirrored changes in CWRS market shares up to 1988. From 1989 to 1992, changes in CWRS market shares were mirrored by changes in U.S. HRS exports while market shares for U.S. HRW remained at 31 percent to 33 percent.

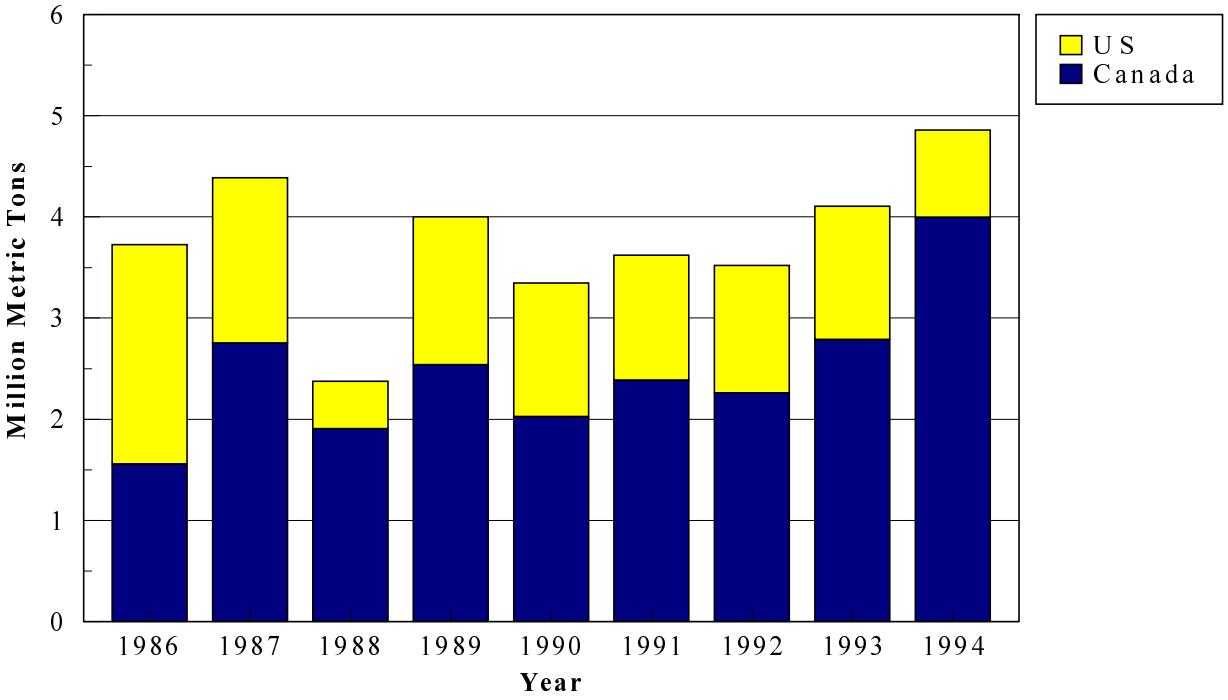

Figure 19. Exports of U.S. and Canadian Durum, 1986-94.

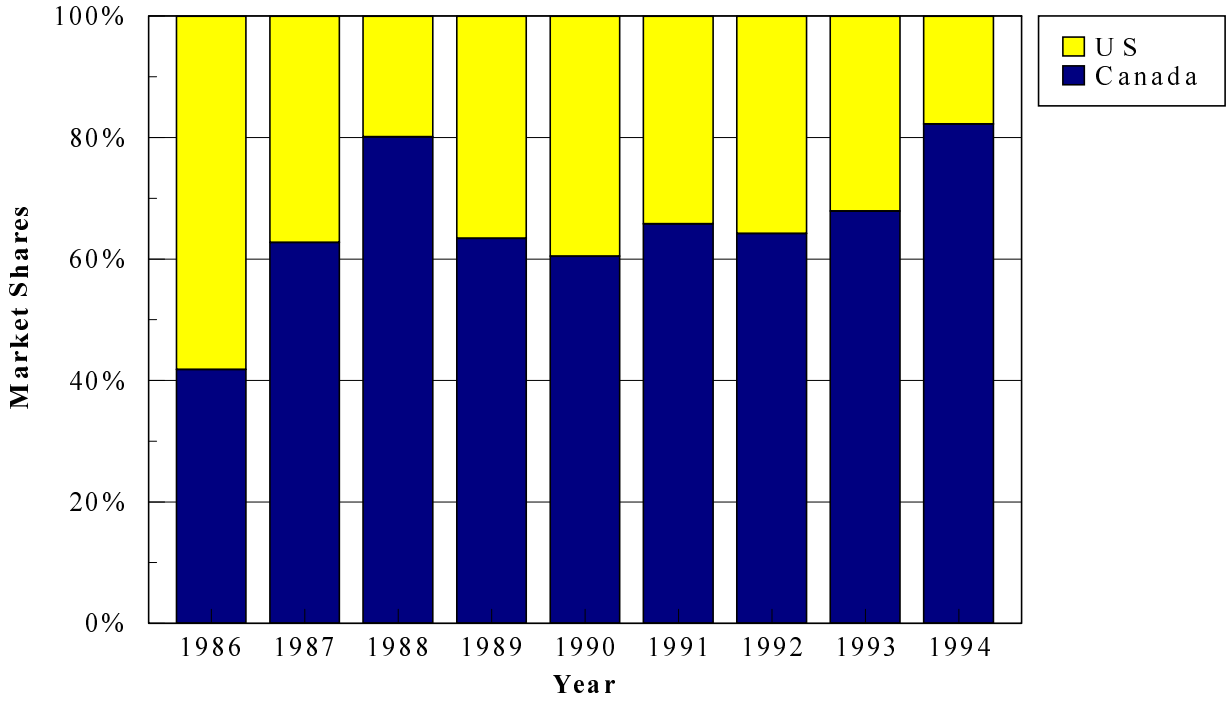

Figure 20. Market Shares for U.S. and Canadian Durum Exports, 1986-94.

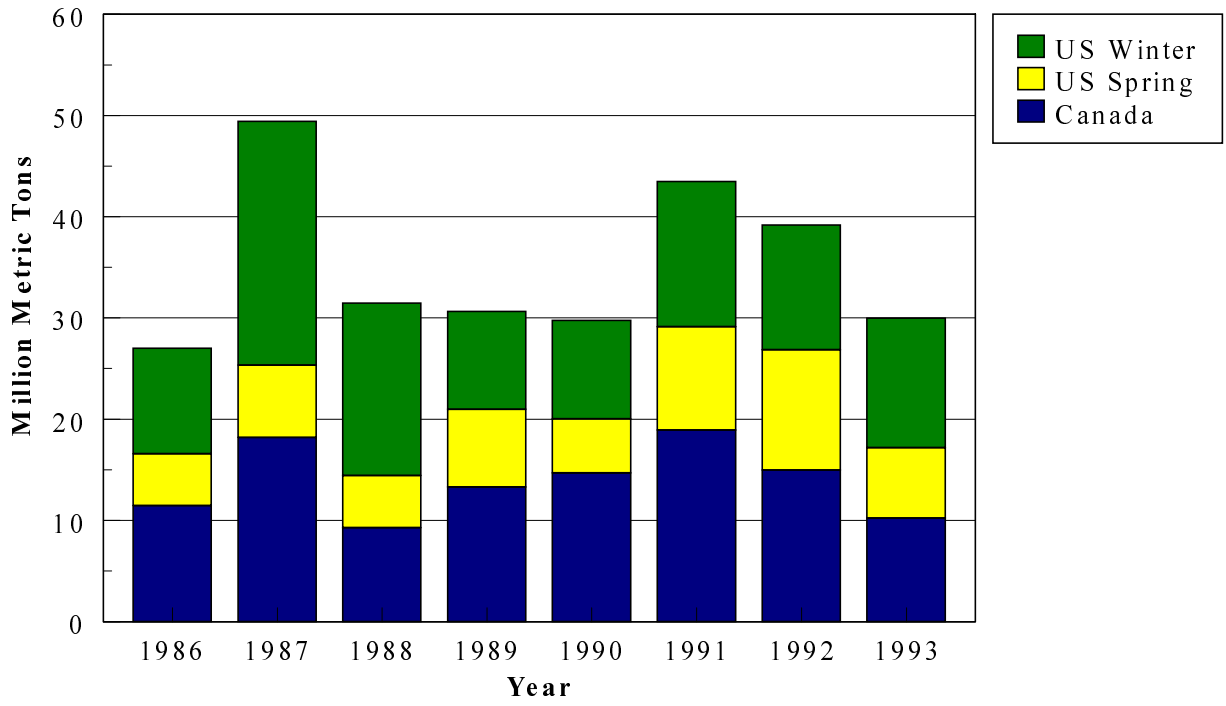

Figure 21. Exports of U.S. Winter, U.S. Spring, and Canadian CWRS Wheat, 1986-93.

Comparison of Exports of Hard Red Wheats by Grade into High Quality Markets

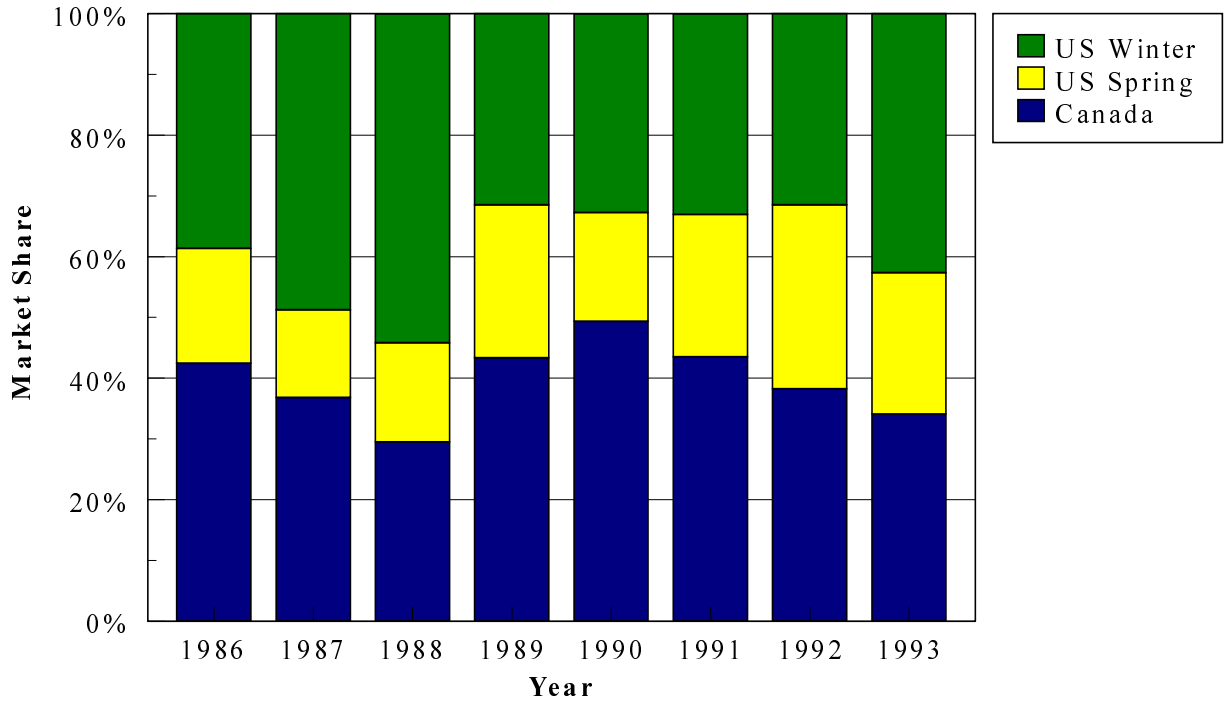

Figure 22. Market Shares for U.S. and Canadian Hard Red Wheat Exports, 1986-93.

Kraft et al. identified countries within the high quality commercial export market. These countries included the European Union, Finland, Norway, Portugal, Dominican Republic, Jamaica, Mexico, Panama, United States, Colombia, Ecuador, Israel, Hong Kong, Japan, South Korea, Malaysia, Singapore, Taiwan, Thailand, South Africa, Australia, and New Zealand. Exports by grade were compared for exports of No. 1 to all countries and total exports of CWRS, HRS, and HRW to these high quality wheat importing countries.

Examination of exports by grade were compared with total exports. In the case of Canadian CWRS, average exports of the highest quality grade CWRS No. 1 from 1986-91 were 8,740 *tmt.* Kraft et al. identified the average size of the high quality market as 49.5 percent of CWRS exports for 1980 to 1993. Meanwhile, exports of the highest quality U.S. wheat averaged 608 *tmt* for U.S. HRS No. 1 and 540 *tmt* for U.S. HRW No. 1 for 1986-94. This reveals that, on average, Canada has sold more than seven times the volume of the United States for the highest quality hard red wheats.

Exports of Canadian CWRS No. 1 to markets designated as high quality markets averaged 2,545 *tmt* per year from 1986-91 (Table 7). This represents 29.1 percent of the average total Canadian CWRS No. 1 exported to all markets. For the United States, exports of HRS No. 1 and HRW No. 1 to high quality markets averaged 594 and 537 *tmt*, respectively, for 1986-94. This represents 97.7 percent and 99.5 percent of total U.S. exports of HRS and HRW No. 1, respectively. Therefore, the markets identified as high quality by Kraft et al. import almost all the U.S. No.1, yet, only import less than 30 percent of the Canadian No. 1's. Further, the distribution of exports to these high quality markets from Canada are largely No. 1, as 84.3 percent of exports to these markets are CWRS No. 1. Exports of U.S. HRS and HRW to the high quality markets are largely U.S. No. 2 or better. Exports of U.S. No. 1 account for 18.9 percent and 15.4 percent of HRS and HRW exports to these high quality markets.

Table 7. Comparison of Average Exports to High Quality* and All Markets, Percent of Total Exports by Grade to High Quality Markets, and Grade Distribution for Exports to High Quality Markets, for Canadian CWRS and U.S. HRS and HRW

	No. 1	No. 2	No. 3	No. 2 OB	No. 3 OB
Average Exports to All Markets (tmt)					
CWRS**	8,740	2,996	2,565		
HRS***	608	3	2	6,882	16
HRW***	540	60	1	12,895	7
Average Exports to High Quality Markets (tmt)					
CWRS**	2,545	369	106		
HRS***	594	2	1	2,543	3
HRW***	537	36	1	2,909	2
Percent of Total Exports Exported to High Quality Markets by Grade (percent)					
CWRS	29.1	12.3	4.1		
HRS	97.7	53.4	7.3	36.9	21.2
HRW	99.5	60.8	9.7	22.6	29.7
Grade Distribution for Exports to High Quality Markets (percent)					
CWRS	84.3	12.2	3.5		
HRS	18.9	0.0	0.0	80.9	0.1
HRW	15.4	1.0	0.0	83.5	0.1

* High Quality is defined as in Kraft, et al.
** Average of 1986-91.
*** Average of 1986-94.

Analysis of Wheat Class/Grade Purchases by Specific Countries

Imports by grade were examined for each of the nine largest importers of U.S. and Canadian durum and each of the ten largest importers of U.S. and Canadian hard red wheats in 1991. Imports by grade were compared for 1986 to 1991 for Canadian imports and 1986 to 1994 for U.S. imports. The next sections compare U.S. and Canadian exports by grade over time for durum and hard red wheats for the top importers by volume.

Durum (U.S. and Canadian)

Importing patterns for grades varied both across time and among suppliers (Figures 23 to 25). For example, the largest importer of durum in 1991 (USSR) imported durum only from Canada from 1986 to 1994. Imports by grade shifted toward a higher percent of higher quality Canadian durum in 1991 than in 1986. This pattern of increasing import market shares of higher quality durum was prevalent in other importers of Canadian durum including Algeria, USSR, Japan, Italy, and Venezuela. This pattern of increasing import market shares for higher quality durum over time does not occur for many countries importing U.S. durum.

Of the nine largest importers, Italy and Venezuela have shown tendencies toward higher imports of U.S. HAD No. 1. Although, for a distinct trend toward purchases of higher quality durums to appear in Italian purchases of U.S. durum, high import market shares of U.S. HAD No. 1 from 1987 to 1989 must be discounted.

The most prevalent pattern of imports by grade for durum is for larger market shares of Canadian durum imports of CWAD No. 1 and larger market shares of lower grades of U.S. durum (U.S. No. 2 OB or U.S. No. 3 OB). Algeria, Venezuela, Belgium-Luxemburg, Guatemala, and Chile are examples of this. In fact, the most extreme example is Belgium-Luxemburg where imports from Canada are almost exclusively CWAD No. 1 and imports from the United States are HAD No. 3 OB.

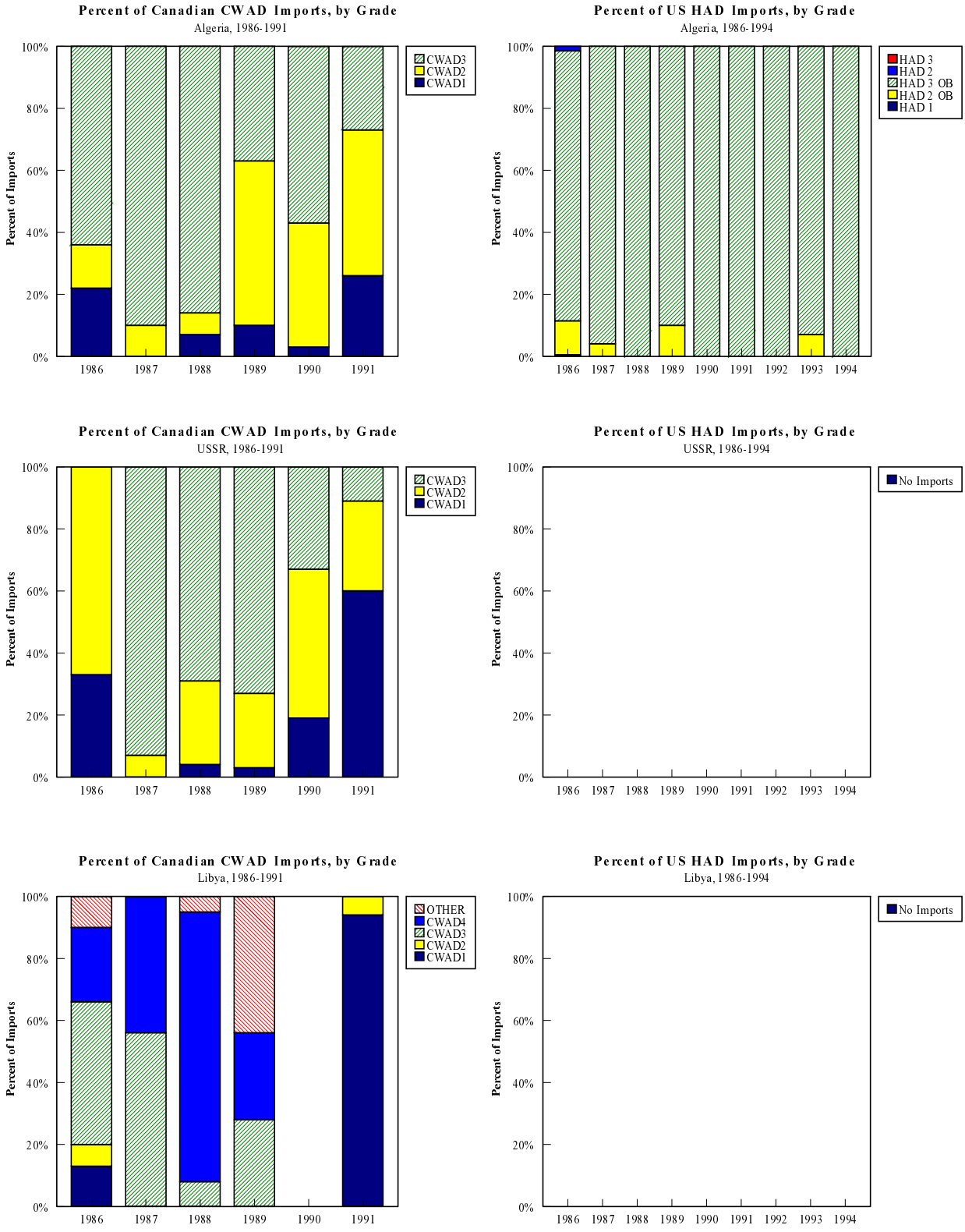

Figure 23. Percent of U.S. and Canadian Durum Imports, by Importing Country and Grade, 1986-94.

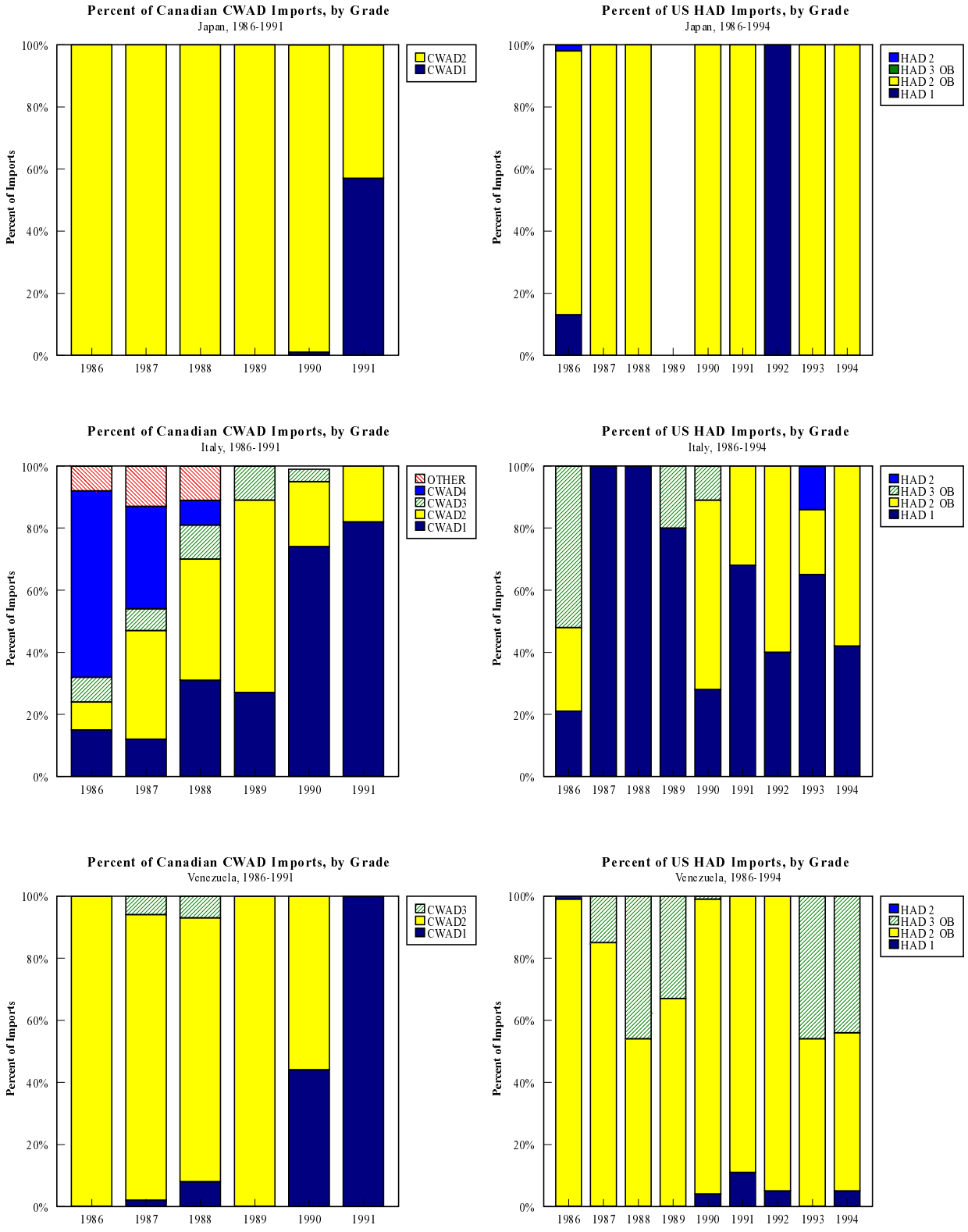

Figure 24. Percent of U.S. and Canadian Durum Imports, by Importing Country and Grade, 1986-94.

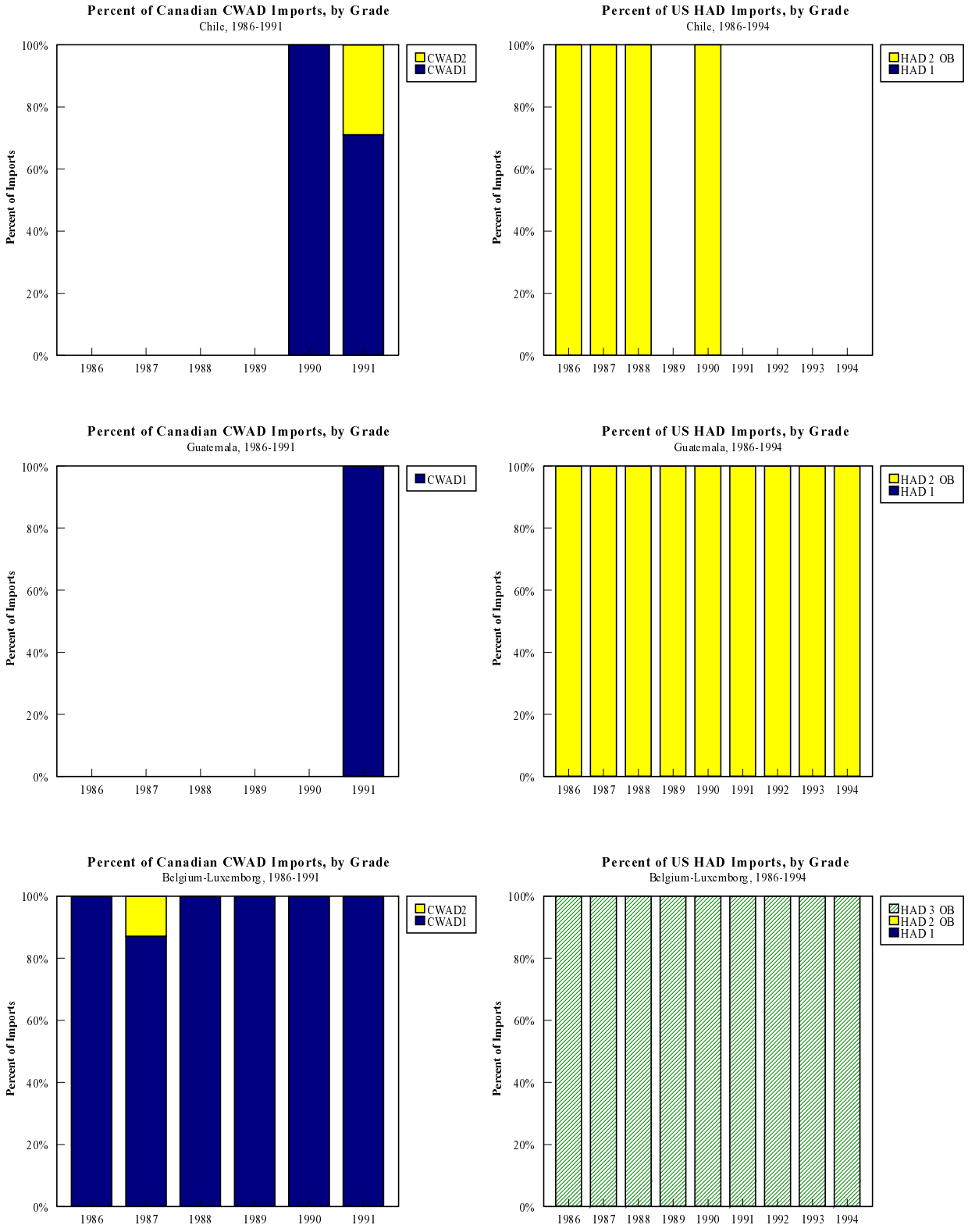

Figure 25. Percent of U.S. and Canadian Durum Imports, by Importing Country and Grade, 1986-94.

Hard Red Wheats (CWRS, HRS, and HRW)

Exports of U.S. and Canadian hard red wheats to the top importing countries display many of the same patterns as durum (Figures 26 to 31). For example, China, the USSR, South Korea, Taiwan, Philippines, Colombia, Mexico, and Venezuela increased their market shares for higher quality Canadian CWRS, similar to many of the top importers of Canadian durum. Meanwhile, for U.S. wheats (HRS and HRW), only South Korea has this pattern of increased market shares for higher quality wheat. Many of the top importers of hard red wheats import large shares of U.S. No. 2 OB, and this pattern has remained unchanged for most of these countries.

The pattern of increasing import market shares of higher grades of Canadian wheats while importing lower grades of U.S. wheats is prevalent in many of the top importing countries much as it is for durum wheats. Countries exhibiting this pattern include China, USSR, Philippines, Colombia, Venezuela, Egypt, and Italy. A few importers have increased imports of U.S. No. 1 HRS and/or HRW in the 1990s, such as HRS in China; however, imports have been sporadic to other countries, such as Brazil and Mexico. Importers that focus on higher quality wheats from all sources include Taiwan, which imported almost exclusively No. 1 from both the United States and Canada from 1986 to 1994; and South Korea which has moved to importing almost exclusively No. 1 from both in the 1990s.

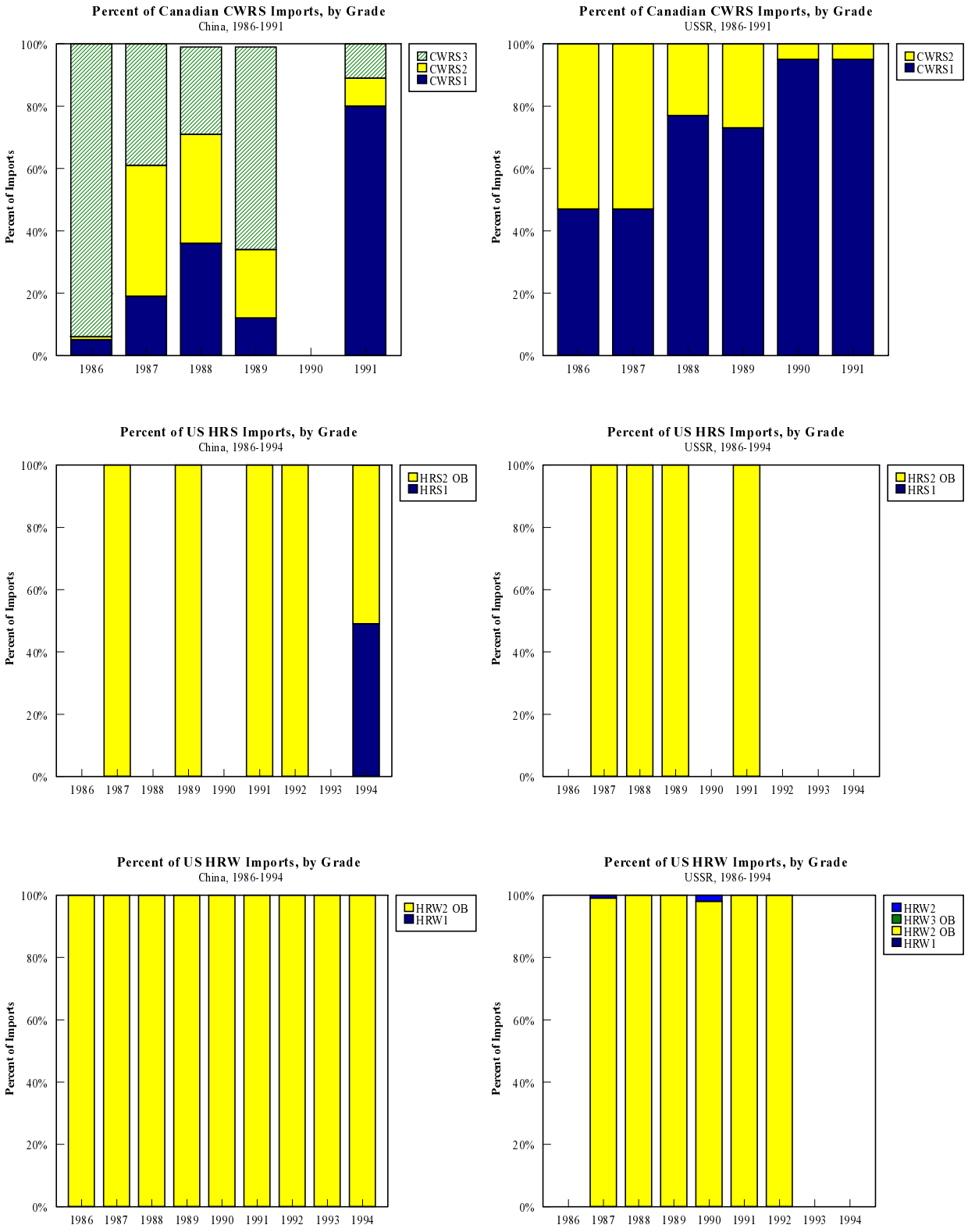

Figure 26. Percent of U.S. and Canadian Hard Red Wheat Imports, by Importing Country and Grade, 1986-94.

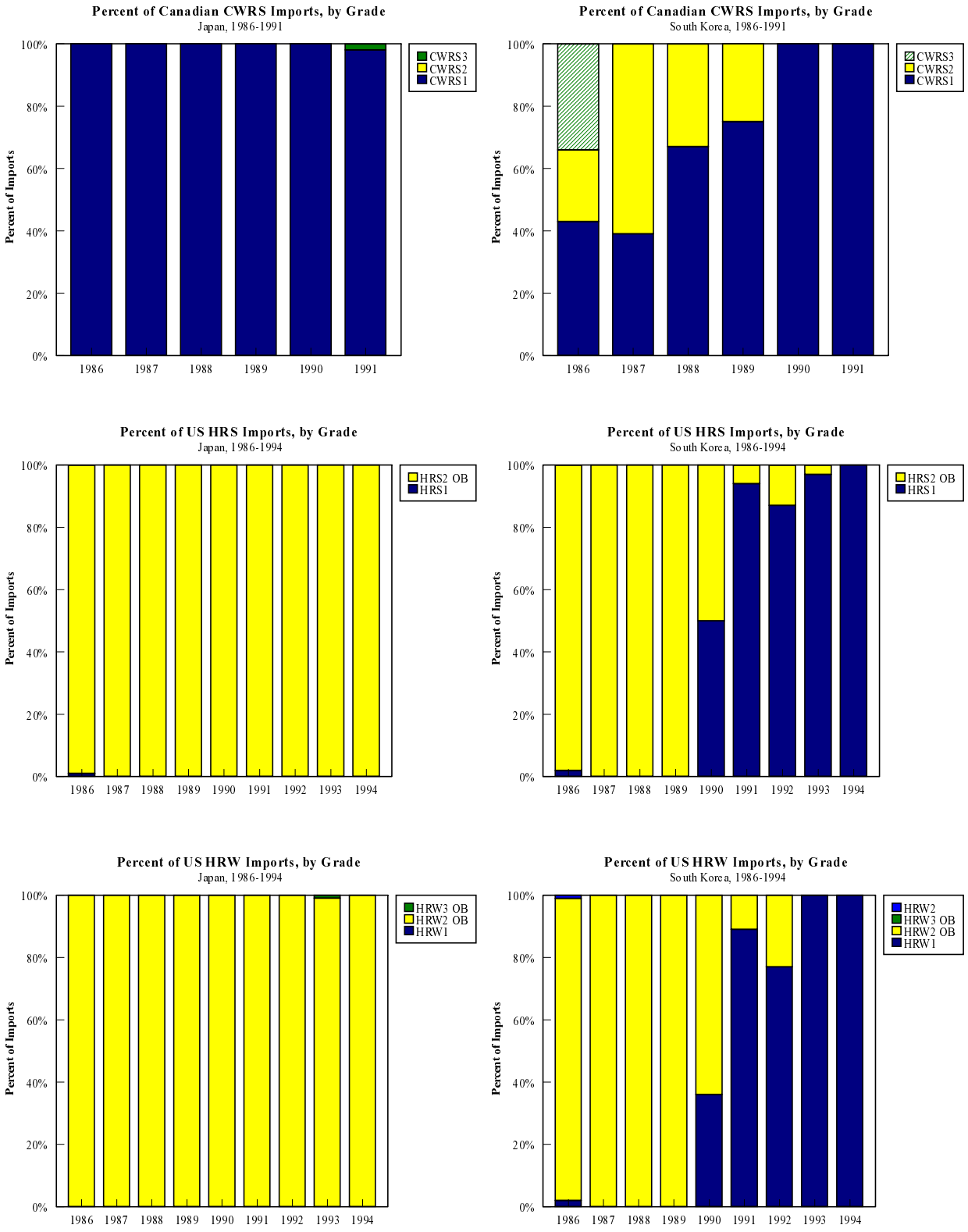

Figure 27. Percent of U.S. and Canadian Hard Red Wheat Imports, by Importing Country and Grade, 1986-94.

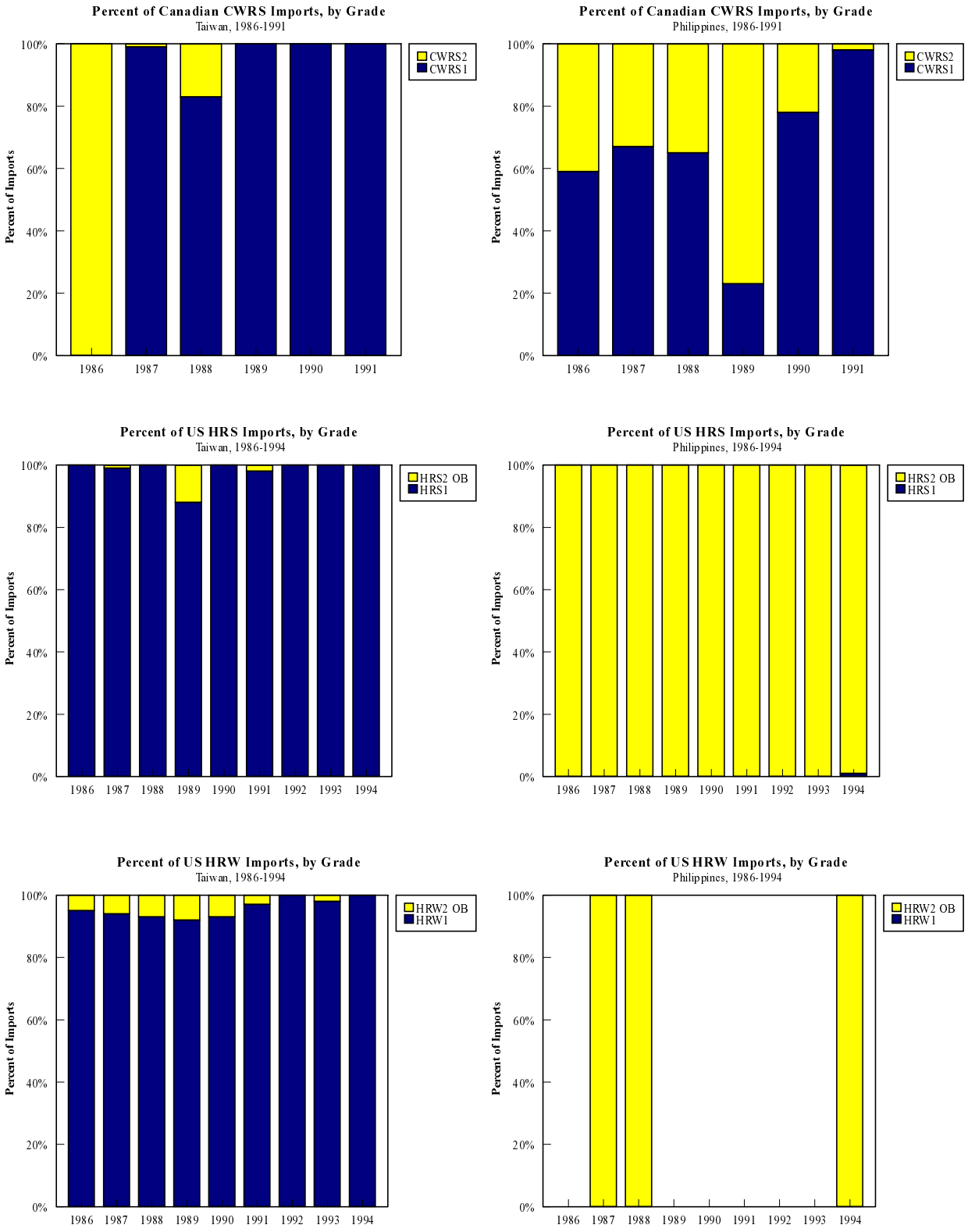

Figure 28. Percent of U.S. and Canadian Hard Red Wheat Imports, by Importing Country and Grade, 1986-94.

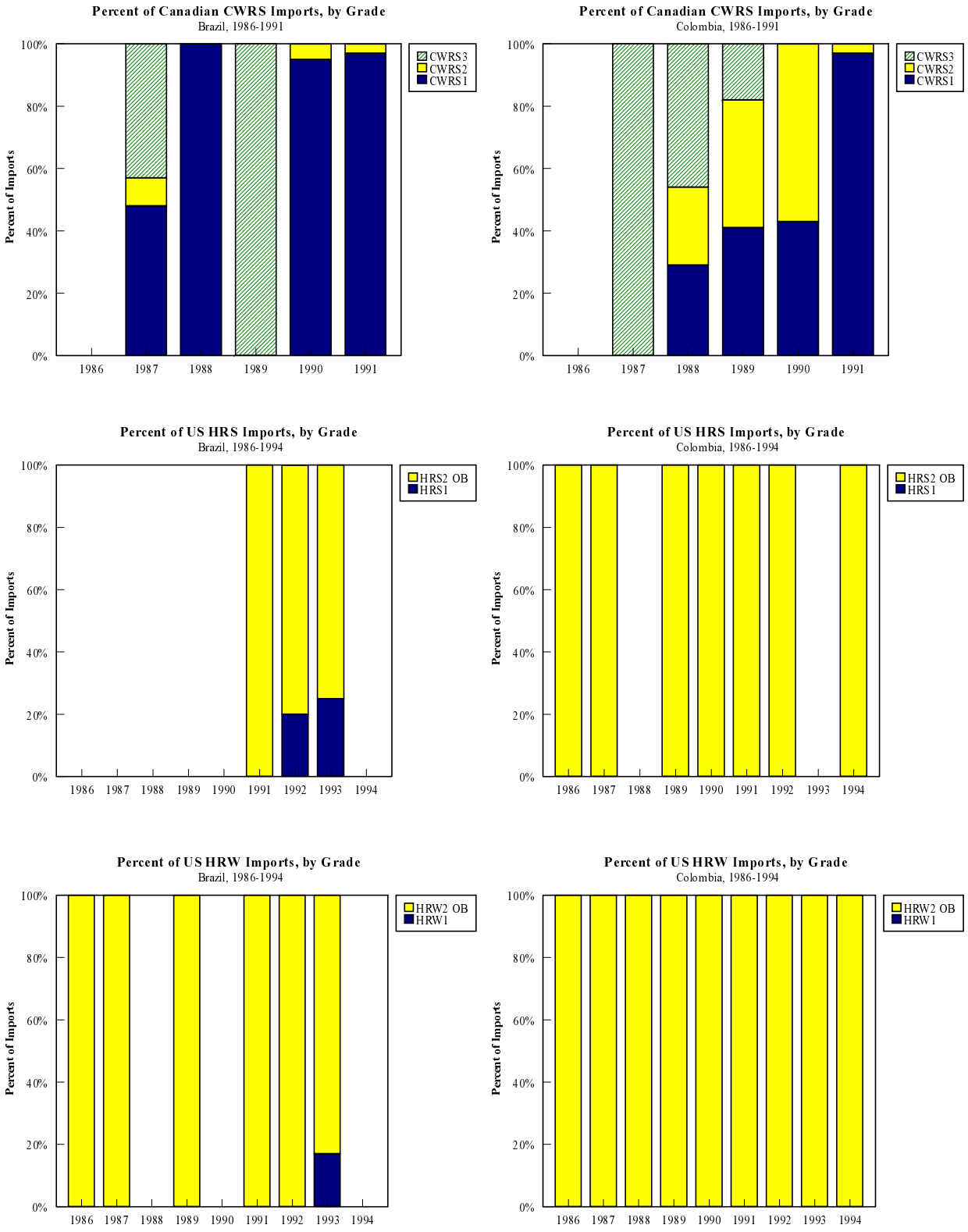

Figure 29. Percent of U.S. and Canadian Hard Red Wheat Imports, by Importing Country and Grade, 1986-94.

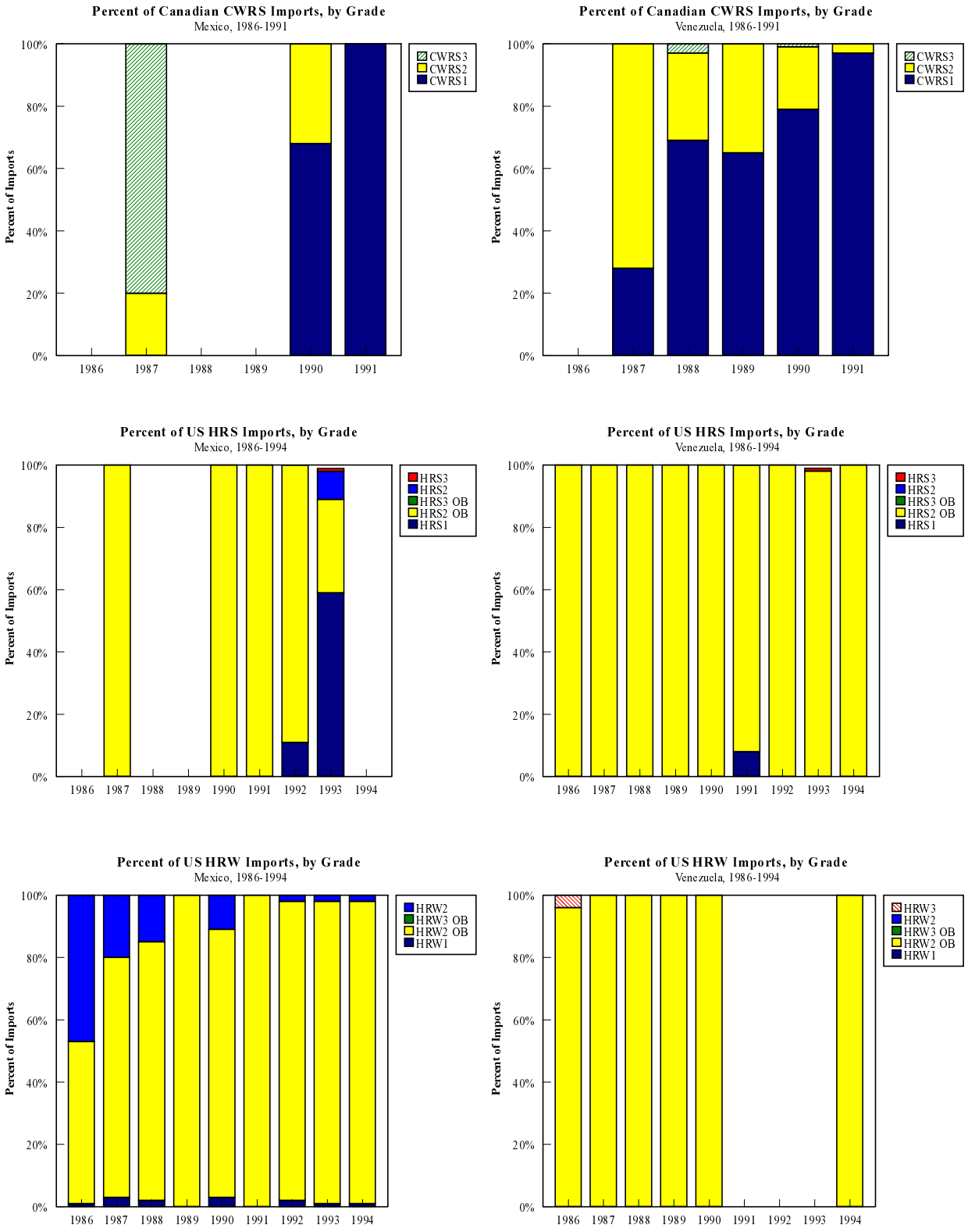

Figure 30. Percent of U.S. and Canadian Hard Red Wheat Imports, by Importing Country and Grade, 1986-94.

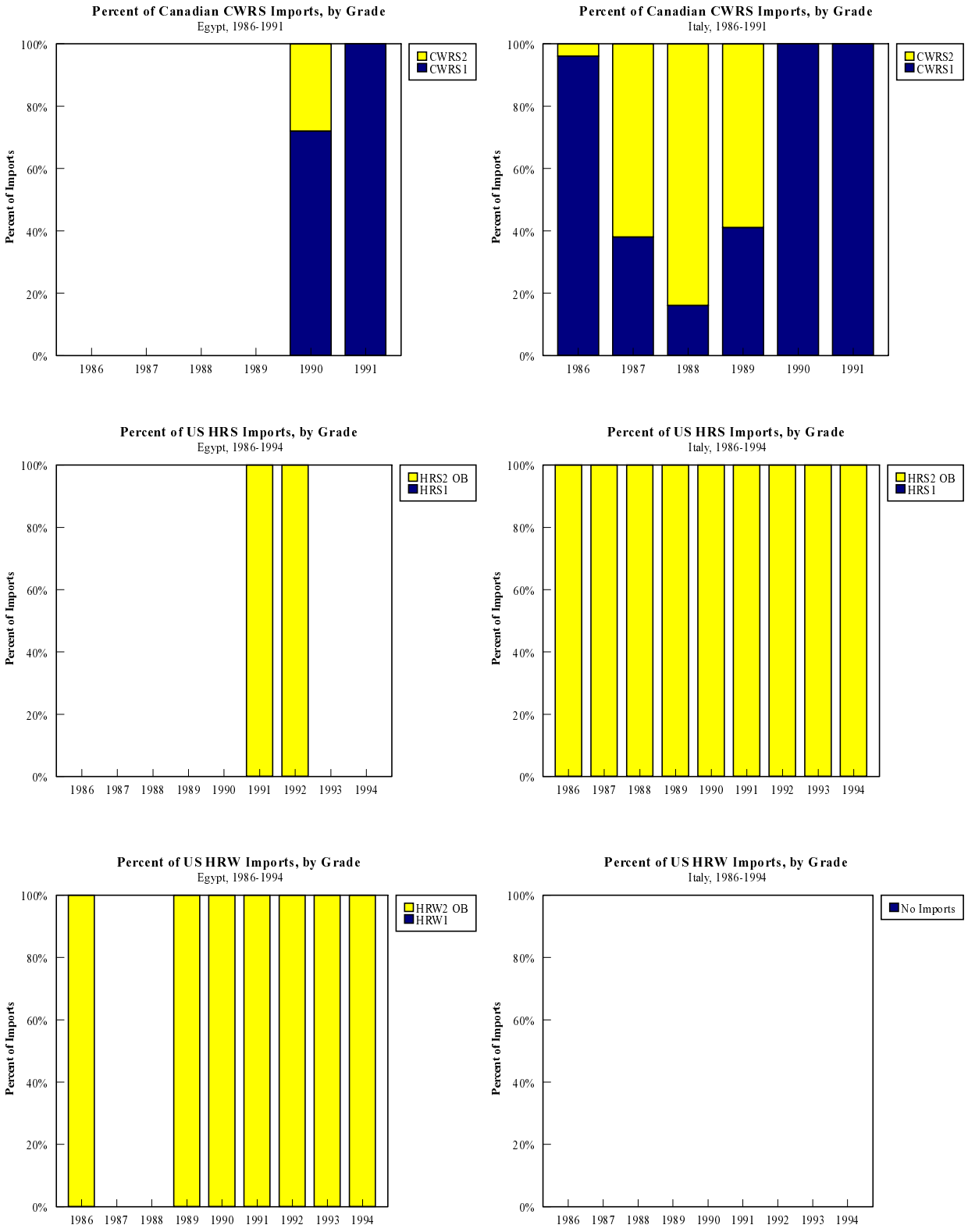

Figure 31. Percent of U.S. and Canadian Hard Red Wheat Imports, by Importing Country and Grade, 1986-94.

Analysis of Specific Factors on U.S. Shipments

Data on dockage, test weight, total defects, and protein were compared for countries importing more than a minimal quantity of U.S. HAD, HRS, and HRW from 1986-94. Average levels of dockage, test weight, total defects, and protein were calculated for each class of wheat by importing country from individual observations for shipments in the EGIS data set. Average levels for these factors were only estimated for countries importing more than 10,000 MT for a class of wheat (12,000 MT in the case of HRW). Observations for individual shipments were weighted so that individual observations reflected the volume shipped. Thus, average levels for a country reflect the average quality for the total volume of all shipments from 1986 to 1994.

HAD

Average dockage levels for U.S. HAD exports by country ranged from a low of .5 percent in Kuwait to over 1.2 percent in Ecuador and Somalia (Figure 32). A number of countries received imports of U.S. HAD with average levels of dockage less than .8 percent. These countries include Kuwait, the Dominican Republic, Finland, Cyprus, Argentina, Peru, Morocco, Italy, and Panama.

Average test weights for U.S. HAD exports ranged from 59.4 lbs/bu for Belgium to 61.8 lbs/bu for Kuwait (Figure 33). Countries importing U.S. HAD from 1986 to 1994 with average test weights over 61 lbs/bu include Kuwait, South Africa, Italy, Chile, Japan, Turkey, and Finland. Of these countries, Italy and Finland also imported HAD with average dockage levels less than .8 percent.

Average levels of total defects for U.S. HAD exports range from 2.2 percent for Japan to 6.2 percent for Belgium (Figure 34). Countries importing HAD with average levels of total defects that would meet U.S. No. 1 standards include Japan, Kuwait, Chile, Italy, Argentina, and Finland. Countries with average levels of total defects larger than 5 percent (U.S. No. 3 specifications) include Yugoslavia, Netherlands, Algeria, Tunisia, and Belgium.

Protein levels for those HAD shipments that reported protein ranged from an average of 15.1 percent to a low of 12.4 percent (Figure 35). A number of countries imported HAD with no protein levels reported. These sales were most likely made with no protein content specified. Countries not specifying protein for HAD included Morocco, El Salvador, Belgium, Somalia, Guatemala, Argentina, South Africa, Algeria, Netherlands, Panama, Finland, and Cyprus. Countries importing HAD with an average protein level higher than 14 percent included Portugal, Poland, Ecuador, Japan, Yugoslavia, Tunisia, Italy, Kuwait, and the Dominican Republic.

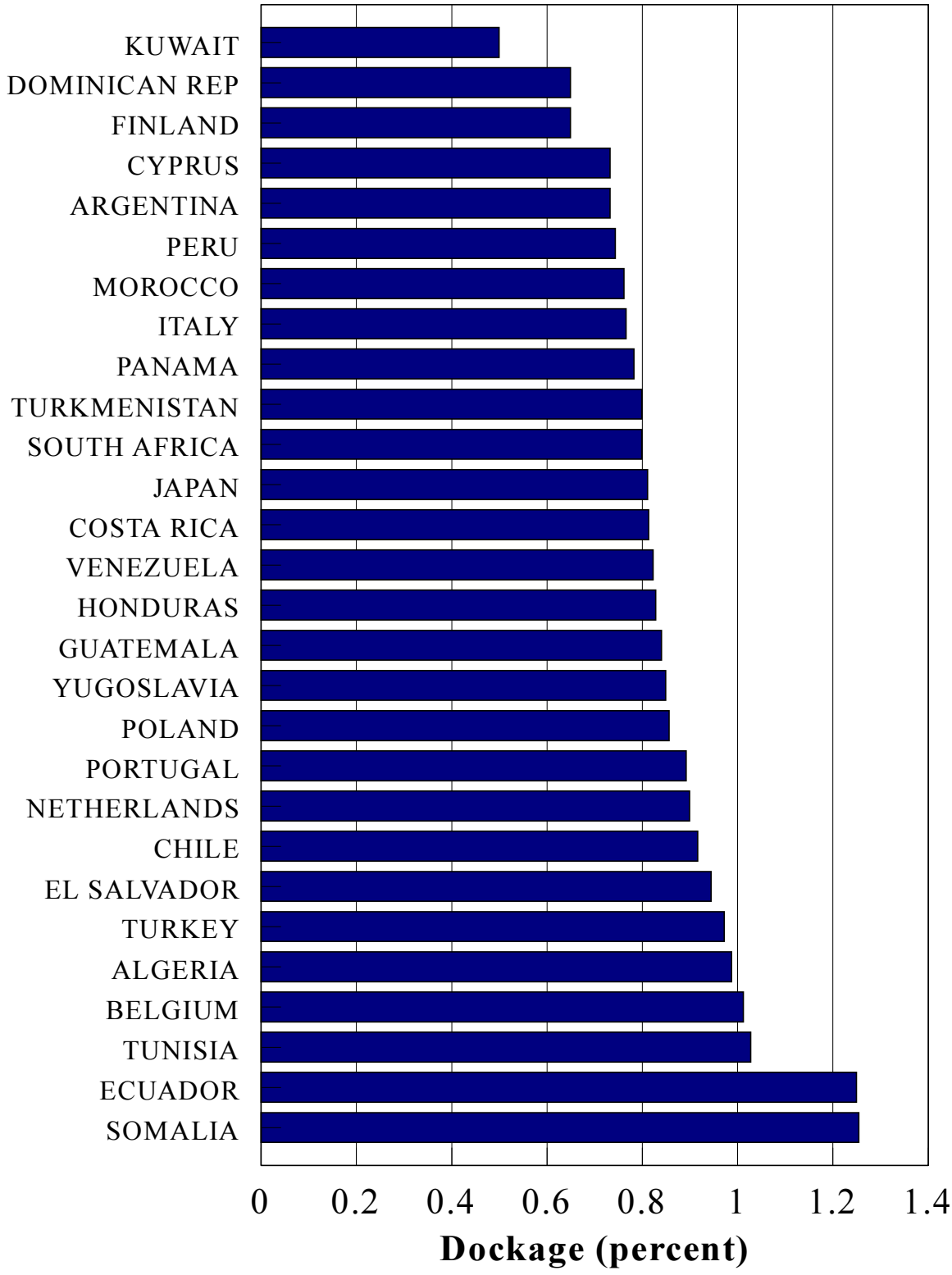

Figure 32. U.S. HAD Exports: Average Dockage Levels for 1986-1994 (Total Sales Over 10,000 MT).

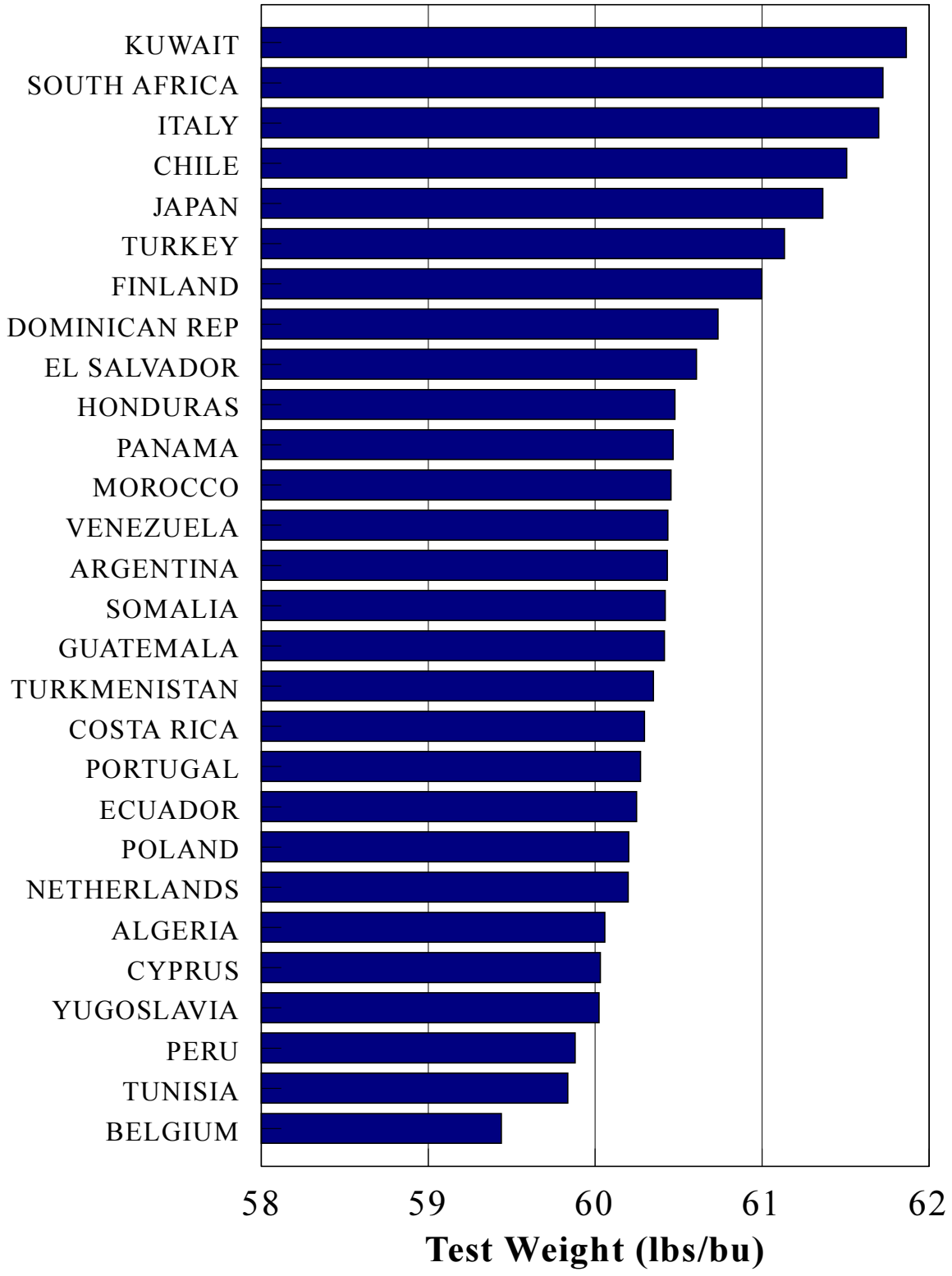

Figure 33. U.S. HAD Exports: Average Test Weight for 1986-94 (Total Sales Over 10,000 MT).

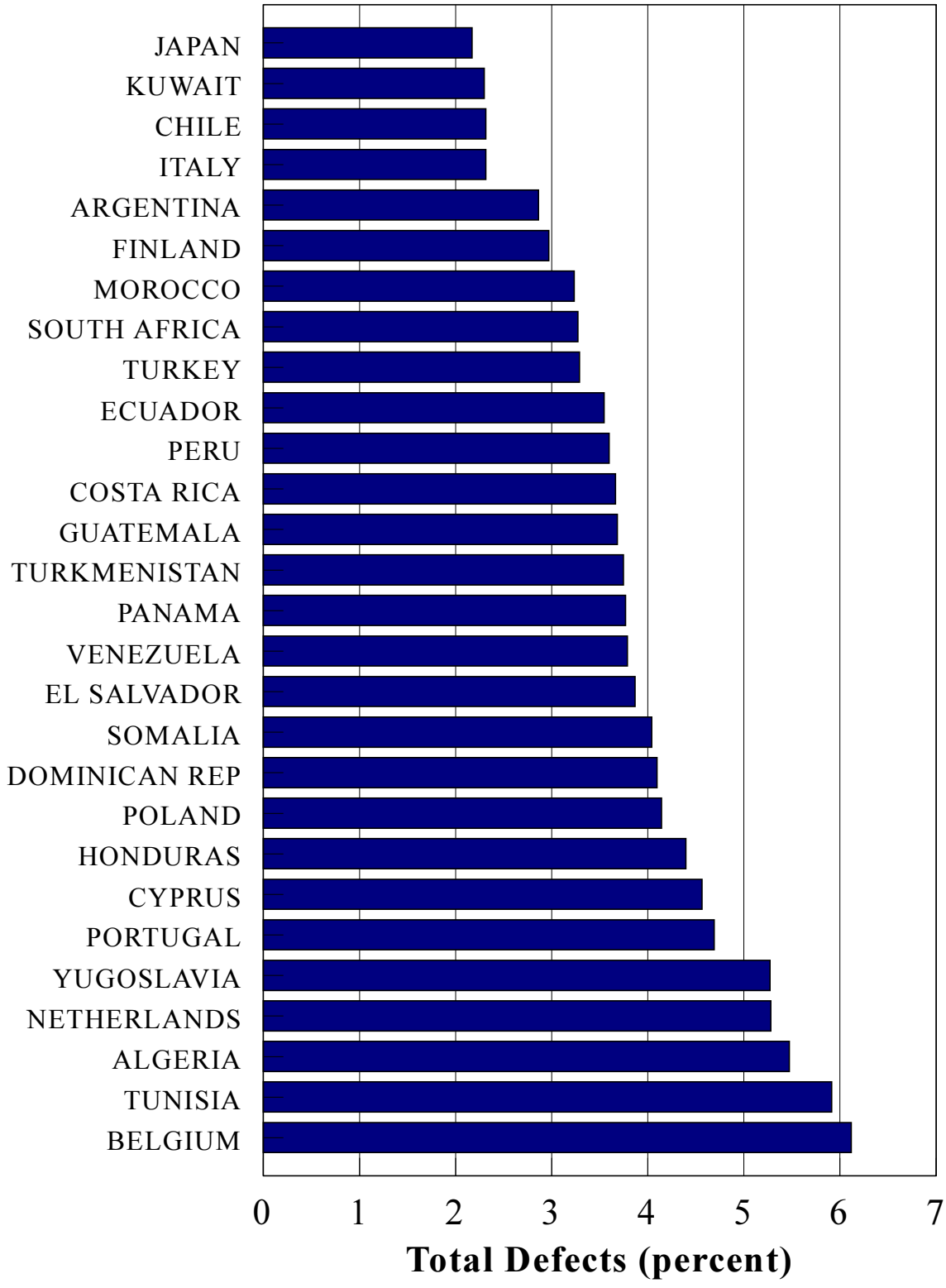

Figure 34. U.S. HAD Exports: Average Total Defects for 1986-94 (Total Sales Over 10,000 MT).

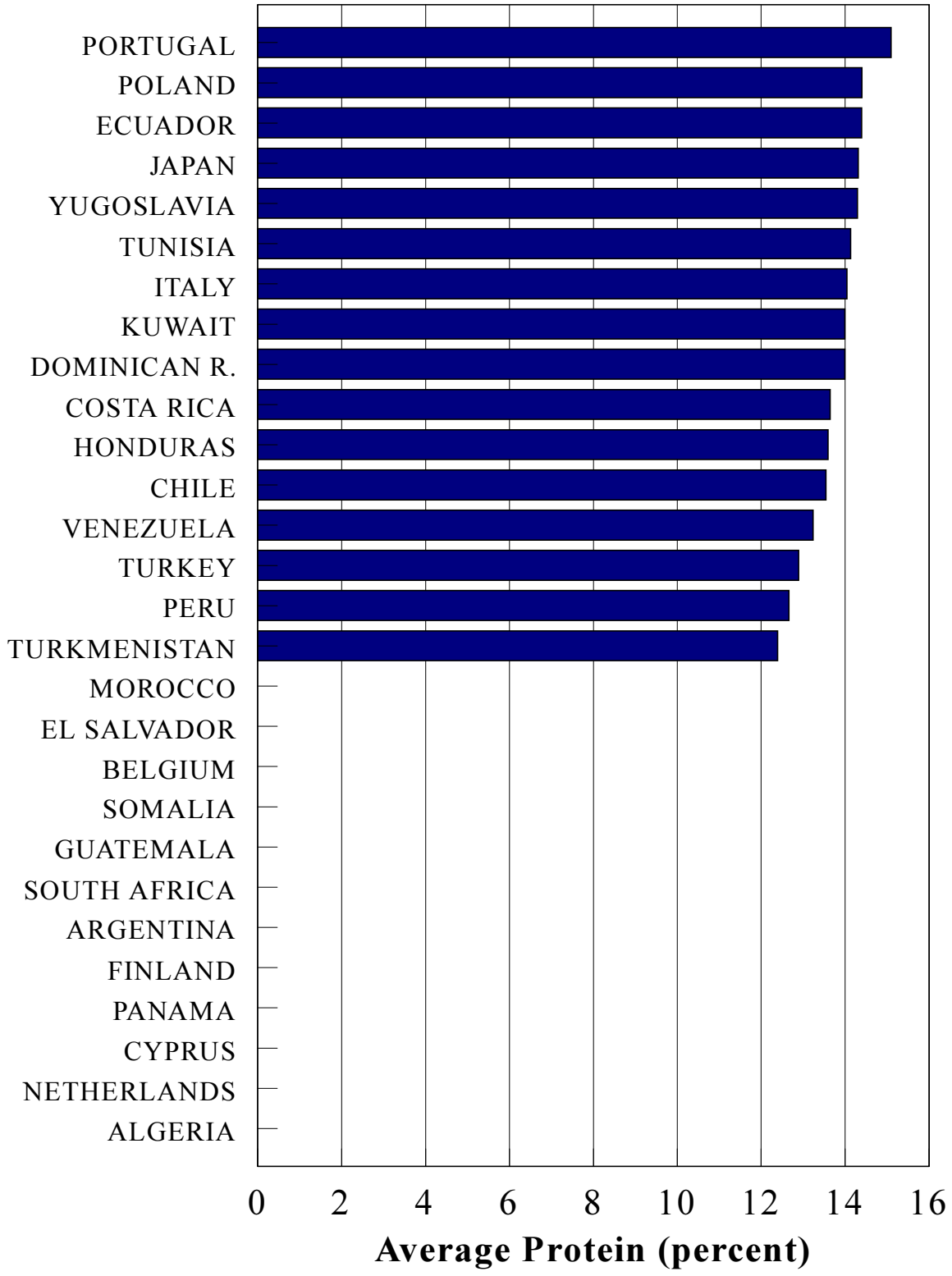

Figure 35. U.S. HAD Exports: Average Protein for Sales Reporting Protein Levels, 1986-94 (Total Sales Over 10,000 MT).

HRS

The bulk of average dockage levels for countries importing HRS was between .6 percent and 1 percent (Figure 36). Norway imported HRS with an average dockage level of .43 percent while Albania, Grenada, Sierra Leone, and Lebanon imported HRS with an average dockage level over 1 percent. Countries importing HRS with dockage below .7 percent included Norway, Liberia, Spain, Yugoslavia, Israel, New Zealand, Finland, and Senegal.

Average test weights for exports of HRS ranged from 59.2 lbs/bu for Lebanon to 61.8 lbs/bu for Singapore (Figure 37). Most countries had average test weight between 59.5 and 61 lbs/bu. Countries with average test weights over 61 lbs/bu included Singapore, New Zealand, Bangladesh, Taiwan, Malaysia, Israel, South Korea, Japan, Sri Lanka, Kuwait, and the Ivory Coast.

Average total defects for HRS imports from 1986-94 ranged from just under 2 percent for New Zealand to a high of 5 percent for Lebanon and Namibia (Figure 38). Most countries had average total defects between 3 percent and 4 percent. Countries importing lower average total defects (less than 3 percent) included New Zealand, Taiwan, Singapore, South Korea, Malaysia, Hong Kong, Indonesia, Japan, Maritanina, Norway, Israel, Thailand, UK, Slovenia, and the Philippines.

Protein levels for those sales that reported protein for HRS ranged from an average of 15.3 percent to a low of 12.2 percent (Figure 39). Many of the East Asian countries, including Hong Kong, Thailand, Taiwan, Malaysia, Singapore, and South Korea imported wheat with average protein levels over 14.4 percent. Japan had lower average protein levels of 14.21 percent. Many other European countries had high levels of protein. These countries included the UK, Portugal, Italy, and West Germany. At the lower end of the range for average protein levels reported are countries such as Russia, Egypt, Kenya, and Sudan, among others.

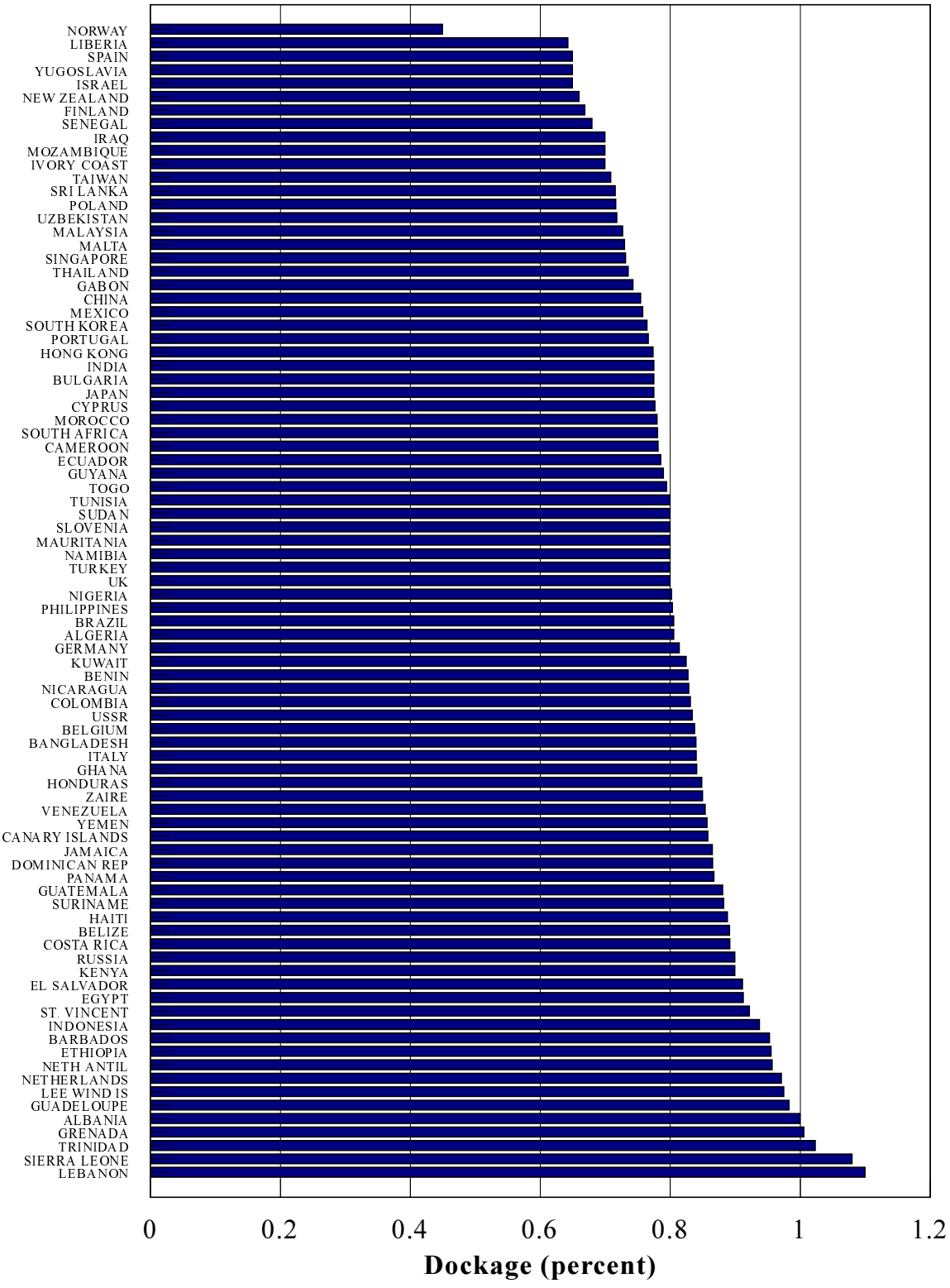

Figure 36. U.S. HRS Exports: Average Dockage Levels for 1986-94 (Total Sales Over 10,000 MT).

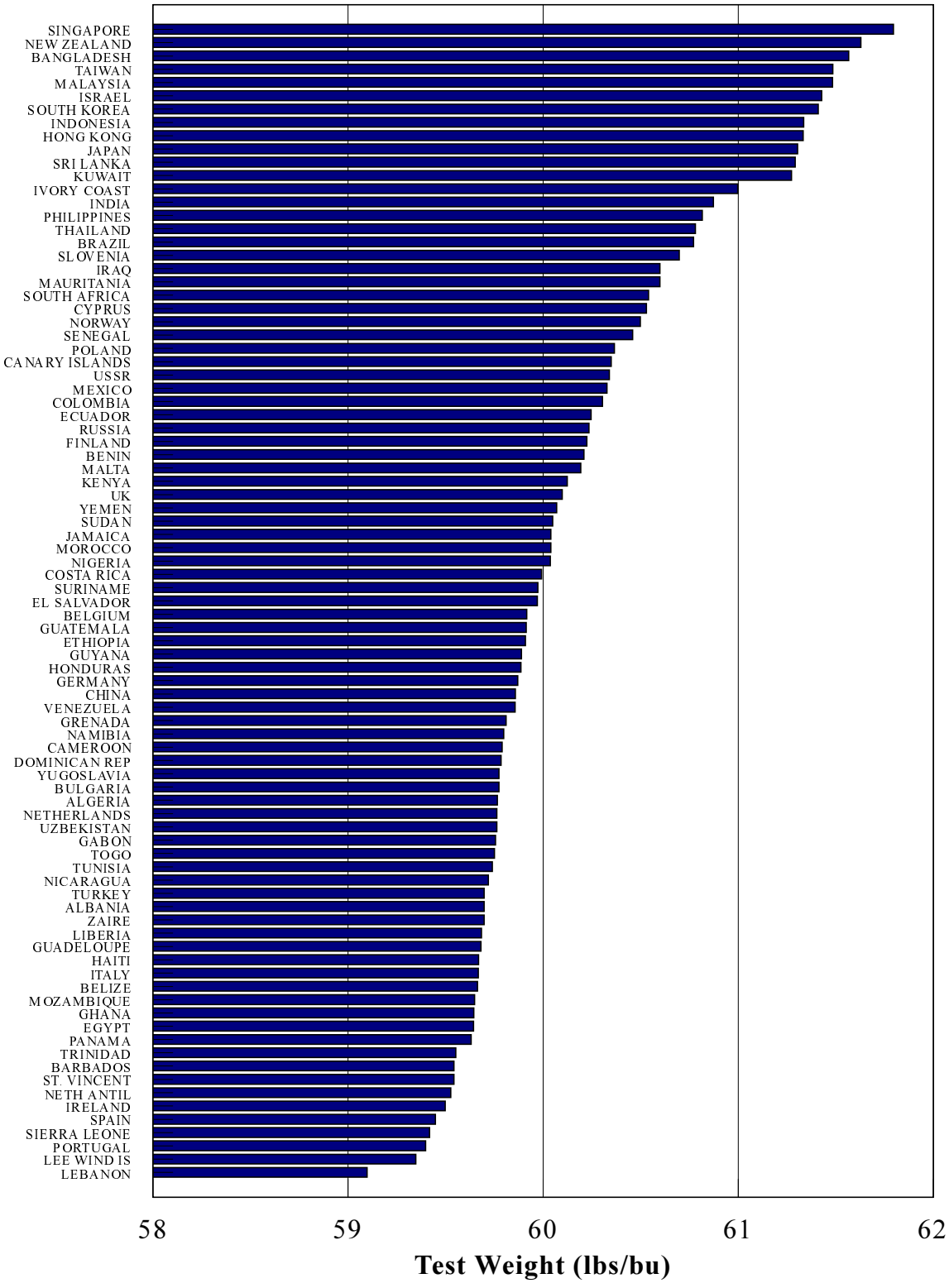

Figure 37. U.S. HRS Exports: Average Test Weight for 1986-94 (Total Sales Over 10,000 MT).

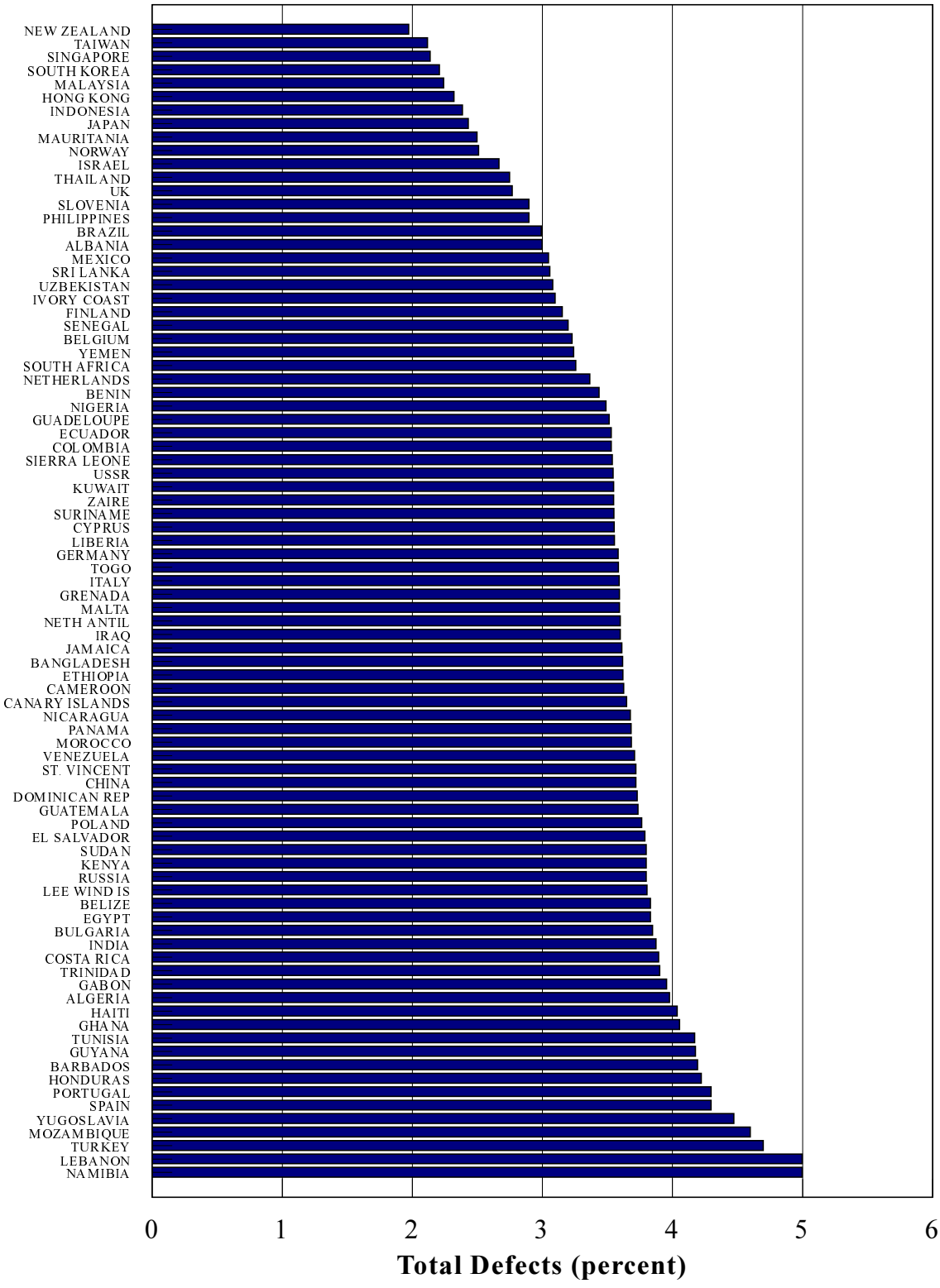

Figure 38. U.S. HRS Exports: Average Total Defects for 1986-94 (Total Sales Over 10,000 MT).

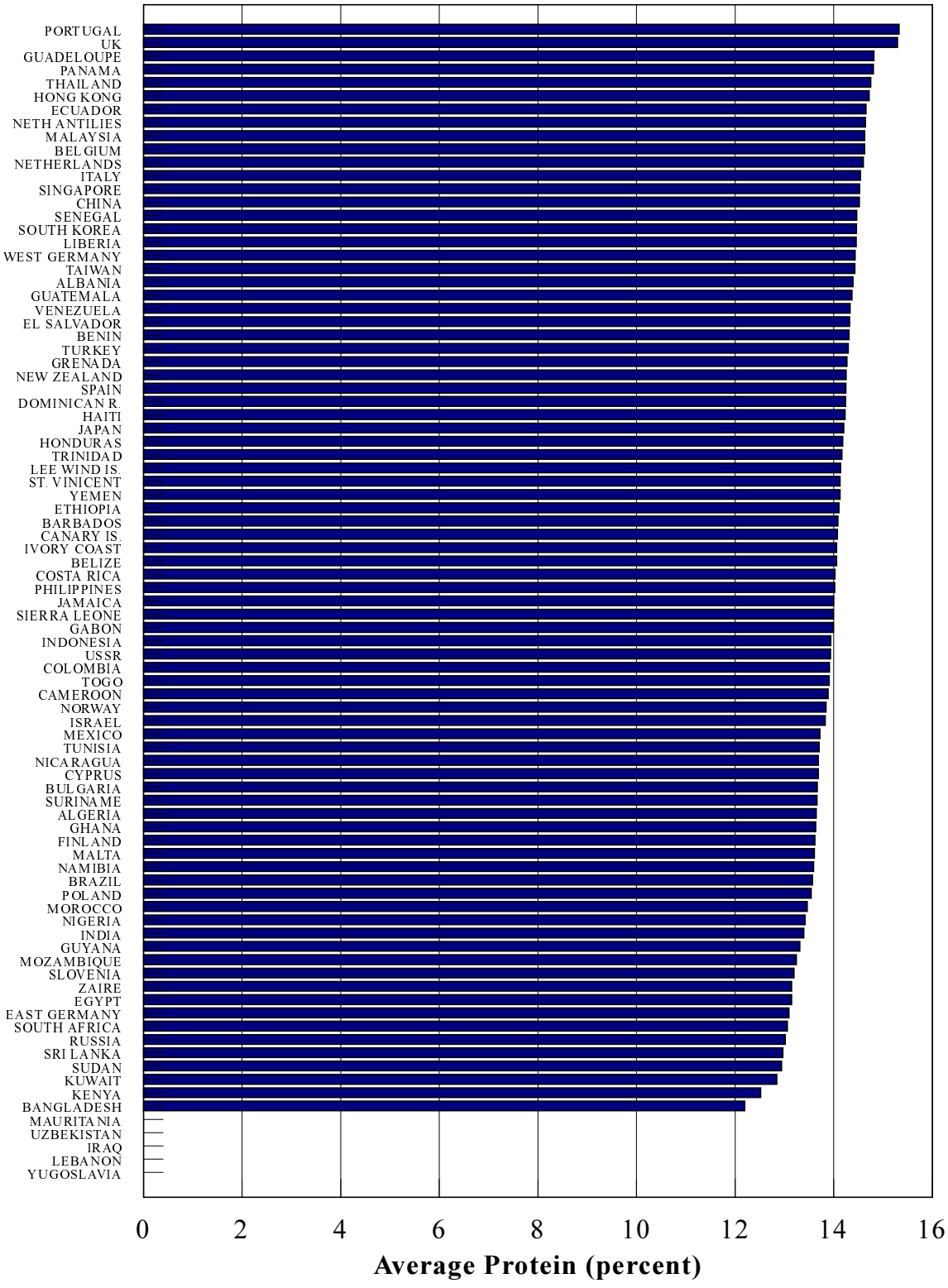

Figure 39. U.S. HRS Exports: Average Protein for Sales Reporting Protein Levels, 1986-94 (Total Sales Over 10,000 MT).

HRW

Average characteristics were estimated for exports of HRW wheat. The bulk of importers of HRW had average dockage levels between .6 percent and .8 percent (Figure 40). This is a lower range than for importers of HRS where most countries had average dockage between .6 percent and 1 percent. Countries importing HRW with average dockage less than .6 percent included Finland, Malaysia, Taiwan, Norway, Philippines, Liberia, South Korea, and Hong Kong.

Average test weights for HRW exports ranged from 59.4 lbs/bu for Kyrgyzstan to 62.2 lbs/bu for Bangladesh. Most of the importers had average test weights from 60 to 62 lbs/bu (Figure 41). Twenty-seven countries imported HRW with an average test weight over 61 lbs/bu. These countries included many of the East Asian countries like Bangladesh, Malaysia, South Korea, Taiwan, Philippines, Japan, Thailand, Indonesia, and Hong Kong. These East Asian countries dominated HRW exports with the highest average test weights with all countries having average test weights over 61.5 lbs/bu.

Average total defects for HRW exports were largely between 2 percent and 4 percent. Ten countries imported HRW with average total defects over 4 percent (Figure 42). These importers of high defect HRW include Russia, Mali, Poland, Lebanon, Uganda, Swaziland, Moldova, Georgia, Armenia, and Kyrgyzstan. These are largely former republics of the USSR and reflect imports after 1992. Average total defects for the USSR prior to the breakup averaged just under 4 percent. Thus, the higher levels probably reflect crop quality problems experienced in 1993 and 1994. Countries importing HRW with low defects are again dominated by East Asian countries. The Philippines, Taiwan, Malaysia, Hong Kong, South Korea, Thailand, Japan, Bangladesh, and Indonesia were among the 13 countries with the lowest average level of total defects.

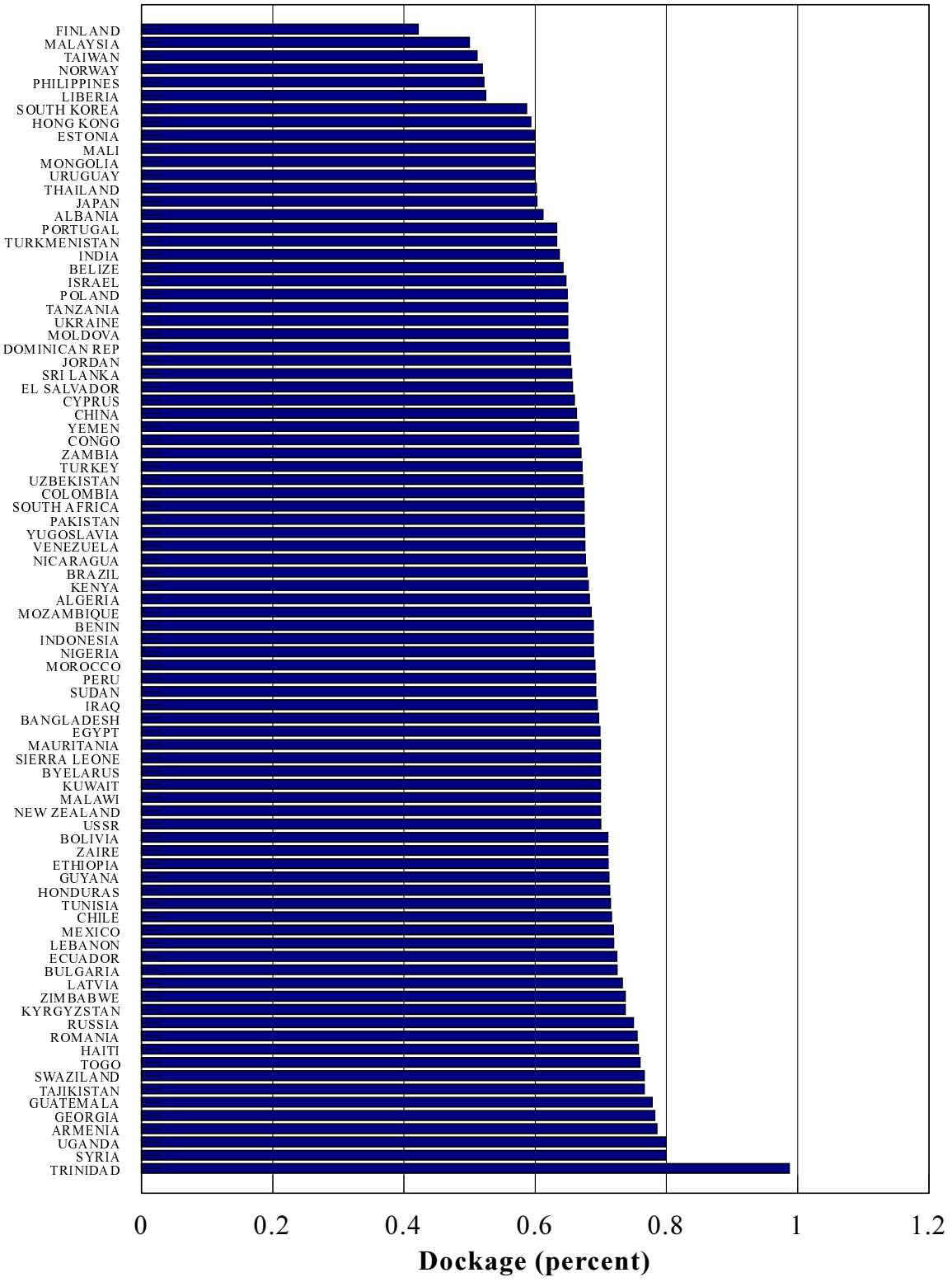

Figure 40. U.S. HRW Exports: Average Dockage Levels for 1986-94 (Total Sales Over 12,000 MT).

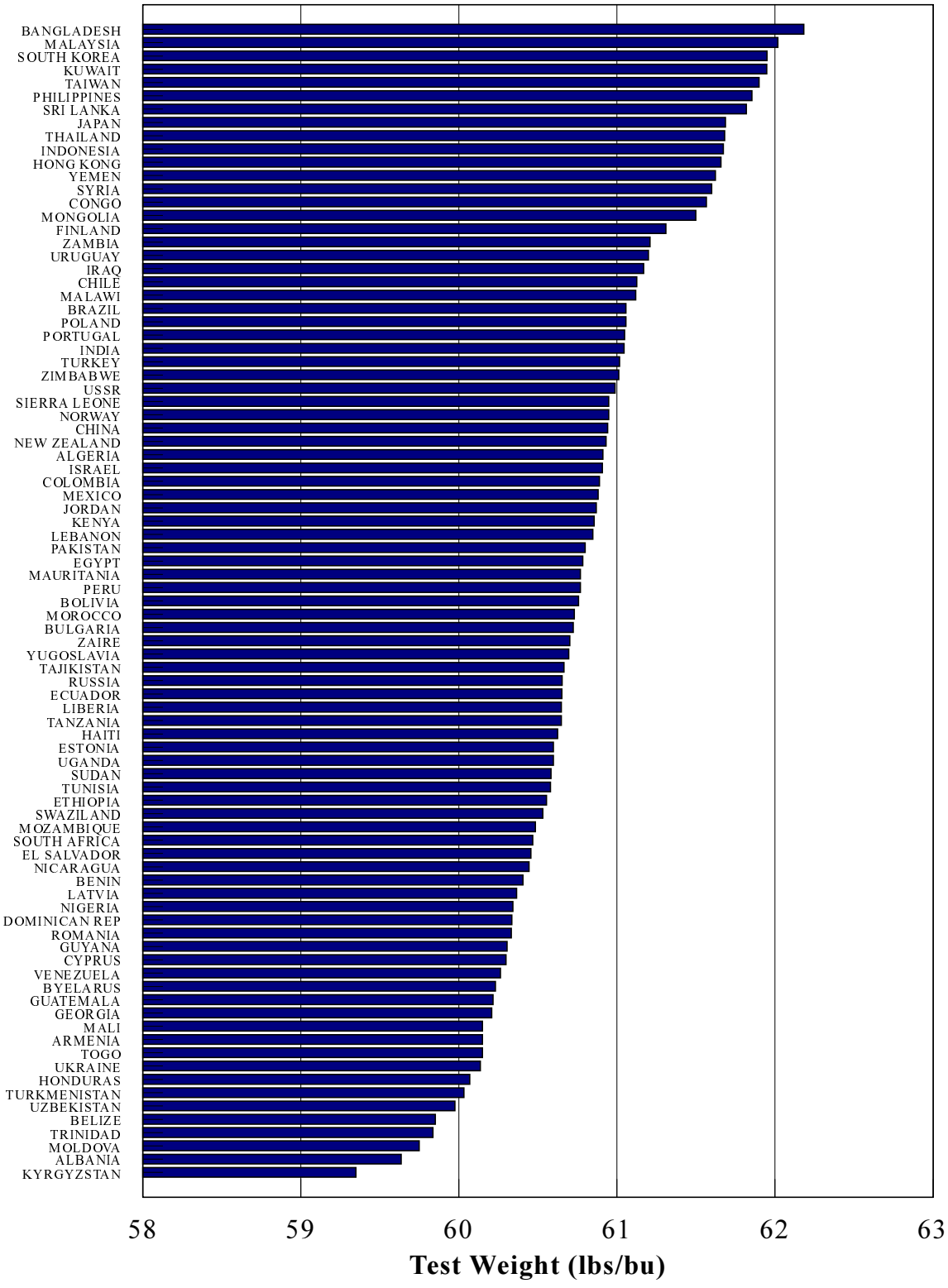

Figure 41. U.S. HRW Exports: Average Test Weight for 1986-94 (Total Sales Over 12,000 MT).

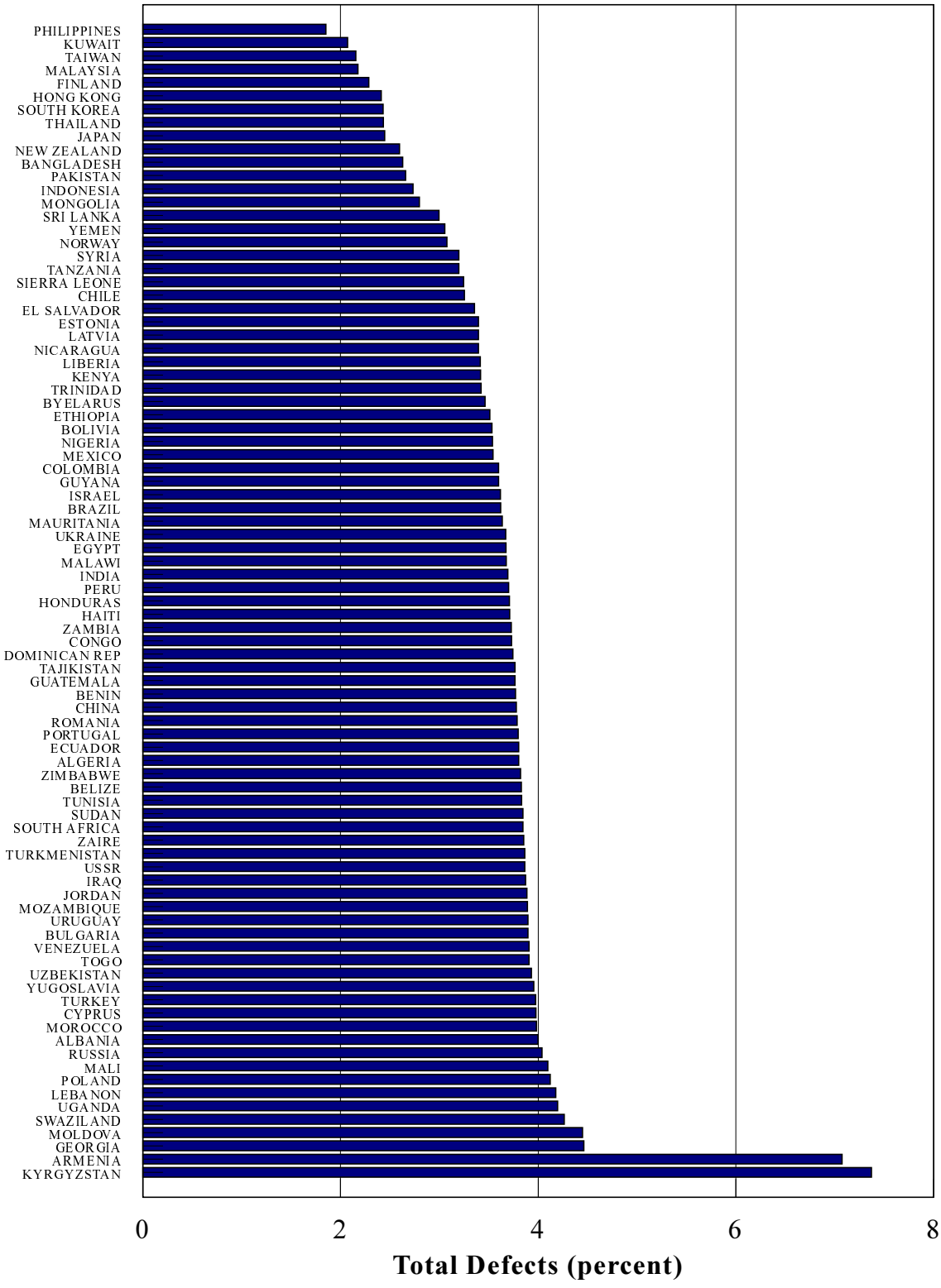

Figure 42. U.S. HRW Exports: Average Total Defects for 1986-94 (Total Sales Over 12,000 MT).

Protein levels for importers of HRW ranged from a high of 13.1 percent for Hong Kong to a low of 10.7 percent for Tanzania (Figure 43). Most countries had average levels between 11.5 percent to 12.5 percent protein. Those countries with average protein levels over 12.5 percent included Hong Kong, Malawi, New Zealand, Taiwan, Finland, Malaysia, Algeria, Yugoslavia, Indonesia, and Haiti. Countries with the lowest average protein levels included many of the former Republics of the Soviet Union and African countries.

The countries that had the highest average test weights are many of the same countries that had the lowest average total defects. However, those countries that had the lowest average dockage levels were not as likely to be either the countries with the highest test weights or the countries with lowest average total defects. This suggests that countries may have a different objective when specifying low dockage other than a desire for high test weight or low total defects. This trend was prevalent in exports of U.S. HAD, HRS, and HRW. For both HRW and HRS, the countries with the highest test weights and lowest total defects were largely from east and southeast Asia. For HAD, the countries with the highest test weight and lowest total defects were Italy, Japan, Chile, Finland, and Kuwait. Thus, while the composition of importers of high test weight and low total defect HRS and HRW are similar, the composition of durum importers demanding the same characteristics is composed of many different countries.

Protein levels also varied in contrast to countries importing with high test weights, low dockage, and low total defects. For example, in the case of HAD, the three countries with the highest average protein levels included Portugal, Poland, and Ecuador. These same countries had average dockage levels that placed them closer to the highs of the range for importers. Test weights, although over 60 lbs/bu, were also closer to the lower end of the scale. Average levels for total defects were also near the higher end, especially for Poland and Portugal. Similar results are indicated for a number of countries in HRS and HRW including Guadeloupe, Panama, Portugal, and Ecuador for HRS and Malawi, Togo, and Cyprus, among others, for HRW.

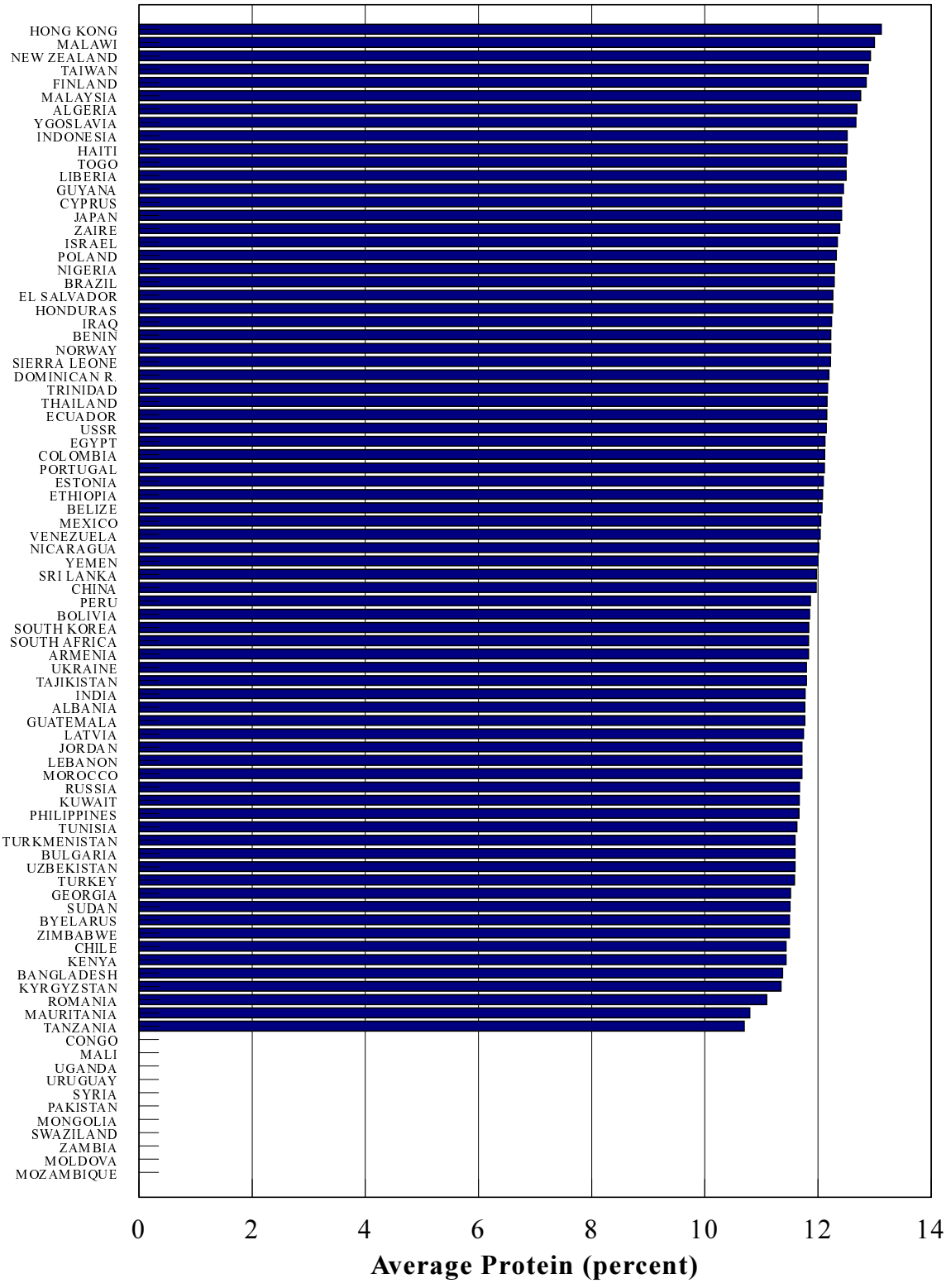

Figure 43. U.S. HRW Exports: Average Protein for Sales Reporting Protein Levels, 1986-94 (Total Sales Over 12,000 MT).

Comparison of Grade Specifications with Buyer's Preference

Since the United States exports a majority of wheat at the seller's option (U.S. No. 2 or better and U.S. No. 3 or better), direct comparisons of exports by inspection grade can be somewhat misleading. Much of the U.S. wheat that is shipped as No. 2 or better actually meets grade specifications for U.S. No. 1. Similarly, some U.S. No. 3 or better meet U.S. No. 1 or U.S. No. 2 specs. This is because in order to comply with import regulations in importing countries, the FGIS only inspects shipments to verify if the grain loaded is in fact equivalent to or better than the grade listed on the export documents. Thus, grain sold as U.S. No. 2 or better gets graded as U.S. No. 2 or better even if it may meet U.S. No. 1 specs (Runge). Therefore, when comparing inspection grades, we are unable to determine whether we are in fact observing 1) importers' preferences for quality; 2) importers' preferences for wheat equivalent to U.S. No. 2 or better with further specifications; or 3) shippers who are not able to meet requirements for U.S. No. 2 and therefore, supply wheat that meets higher specifications.

Comparisons for All Shipments

Inspection grades for U.S. shipments were compared with the estimated grade based on shipment characteristics by class for 1986-94. For U.S. HAD, a higher percentage of HAD was exported that would meet grade specifications for U.S. No. 1 and U.S. No. 2 (Figure 44). This was especially apparent from 1990 to 1993. In other years, inspection grades are not that different from the grade based on shipment characteristics.

Comparisons for U.S. HRS show a large disparity between inspection grades and

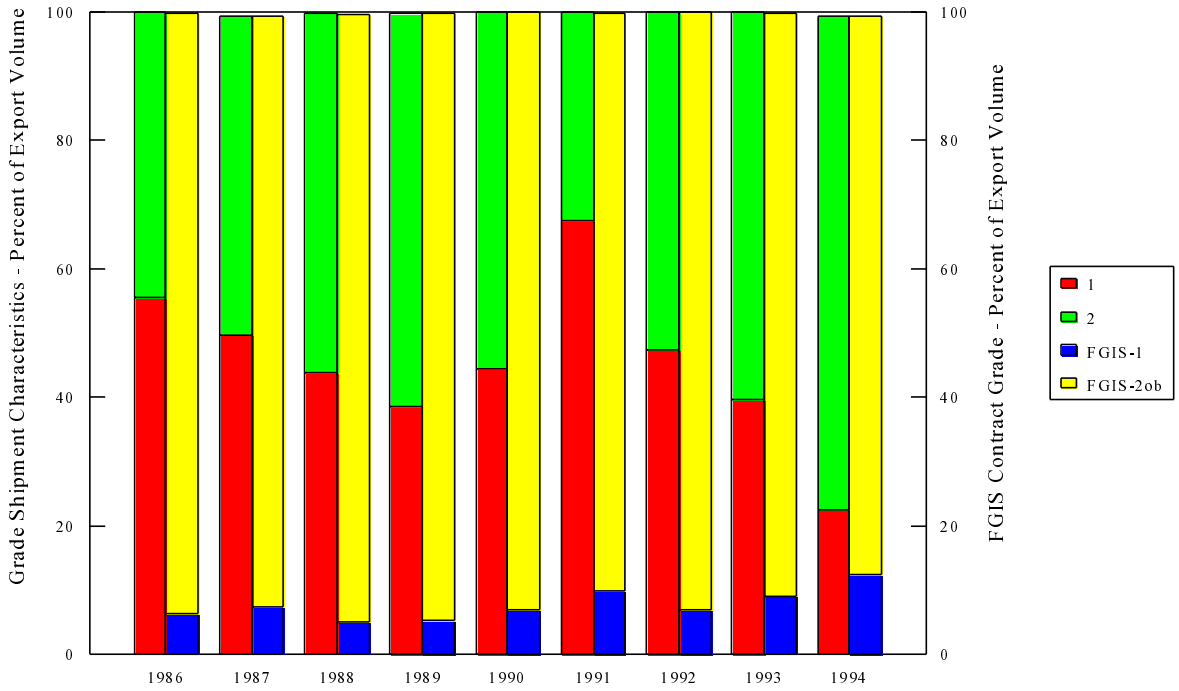

Figure 44.. Comparison of Inspection Grade and Grade of Shipment Characteristics for U.S. HRS, 1986-94.

shipment characteristics. From 1986 to 1993, the percent of export volume that was sold as U.S. No. 1 ranges from 5 percent to 15 percent (Figure 45). However, the grade of shipment characteristics indicates that in these years, 40 percent to 50 percent of the export volume met U.S. No. 1 specifications.

Comparisons of U.S. HRW exports indicate a lesser divergence between inspection grades and shipment characteristics than for U.S. HRS. The percent of export volume that is shipped as U.S. No. 1 from 1986 to 1994 is less than 10 percent (Figure 46). During this same period, the percent of export volume that has shipment characteristics that would meet grade specs for U.S. No. 1 ranges from 15 percent to near 30 percent. This represents 2 to 3 times the percent of export volume that is shipped as U.S. No. 1 based on FGIS inspection grades.

Comparisons of inspection grades and grades of shipment characteristics for U.S. wheat exports indicate that wheat that meets specifications for higher grades is being shipped in significant quantities when exports are sold as shipper's preference (U.S. No. 2 OB, U.S. No. 3 OB, etc.). This has been more prevalent for U.S. HRS than for the other classes although the amount of HRS that has shipment characteristics that would meet U.S. No. 1 specifications dropped dramatically in 1994.

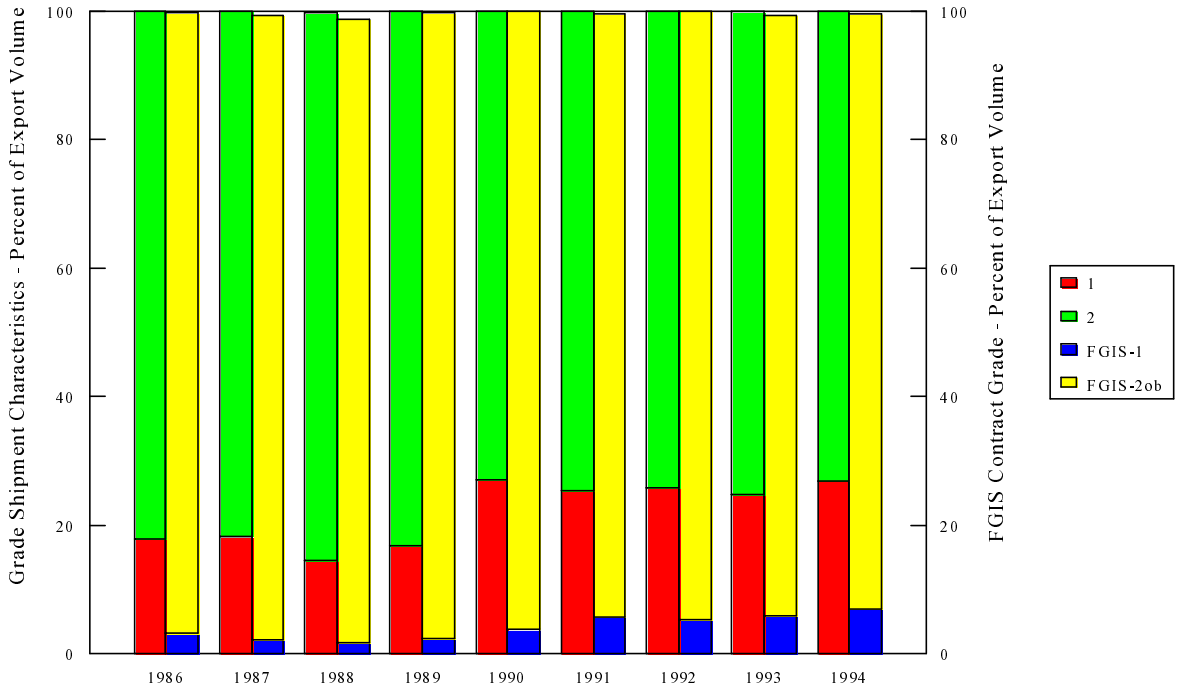

Figure 46. Comparison of Inspection Grade and Grade of Shipment Characteristics for U.S. HRW, 1986-94.

Comparison by Port Locations

Inspection grades and the expected grade based on shipment characteristics were also compared across port locations. Port locations were aggregated into four main categories: 1) Duluth-Superior; 2) Gulf port locations including Interior, east Gulf, north Texas, south Texas, and the Mississippi River; 3) Pacific Northwest (PNW) including Columbia River and Puget Sound; and 4) Other including California, Toledo, Chicago, Seaway, and North Atlantic regions. Comparisons were made among grade specifications for each class of wheat for 1986-94 by port location.

U.S. HAD exports from the PNW and Other ports had the highest average of exports that had shipment characteristics that meet specifications for U.S. No. 1 (Figure 47). In the PNW, about 5 percent of HAD shipments were inspected and shipped as U.S. No. 1, while about 78 percent of shipments had shipment characteristics that would meet U.S. No. 1. In comparison, from Duluth-Superior and Gulf ports, export shipments of U.S. HAD had shipment characteristics that would meet U.S. No. 1, less than 6 percent and 24 percent, respectively.

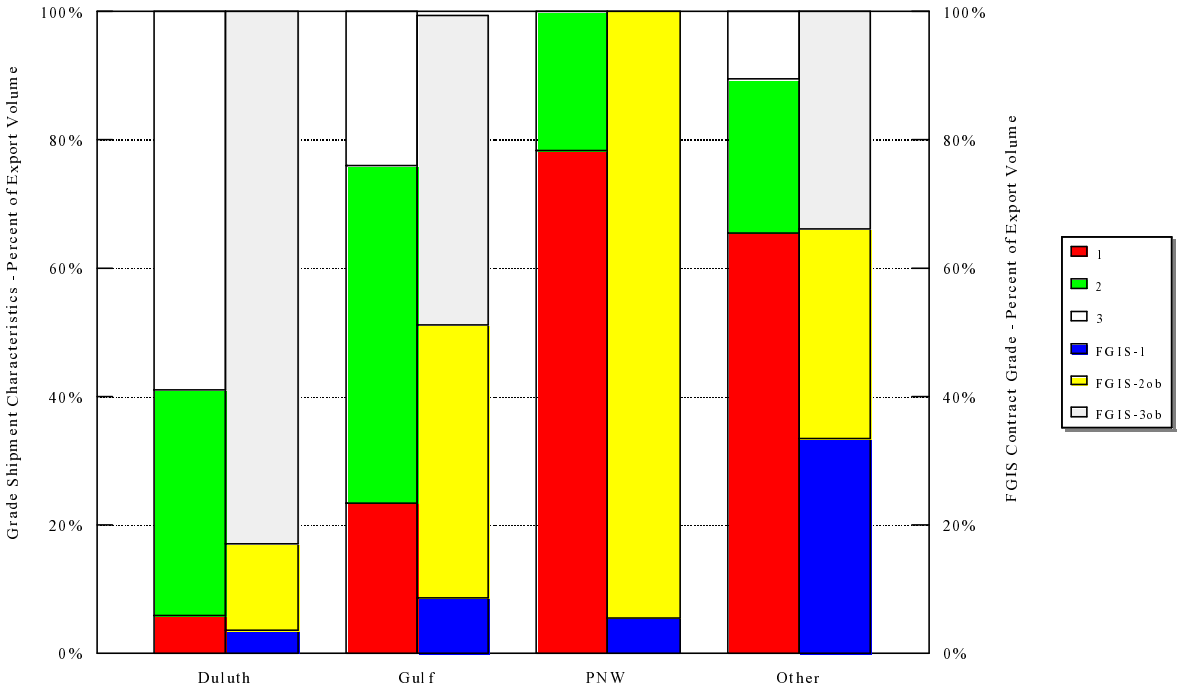

Figure 47. Comparison of FGIS Inspection Grade and Grade for Shipment Characteristics: U.S. HAD, by Port Location, Average of 1986-94.

Comparisons of inspection grades and shipment characteristics for HRS and HRW show a similar pattern, where a higher percent of exports from PNW locations are exported with shipment characteristics that would meet U.S. No. 1 specifications (Figures 48 and 49). The near 50 percent of U.S. HRW exported from Duluth-Superior and near 90 percent from other ports are probably due to the low levels of HRW exported from these ports. These results indicate a trend where buyers of U.S. No. 2 OB wheat exports from PNW ports are more likely to actually receive wheat that would meet specifications for U.S. No. 1 than for exports shipped from the remaining U.S. port locations.

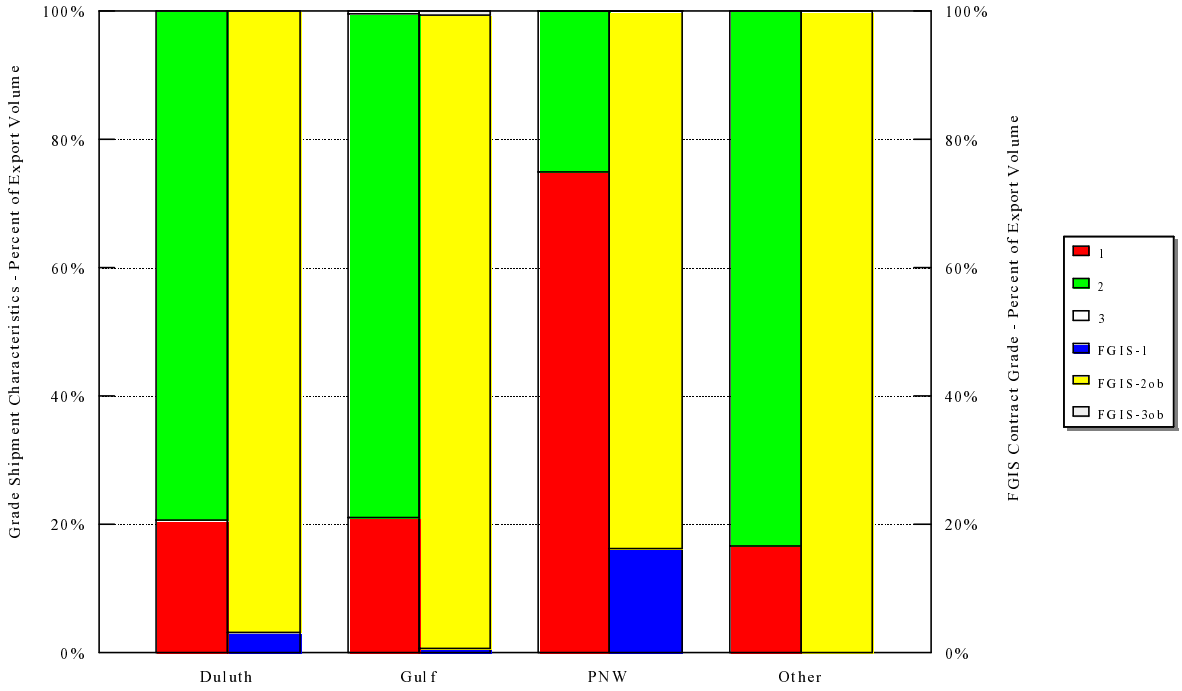

Figure 48. Comparison of FGIS Inspection Grade and Grade for Shipment Characteristics: U.S. HRS, by Port Location, Average of 1986-94.

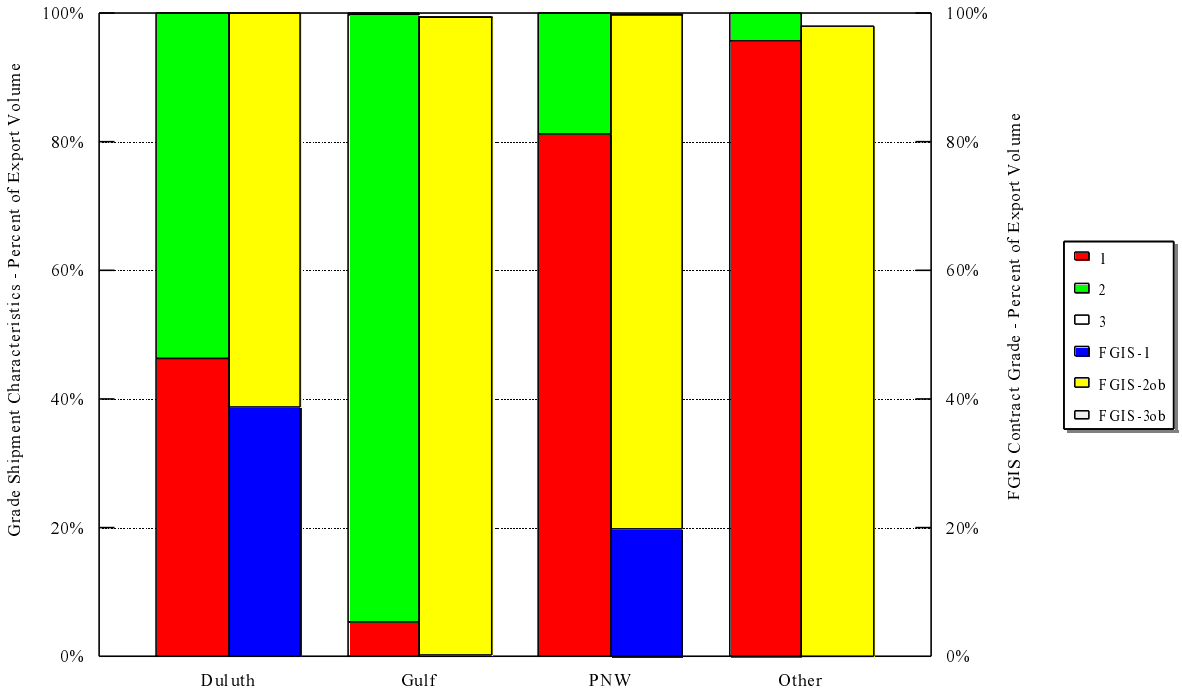

Figure 49. Comparison of FGIS Inspection Grade and Grade for Shipment Characteristics: U.S. HRW, by Port Location, Average of 1986-94.

Analysis of U.S. No. 1 HRS Exports

Exports of U.S. No. 1 HRS exports were categorized by protein and dockage to identify countries that were significant buyers and what categories of wheat they purchased. Protein was divided into three categories: 1) below 13.5 percent, 2) 13.5 percent to less than 14.5 percent, and 3) 14.5 percent or more. Dockage was divided into two categories: 1) less than 1 percent dockage and 2) 1 percent dockage or more. Countries importing U.S. No. 1 are listed in Table 8 by year, category, and amount purchased.

Imports of the highest quality U.S. HRS (protein 14.5 percent or more and dockage less than 1 percent) from 1986-94, appear to be dominated by South Korea, Taiwan, and Belgium-Luxemburg. Other countries import this highest classification of U.S. No. 1 HRS, but on a less consistent basis and in lower quantities. Examination of 1993 and 1994 reveals the effects of crop quality problems on purchases by the major purchasers (South Korea, Taiwan, and Belgium-Luxemburg) who opted for lower protein HRS in those years.

Cluster Analysis of Quality Characteristics of U.S. Shipments

Characteristics of shipments of U.S. HAD, HRS, and HRW were compared to identify countries with similar purchasing patterns. Analysis of grade and non-grade parameters was done using cluster analysis of average import characteristics for grade and non-grade quality characteristics.

Four grade and non-grade parameters were used to derive market segments. These included average annual dockage, test weight, adjusted protein, and total defects. Protein observations were not available for many of the observations. These missing observations can be interpreted as protein not-specified or ordinary protein. To capture the effect of this information, an adjusted protein value was estimated. This was equivalent to the average protein value if specified and set at a fixed lower level for missing observations (10 percent for durum and HRS, 8 percent for HRW). A Ward clustering algorithm was used to cluster groups. This is a hierarchial clustering method that minimizes variance between segments.

Market segments were first derived for the entire period 1986-94 for each class of wheat. The number of segments identified by each class included HAD (3 or 5 segment clusters), HRS (4 segments), and HRW (4 segments). Average values for grade and non-grade parameters were calculated for each market segment by class. In addition, the number of years a country was in a segment, years importing, and percent of years in each segment were estimated.

Table 8. Countries Importing High Quality Spring Wheat by Category, 1986-94					
Year	Grade	Protein	Dockage	Country	Quantity
1986	1	>=14.5	<=1%	Taiwan Hong Kong South Korea	274,569 2,100 517
1986	1	>=14.5	>1%	Taiwan South Korea Japan	11,550 4,660 525
1986	1	13.5-14.5	>1%	Japan Indonesia	12,232 567
1986	1	<=13.5	>1%	Malaysia	1,271
1987	1	>=14.5	<=1%	Taiwan Singapore	257,645 2,900
1987	1	13.5-14.5	<=1%	Taiwan Lee Wind IL	49,933 1,409
1987	1	>=14.5	>1%	Taiwan	12,259
1987	1	13.5-14.5	>1%	Taiwan	12,366
1988	1	>=14.5	<=1%	Taiwan	331,929
1989	1	>=14.5	<=1%	Taiwan Indonesia U.K. Netherlands Canada Japan USSR Ecuador	262,241 32,025 23,885 19,520 9,714 1,813 1,382 1,365

Table 8. (Cont.) Countries Importing High Quality Spring Wheat by Category, 1986-94					
Year	Grade	Protein	Dockage	Country	Quantity
1990	1	>=14.5	<=1%	Taiwan South Korea New Zealand Belgium-Lux U. K. Netherlands Canada Hong Kong	290,670 161,738 18,900 16,586 10,340 5,029 4,250 2,200
1990	1	13.5-14.5	<=1%	New Zealand South Korea	47,265 45,522
1991	1	>=14.5	<=1%	Taiwan South Korea Belgium-Lux Venezuela Canada New Zealand Hong Kong	369,726 227,956 36,616 16,800 16,652 10,500 3,495
1991	1	13.5-14.5	<=1%	South Korea New Zealand Belize	64,012 23,619 500
1991	1	>=14.5	>1%	South Korea	7,615
1991	1	13.5-14.5	>1%	South Korea	1,177
1992	1	>=14.5	<=1%	South Korea Taiwan Belgium-Lux New Zealand	217,879 126,160 6,126 5,500

Table 8. (Cont.) Countries Importing High Quality Spring Wheat by Category, 1986-94					
Year	Grade	Protein	Dockage	Country	Quantity
1992	1	13.5-14.5	<=1%	Taiwan South Korea Belgium-Lux New Zealand Mexico	241,407 67,936 28,995 10,395 8,400
1992	1	<=13.5	<=1%	South Africa Brazil	33,002 15,750
1992	1	13.5-14.5	>1%	South Korea	8,800
1993	1	>=14.5	<=1%	South Korea Belgium-Lux Taiwan	34,658 11,436 5,250
1993	1	13.5-14.5	<=1%	Taiwan South Korea Belgium-Lux New Zealand	412,495 230,249 23,823 9,100
1993	1	<=13.5	<=1%	Taiwan South Korea Brazil	99,952 39,797 15,750
1993	1	13.5-14.5	>1%	South Korea Taiwan	11,944 11,780
1994	1	>=14.5	<=1%	Belgium-Lux Netherlands China South Korea	51,709 40,107 4,950 1,210
1994	1	13.5-14.5	<=1%	Taiwan South Korea Finland Philippines	480,855 363,002 11,000 5,464
1994	1	<=13.5	<=1%	South Korea	19,173

An analysis was also conducted over three time periods to determine if changes in both the number and composition of segments had changed. The first time period was for 1986 to 1989. During this time period, clustering algorithms for each of the three U.S. wheat classes indicated the following number of segments: HAD (3 segments), HRS (2 segments), and HRW (2 segments). The second time period, 1991 to 1994, included two years with significant crop quality problems (1993 and 1994). The number of segments identified during this time period was HAD (4 segments), HRS (5 segments), and HRW (4 segments). A third time period without crop quality problems was also examined 1991 to 1992. Using this time frame, the same number of market segments was identified for HAD, HRS, and HRW. Descriptions of all the segments are discussed by class in the next sections.

HAD Cluster Analysis

Clustering for 1986-94

Clustering for U.S. HAD importers for 1986 to 1994 indicated three distinct market segments. Average characteristics for each segment indicate that Segment 1 had the lowest average dockage level, total defects, and highest test weight, protein, and percent of protein specified (Table 9). This segment can be considered the high quality importers. Segment 3 had the highest average dockage levels, total defects, lowest test weight, and near the lowest percent protein specified. Importers in this group were importers of low quality HAD with protein predominantly classed as ordinary. Segment 2 had average values closer in value to Segment 1; however, percent of protein specified was the lowest of the three segments. Thus, Segment 2 is also higher quality wheat importers; however, they do not specify protein levels.

A second group of market segments was also suggested for HAD. This was a clustering with five market segments. Segments equivalent to Segments 1 and 3 were retained. Segment 2 was split into two segments: one which consisted of imported HAD with lower average total defects and one which consisted of higher average total defects. Part of Segment 3 was also split off into a fifth segment which had higher levels of average total defects. This clustering was not indicated to be as strong as the three-segment grouping. However, it gives insight into the significance of these grade and non-grade parameters into buying decisions for U.S. HAD wheat.

Table 9. Segment Rankings and Segment Means for Grade and Non-grade Parameters for U.S. HAD, 1986-94

Segment	1	2	3
Segment Rankings			
Dockage	1	2	3
Test Weight	1	2	3
Total Defects	1	2	3
Average Protein	1	2	3
Specify Protein	1	3	2
Segment Means			
Dockage	0.67%	0.79%	1.00%
Test Weight	61.05	60.75	59.28
Total Defects	2.79%	3.60%	5.62%
Average Protein	14.26%	14.00%	12.92%
Specify Protein	91.0%	3.0%	5.0%

Cluster Evaluation Across Time Periods: HAD

From 1986 to 1989, three distinct market segments were suggested for countries that imported HAD. Two of the market segments tended to not specify protein and imported the lower quality HAD. Segment 1 had average total defects of 4 percent, and group 2 had average total defects of 5.8 percent (Table 10). Segment 3 tended to specify protein and had the lowest average total defects (1.8 percent). Test weight and dockage followed the same pattern with the worst averages belonging to group 2 and the best to group 3. Thus, in this earlier time period, there appears three distinct groupings that are similar to grades 1-3, where protein levels were tended to be specified only for U.S. No. 1.

From 1991 to 1994, four distinct market segments were indicated. Three of the segments resembled the three groups indicated in the earlier period. However, in this later time period, it appeared that the segment importing the highest quality HAD in the prior time period splits into two groups: one that tends to specify protein and one which does not. This same general clustering of countries was found for 1991-92 also; however, average characteristics for the segments were slightly different.

Table 10. Segment Means for Grade and Non-grade Parameters for U.S. HAD, 1986-89, 1991-94, and 1991-92

Segment	1	2	3	4
Segment Means 1986-89				
Dockage	0.90%	1.11%	0.77%	
Test Weight	60.8	59.4	61.6	
Total Defects	4.0%	5.8%	1.8%	
Average Protein	14.2%	13.3%	14.4%	
Specify Protein	11.0%	2.0%	98.0%	
Segment Means 1991-94				
Dockage	0.82%	0.60%	0.70%	0.55%
Test Weight	59.8	60.9	60.6	61.7
Total Defects	4.5%	2.7%	3.5%	2.1%
Average Protein	13.2%	13.8%	13.5%	13.4%
Specify Protein	2.0%	91.0%	4.0%	3.0%
Segment Means 1991-92				
Dockage	0.81%	0.49%	0.50%	0.71%
Test Weight	60.2	60.7	61.5	60.7
Total Defects	4.0%	1.6%	2.5%	3.1%
Average Protein	14.1%	15.1%	14.0%	13.6%
Specify Protein	2.0%	100.0%	9.0%	48.0%

Segments representing higher quality HAD wheat importing countries are Segment 3 for 1986-89, Segments 2 and 3 for 1991-92, and Segments 2 and 4 for 1991-94. Importers falling into each of these segments and the number of years in which they were classified in this segment are listed in Table 11. Two segments are listed for both of the latter time periods, because both have average total defects less than grade 1 specifications; however, one tends to specify protein, while the other does not. This is interesting because Italy, one of the dominant importers of U.S. HAD, did not specify protein. In the 1986-89 period, Italy was grouped into a segment of lesser quality that did not specify protein. Further, both segments that did not specify protein in the later time periods had higher average test weights than the segments that did specify protein, and the segment for 1991-94 has lower average total defects than its counterpart. This suggests that factors other than protein may have large impacts on purchases of high quality HAD wheat, like total defects and test weight. Another interesting aspect is that the number of countries classified into higher quality importer segments increased from the earlier time period to the later time periods.

Table 11. Composition of Importing Countries Within High Quality U.S. HAD Segments and Years in Segment for Three Time Periods: 1986-89, 1991-92, and 1991-94

Segment #3 1986-89	Yrs. in Seg.	Segment #3 1991-92	Yrs. in Seg.	Segment #2 1991-92	Yrs. in Seg.	Segment #4 1991-94	Yrs. in Seg.	Segment #2 1991-94	Yrs. in Seg.
Japan	3	Finland	2	Japan	2	Italy	4	Costa Rica	3
Chile	2	Italy	2	Indonesia	1	Finland	2	Japan	3
Egypt	1	Argentina	1	Kuwait	1	South Africa	2	Kuwait	3
Senegal	1	Cyprus	1	Mexico	1	Argentina	1	Peru	2
		Dominican Rep.	1			Dominican Rep.	1	Indonesia	1
		El Salvador	1			Norway	1	Israel	1
		Kuwait	1			Philippines	1	Mexico	1
		Norway	1			Turkey	1	Philippines	1
		South Africa	1					Taiwan	1
								Tunisia	1
								Turkmenistan	1

HRS Cluster Analysis

Clustering for 1986-94

Clustering for HRS wheat for 1986-94 indicated 4 segments of importing countries. Segment 1 represents the highest quality importers (Table 12). It had the second lowest average dockage level, just 1/100th more than Segment 3. Otherwise, Segment 1 had the highest test weight, protein, protein specified, and lowest total defects. Countries predominately in this segment from 1986 to 1994 were many of the Far East and East Asian importers, including Taiwan, South Korea, Hong Kong, Singapore, Japan, Malaysia, Thailand, Philippines, Indonesia, and New Zealand (Appendix Table 2). Segment 3 is similar to Segment 1; however, it has higher defects, lower protein, and the lowest percent protein specified of all the segment groupings. Segments 2 and 4 are the lowest quality importers. The major difference between these two segments is that Segment 2 was more likely to specify protein and, as such, received higher protein, lower dockage, and total defects than Segment 4.

Table 12. Segment Rankings and Segment Means for Grade and Non-grade Parameters for U.S. HRS, 1986-94

Segment	1	2	3	4
Segment Rankings				
Dockage	2	3	1	4
Test Weight	1	3	2	4
Total Defects	1	3	2	4
Average Protein	1	2	4	3
Specify Protein	1	2	4	3
Segment Means				
Dockage	0.74%	0.78%	0.73%	1.03%
Test Weight	61.4	60.0	60.6	59.5
Total Defects	2.3%	3.7%	3.3%	3.9%
Average Protein	14.5%	14.2%	13.4%	14.0%
Specify Protein	99.0%	94.0%	39.0%	65.0%

Cluster Evaluation Across Time Periods: HRS

When HRS is examined across time periods, an increase in differentiation similar to that for U.S. HAD is indicated, however, to a greater degree. In 1986-89, two distinct segments of importing countries are indicated (Table 13). Each segment tends to specify protein; however, differences in average total defects indicate a larger group that buys lower quality wheat (average total defects 3.9 percent, test weight 59.6 lbs/bu, dockage .9 percent, and protein 14 percent) and a smaller group that buys higher quality wheat (average total defects 2.2 percent, test weight 61.7 lbs/bu, dockage .8 percent, and protein 14.4 percent). In the later time period (1991-94), five segments are indicated. Two pairs of segments (1 and 3 and 2 and 5) are similar with the fifth segment (Segment 4) importing the highest quality HRS. Segments 1 and 3 are similar in that they both have high levels of dockage and average total defects of 3.4 percent to 3.5 percent. This difference is Segment 1 tends not to specify protein and had slightly higher test weights and lower protein, while Segment 3 tended to specify protein and had slightly lower test weights and higher protein. Segments 2 and 5 have similar protein and dockage; however, Segment 2 has lower defects and higher test weights while Segment 5 has higher defects and lower test weights.

Table 13. Segment Means for Grade and Non-grade Parameters for U.S. HRS, 1986-89, 1991-94, and 1991-92

Segment	1	2	3	4	5
Segment Means 1986-89					
Dockage	0.88%	0.77%			
Test Weight	59.6	61.7			
Total Defects	3.9%	2.2%			
Average Protein	14.0%	14.4%			
Specify Protein	71.0%	99.0%			
Segment Means 1991-94					
Dockage	0.84%	0.79%	0.96%	0.65%	0.79%
Test Weight	60.2	60.7	59.9	61.2	59.6
Total Defects	3.5%	3.0%	3.4%	2.4%	4.1%
Average Protein	13.4%	13.9%	14.1%	14.3%	13.7%
Specify Protein	11.0%	96.0%	85.0%	89.0%	91.0%
Segment Means 1991-92					
Dockage	0.86%	0.71%	0.88%	1.16%	0.70%
Test Weight	60.0	60.9	60.2	59.7	61.4
Total Defects	3.2%	2.8%	3.3%	3.7%	2.3%
Average Protein	14.3%	13.9%	14.0%	14.4%	14.5%
Specify Protein	90.0%	81.0%	7.0%	87.0%	98.0%

The groupings for 1991-92 are different from the segments for 1991-94. Average characteristics indicate more distinct groupings. A high quality segment (5) is identified similar to Segment 4 for 1991-94, however, this segment (5) had a higher tendency to specify protein and higher protein level than for the four-year period (1991-94). A second group (4) imported high dockage, low test weight, and high defect HRS with high protein. A third group (2) imported wheat similar to Segment 5, although test weights and protein were lower and dockage and total defects were higher, although the average level was still within U.S. No. 1 specs for defects. The remaining two groups (1 and 3) are similar except one tends to specify protein while the other does not. Average total defects are 3.2 percent and 3.3 percent. Protein was slightly higher for Group 1 which specified protein. Average levels were 14.3 percent and 14 percent for Groups 1 and 3, respectively. These clusterings in all three time periods suggest that importers are potentially increasing their specificity when buying imports over earlier time periods.

Countries in the high quality HRS segments across the three time periods are largely East Asian countries (Table 14). The number and composition is not that different from 1986-89 to the 1991-92 period. However, the 1991-94 segment has twice the number of countries as the other two time periods. Most of these new importing countries appear only once. Further, not all of the traditional high quality HRS importers were included in every year of this later clustering.

Table 14. Composition of Importing Countries Within High Quality U.S. HRS Segments and Years in Segment for Three Time Periods: 1986-89, 1991-92, and 1991-94.

Segment 2 1986-89	Years in Segment	Segment 5 1991-92	Years in Segment	Segment 4 1991-94	Years in Segment	Segment 4 (cont) 1991-94	Years in Segment
Hong Kong	4	Hong Kong	2	Taiwan	4	South Korea	4
Japan	4	Japan	2	Belgium	2	Malaysia	3
Malaysia	4	Malaysia	2	Barbados	1	New Zealand	3
Singapore	4	New Zealand	2	Benin	1	Singapore	3
South Korea	4	Philippines	2	Burkina Faso	1	Japan	2
Taiwan	4	Singapore	2	Canary Islands	1	Norway	2
Thailand	4	South Korea	2	Colombia	1	Philippines	2
Philippines	3	Taiwan	2	Cyprus	1	Thailand	2
Indonesia	2	Thailand	2	Finland	1	Mali	1
Sri Lanka	2	Barbados	1	Gabon	1	Malta	1
Benin	1	Belgium	1	Hong Kong	1	Martinique	1
Netherlands	1	Canary Islands	1	Iceland	1	Mexico	1
Nigeria	1	Israel	1	Israel	1	Netherlands	1
UK	1	Martinique	1	Ivory Coast	1	Senegal	1
USSR	1	Senegal	1	Jamaica	1	Sri Lanka	1

HRW Cluster Analysis

Clustering for 1986-94

Clustering for U.S. HRW wheat from 1986 to 1994 indicated 4 segments of importing countries similar to HRS. Segments 3 and 4 in HRW wheat were similar to Segments 2 and 4 in HRS (Table 15). Both represent higher dockage and total defects and lower test weight and protein. Segment 3, which ranks higher for most parameters, had the lowest protein specified. Segment 4 had similar protein specified as Segments 1 and 2, although it was the lowest of the three. Segments 1 and 2 both have high levels of protein specified. The difference between these two segments is that Segment 2 had a higher level of total defects than Segment 1. Therefore, Segment 1 is the highest quality importers and like HRS includes many of the East Asian importers, including Taiwan, Bangladesh, South Korea, Thailand, Japan, Hong Kong, and Malaysia (Appendix Table 3).

Table 15. Segment Rankings and Segment Means for Grade and Non-grade Parameters for U.S. HRW, 1986-94

Segment	1	2	3	4
Segment Rankings				
Dockage	1	2	3	4
Test Weight	1	2	3	4
Total Defects	1	2	3	4
Average Protein	1	2	4	3
Specify Protein	2	1	4	3
Segment Means				
Dockage	0.55%	0.61%	0.70%	0.75%
Test Weight	62.1	61.1	60.7	60.3
Total Defects	2.1%	3.3%	3.7%	4.0%
Average Protein	12.3%	12.2%	11.9%	12.1%
Specify Protein	89.0%	90.0%	13.0%	88.0%

Cluster Evaluation Across Time Periods: HRW

Clustering of HRW indicated 2 segments of importing countries for 1986-89. Groupings are similar to those of this period for HRS. Segment 1 is a large segment with more dockage, lower test weight, higher total defects, and a lower tendency to specify protein than Segment 2 (Table 16). Segment 2 is a small higher quality segment. Clustering for the two later time periods (1991-94 and 1991-92) indicated 4 segments; however, in the 1991-92 time period, one of the segments (Segment 4) was an outlier with high dockage, total defects, protein, and low test weight. The other 3 segments in the 1991-92 period are a high quality segment (Segment 2) and two lower quality segments: one that specified protein (Segment 1) and one that tends to not specify protein (Segment 3). Clustering for 1991-94 appears to be the most distinct. It clustered into 4 segments. Segment 3 is a high quality segment. It has the highest test weight and protein and lowest dockage and total defects. Segments 1 and 2 are similar. Both have average total defects that would meet grade specs for U.S. No. 2. Dockage, test weight, and protein are similar. The major difference between these two segments is one specifies protein (Segment 1) and the other does not (Segment 2). The fourth segment (Segment 4) is the lowest quality segment. It has the lowest test weight, protein, and highest dockage and total defects. The average total defects would meet grade specs for U.S. No. 3.

Countries predominately in the highest quality segments for each of the time periods are the East Asian countries, Norway, and Finland (Table 17). A larger number of countries are included in the 1986-89 clustering; however, a higher number of countries have more years in the segment for the 1991-94 clustering. Shifts in composition of the highest quality importing segments appear minimal.

An interesting result of these clustering analyses for both HRS and HRW is revealed when countries grouped in the high quality market segments are compared to those countries identified as “high quality” markets by Kraft et al. Most of the East Asian countries that were grouped into the highest quality segments were also identified as “high quality” markets by Kraft et al. However, there is a large subset of countries identified by Kraft et al. that are largely composed of Caribbean, some South American, Israel, South Africa, and selected EU counties that are not consistently in the highest quality segments identified here. Further, a few East Asian countries like the Philippines, Indonesia, and Bangladesh are indicated by the market segments as being high quality importers, but were not identified as such by Kraft et al.

Table 16. Segment Means for Grade and Non-grade Parameters for U.S. HRW, 1986-89, 1991-94, and 1991-92

Segment	1	2	3	4*
Segment Means 1986-89				
Dockage	0.72%	0.58%		
Test Weight	60.7	62.1		
Total Defects	3.9%	2.6%		
Average Protein	12.1%	12.3%		
Specify Protein	43.0%	92.0%		
Segment Means 1991-94				
Dockage	.67%	.69%	.55%	1.24%
Test Weight	60.3	60.6	61.7	59.9
Total Defects	3.7%	3.6%	2.1%	5.5%
Average Protein	12.0%	11.8%	12.3%	11.6%
Specify Protein	94.0%	20.0%	89.0%	79.0%
Segment Means 1991-92				
Dockage	.65%	.58%	.69%	2.90%
Test Weight	60.3	61.9	60.8	58.8
Total Defects	3.6%	2.2%	3.5%	3.3%
Average Protein	12.1%	12.6%	12.1%	12.9%
Specify Protein	91.0%	96.0%	16.0%	100.0%

* Represents outlier for 1991-92.

Table 17. Composition of Importing Countries Within High Quality U.S. HRW Segments and Years in Segment for Three Time Periods: 1986-89, 1991-92, and 1991-94.

Segment 2 1986-89	Years in Segment	Segment 2 1991-92	Years in Segment	Segment 3 1991-94	Years in Segment
Hong Kong	4	Hong Kong	2	Japan	4
Japan	4	Indonesia	2	South Korea	4
South Korea	4	Japan	2	Taiwan	4
Taiwan	4	Malaysia	2	Thailand	4
Thailand	4	South Korea	2	Bangladesh	3
Bangladesh	3	Taiwan	2	Hong Kong	3
Finland	2	Thailand	2	Malaysia	3
Indonesia	2	Bangladesh	1	Norway	3
Norway	2	Norway	1	Finland	2
Philippines	2	Singapore	1	Indonesia	2
Sierra Leone	2	Sri Lanka	1	Kuwait	2
Sri Lanka	2			Belgium	1
Benin	1			Costa Rica	1
Bolivia	1			Djibouti	1
Cameroon	1			Netherlands	1
Chile	1			Philippines	1
Costa Rica	1			Russia	1
Egypt	1			Singapore	1
Kenya	1			Sri Lanka	1
Mali	1			Sudan	1
Oman	1			Yemen	1
Senegal	1				
Singapore	1				
Suriname	1				
Tunisia	1				

Summary and Conclusions

An important aspect of competition and demand in the international wheat market that has escalated in recent years is related to quality differences among exporters. Of particular interest is the differences in exports by grade and class. Maturing of the international market has the effect of increasing the importance of differentiation as a source of competitive advantage among exporters. The importance of quality as an element of competition is further escalated as countries privatize their importing function, a major trend in the world market. These problems are particularly apparent in the competition among hard wheats, notably HRS, HRW, and Durum. Both the United States and Canada are the dominant producers of these types of wheat. However, these countries' marketing systems differ with respect to quality, as does the distribution among grades of their excess exportable quantities.

The purpose of this study was to analyze the composition of exports in hard wheat from the United States with comparisons to Canada. The scope of the study was limited to hard wheat which were defined to include the following: Hard Red Spring (HRS), Hard Red Winter (HRW), and Canadian Western Red Spring (CWRS). Durum wheats are also included in the analysis and are referred to as HAD from the United States and CWAD from Canada. The analysis used data on individual grade and non-grade factors from the United States export shipments. Similar data are not available for Canadian exports; however, exports by grade/class and protein were available by country through 1991. These data were used to document the composition of exports by class and grade, evaluate changes through time, compare quality specifications implied in export shipments across importers, and to categorize countries with similarities in grade specifications. Results are summarized below:

- ***Composition of Exports***. Canada exports a substantially larger portion of its exports as No. 1 than does the United States. This is true for each class. The average share of exports for No. 1 for each class over the period 1986-91 were HRW, 3 percent; HRS, 7 percent; CWRS, 60 percent; HAD, 5 percent; and CWAD, 25 percent.

- ***Changes in the Composition of Exports (Shift-share Analysis).*** There have been some dramatic changes in the distribution among exports by grade and class which has important implications for demand and competition. Generally, results from this study indicated

  By class. From the early 1980s to the mid-1990s, wheat classes whose exports increased the fastest (measured as *net shift* from a shift-share analysis and listed in rank order) were U.S. HRS, followed by Canada Other, CWRS, and CWAD. Those classes experiencing negative growth included U.S. HAD, soft and HRW (listed from least to greatest negative growth). The realized growth in Canadian Other is likely related to the one-shot increase in feed wheat experienced during 1993 and probably related to crop quality problems in that year.

By grade. There have also been some notable changes in the composition of exports among grades from each country. Over the period 1986-1987 to 1993-1994, there was a notable shift in exports for each of HRW, HRS, and HAD, in all cases from lesser amounts of lower grade wheat to greater proportions of higher grade wheat. Most notable (in percent net shift) has been the growth in No. 1 exports of HRS followed by No. 1 HRW. In each case, these represent a shift from lower grades. Similar growth has occurred in No. 1 HAD, but not as dramatic, though the reduction in No. 3s was notable. To a large extent, the shift among grades is largely a South Korean phenomenon, especially for HRS. However, Taiwan, which imports almost exclusively U.S. No. 1, has also increased imports of U.S. HRS. Other countries have imported limited quantities of U.S. No. 1; however, imports are small and sporadic.

●***Quality Levels in Shipments and Received***. The level of individual characteristics reported in shipments for individual importers of U.S. exports varied substantially.

Quality levels by importers. There was substantial variability in dockage levels, test weights, total defects, and protein levels across importers. It appears that those specifying the tightest levels for these characteristics include Finland, New Zealand, Taiwan, Singapore, and South Korea. However, the fact that these levels vary greatly suggests differences in requirements and preferences across importers.

Factor levels greater than specifications. In many cases, the actual level of an individual factor exceed that of the particular grade purchased. For example, buyers frequently specify a grade level (e.g., No. 2 or No. 2 OB), but receive levels greater than the factor limit; and in many cases, these are substantial. This observation was true for exports from all port areas, but was notable from the PNW. In many cases, exports from that port had factor levels comparable to No. 1 limits, even though the grade was No. 2 OB. Shipments from the Gulf port locations and Duluth-Superior generally had the lowest probability of No. 2 OB exports meeting specifications of No 1.

●***Comparison of Exports into High Quality Markets***. Exports of hard red wheats into markets identified as high quality by Kraft et al. were examined. For exports to high quality markets, Canada exports largely No. 1 CWRS (83.4 percent of exports to high quality markets), while the U.S. exports largely No. 2OB. However, Canadian exports of No. 1 to these high quality markets represent only 30 percent of Canada's total No. 1 exports. U.S. No. 1 HRS and HRW account for 18.9 and 15.4 percent of exports to designated high quality markets, yet they amount to 97.7 and 99.5 percent of total U.S. exports of HRS and HRW No. 1, respectively. Canada has exported an average volume of No. 1 greater than 7 times that of U.S. No. 1 exports worldwide.

●***Market Segments***. Cluster analysis was used to identify countries importing similar quality. Countries importing wheat with similar characteristics are referred to as segments, and their behavior and composition have important marketing implications. Results from this analysis indicated

Number of segments. Over the entire period, each hard wheat class had several distinct segments. HAD had three segments and HRS and HRW each had four segments. In general, these were distinguished by the levels of dockage, test weight, defects and protein level.

Changes in segment numbers over time. There were notable changes in the definition and composition of segments over the time period of the study. The number of segments existing in HAD exports increased from three to four, HRS increased from two to five segments, and HRW increased from two to four segments.

Changes in segment composition. Countries included in what should be defined as the higher quality segments varied, and in some cases, they jumped in and out of a segment. Those countries that were in the higher quality HAD segment more than 50 percent of the time in the more recent years were Italy, Costa Rica, Japan, and Kuwait. Those in the higher quality HRS segment at least 50 percent of the time were Taiwan, South Korea, Malaysia, New Zealand, and Singapore. Those in the higher quality HRW segment at least 50 percent of the time included Japan, South Korea, Taiwan, Thailand, Bangladesh, Hong Kong, Malaysia, and Norway. Other countries were also categorized as being part of these segments, but were there only periodically.

●***High Quality Demands***. The data were used to define those countries that routinely purchase No. 1 specifications and have tighter specifications of protein and dockage. These could be interpreted as those buying higher quality hard wheats. For HRS, these include largely South Korea and Taiwan. Other countries such as Belgium-Luxembourg, Hong Kong, New Zealand, and the United Kingdom have imported limited quantities of high protein low dockage HRS.

A number of implications can be discerned from these results that are important for both the public and private sectors. First, it is notable that the fastest growth markets has been HRS, while HRW has fallen sharply, suggesting a significant shift in the composition of demand over the past decade. Second, in the United States, there has been debate about whether to attempt to regulate the quality level of wheat exports through factor limits, as opposed to relying upon contractual specifications between buyers and sellers. These results suggest that over time, buyers are increasing the quality of wheat imported, thus implying importers have been successfully implementing contractual specifications to obtain higher quality wheats. Third, these results likely have important market development implications. On the one hand, past efforts of encouraging buyers to specify tighter quality specifications are having an effect. On the

other hand, the notable shift away from lower grades to higher grades would suggest that market development strategies for the former should be re-evaluated. Finally, comparisons between U.S. and Canadian exports and prices must take into account the important differences in the distribution of their respective exports among classes. The large proportion of No. 1s exported from Canada compared to that from the United States would suggest that the extent of differentiation is substantial and that comparison of routinely quoted prices is likely futile.

A number of implications for the private sector can also be identified from these results. First, the shift in U.S. exports toward greater specificity and generally toward higher quality wheats has implications for the domestic processing sector. Traditionally, the processing sector dominated the consumption of higher quality hard wheats, leaving the remainder for the export market. The shifts identified in this analysis suggest that in the future, the domestic market will have less dominance over the higher quality wheat supply, thus, having the effect of raising premiums.[14] A second notable implication relates to the apparent increase in differentiation and number of segments in the international wheat market. This should be viewed positively by traders and others in the supply chain by allowing them to compete in some segments less characteristic of "commoditization" as defined by Rangan and Bowman and developed in the context of the international wheat market by Wilson (1996). However, to do so may very well require the ability to create segregations that are maintained throughout the supply chain through use of either increasingly more sophisticated premium/discount schedules and/or through other vertical coordination mechanisms.

[14]This phenomenon is analyzed in great detail in Johnson, Wilson, and Diersen.

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APPENDIX

Calculation of Percent Net Shift

The actual change in market segment I from time period t-1 to t is measured as:

$$\Delta V_i = V_{i,t} - V_{i,t-1}$$

The total growth rate for the market composed of m segments is equal to the ratio of the total value in the terminal period to the corresponding value in the initial period.

$$k = \sum_{i=1}^{m} V_{i,t} \; / \; \sum_{i=1}^{m} V_{i,t-1}$$

To calculate net shift, an expected change is calculated for each market segment (I) where

$$E(\Delta V_{i,t}) = V_{i,t-1} * (k-1)$$

Then a net shift is estimated as the difference between the actual change and the expected change for a given market segment.

$$N_i = \Delta V_i - E(\Delta V_i)$$

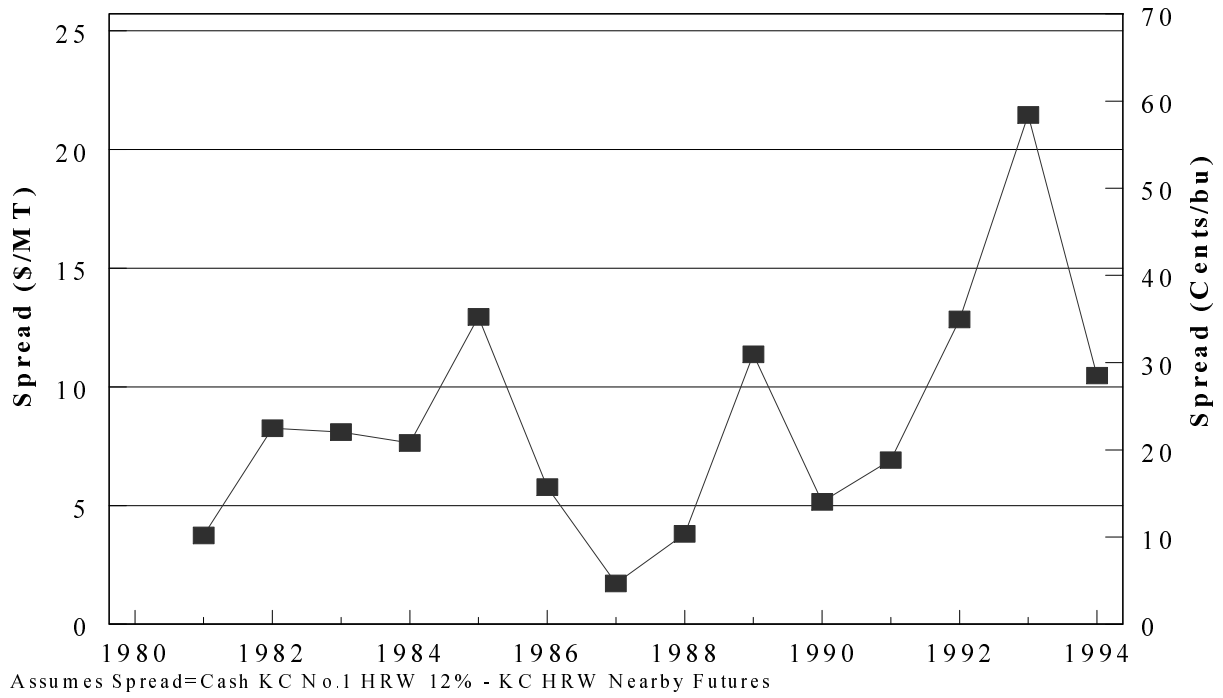
A total absolute net shift is then calculated as the sum of all positive net shifts or the sum of all negative net shifts or alternatively:

$$S = [\sum_{i=1}^{m} |\Delta V_i - E(\Delta V_i)|] \; / \; 2$$

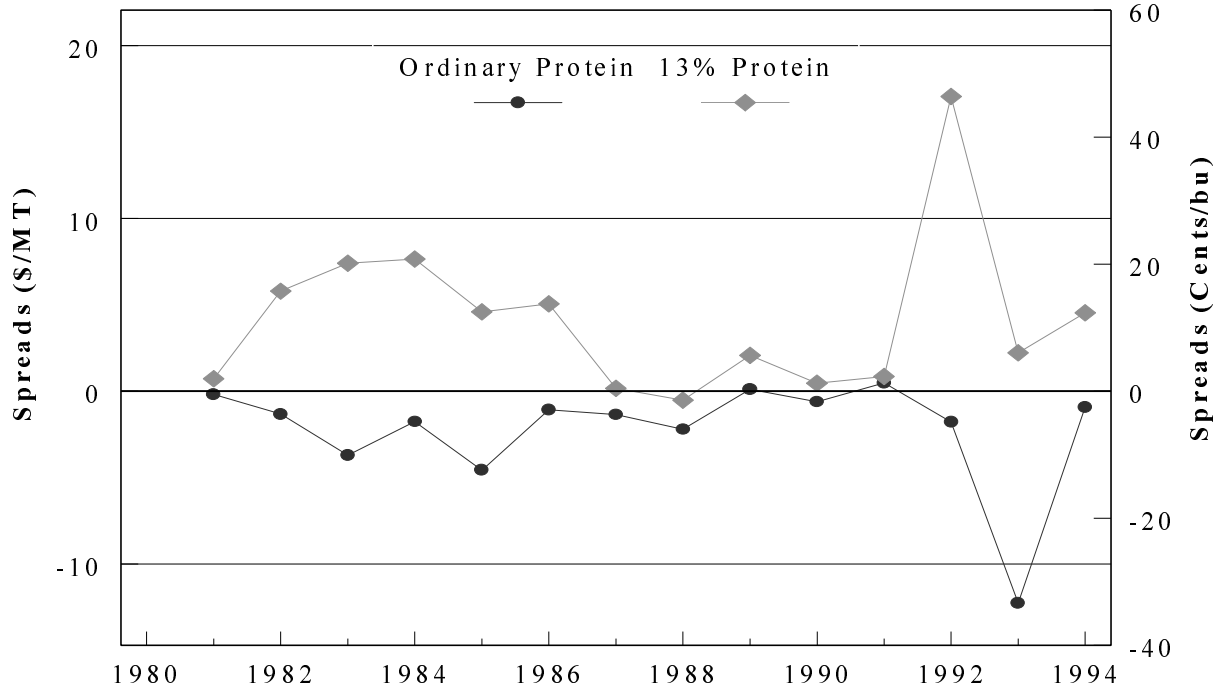
The percent net shift for each market segment (P_i) is then the net shift (N_i) divided by the absolute net shift (S) multiplied by 100.

$$P_i = N_i \; / \; S$$

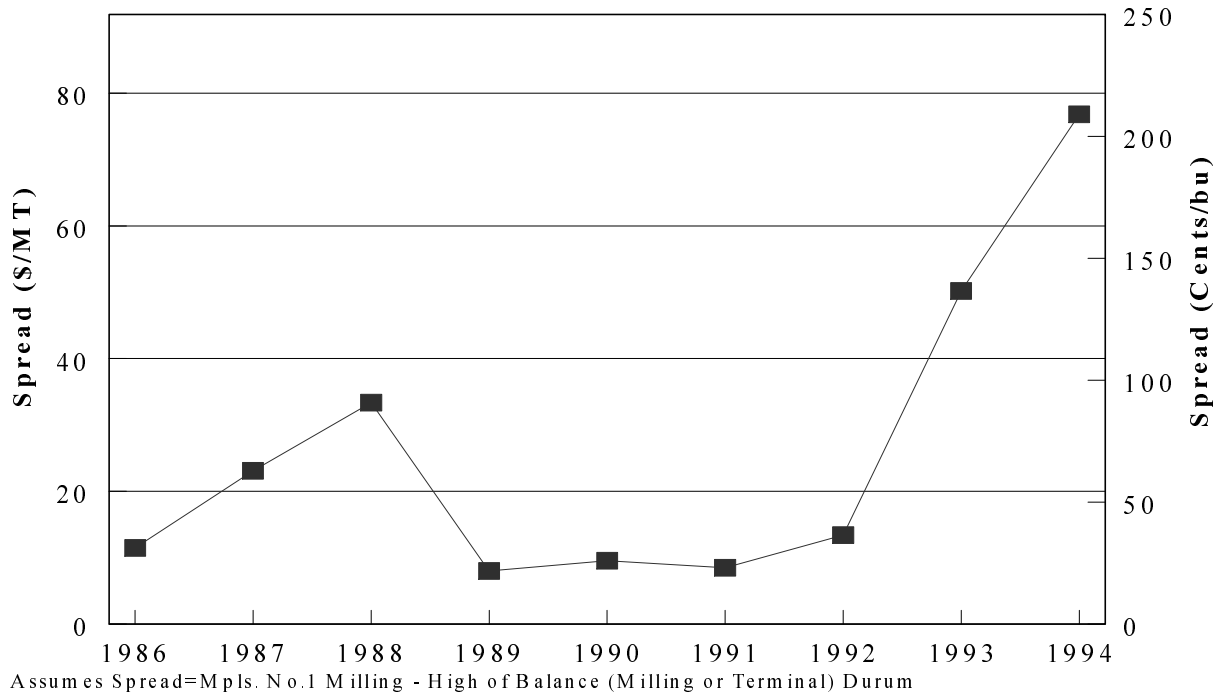
For more information on the net shift method, see Huff and Sherr.



Appendix Figure 1. Average Marketing Year Spread Between No. 1 HRW and No. 2 HRW, 1981-94.



Appendix Figure 2. Average Marketing Year Protein Premium/Discount Over 12% KC HRW, 1981-94.



Appendix Figure 3. Average Marketing Year Spread Between No. 1 Milling HAD and Balance Milling HAD, 1986-94.

Appendix Table 1. Segments for U.S. Durum Wheat, 1986-94

Segment 1				Segment 2			
Countries	Years in Segment	Total Years Importing	Percent of the time in Segment	Countries	Years in Segment	Total Years Importing	Percent of the time in Segment
Japan	7	7	100%	Italy	9	9	100%
Costa Rica	4	9	44%	Guatemala	9	9	100%
Kuwait	3	3	100%	Panama	8	9	89%
Chile	3	4	75%	Venezuela	7	9	78%
Taiwan	2	2	100%	Honduras	7	9	78%
Portugal	2	4	50%	Algeria	5	9	56%
Poland	2	9	22%	Turkey	4	4	100%
Turkmenistan	1	1	100%	Finland	4	5	80%
Mexico	1	1	100%	Dominican Republic	4	5	80%
Egypt	1	1	100%	Cyprus	4	5	80%
Indonesia	1	1	100%	El Salvador	4	7	57%
Senegal	1	1	100%	Belgium	4	9	44%
Philippines	1	2	50%	Poland	4	9	44%
Yugoslavia	1	2	50%	South Africa	3	3	100%
Israel	1	4	25%	Argentina	3	3	100%
Peru	1	4	25%	Costa Rica	3	9	33%
Dominican Republic	1	5	20%	Morocco	2	3	67%
Tunisia	1	6	17%	Netherlands	2	3	67%
				Israel	2	4	50%
				Norway	1	1	100%
				Romania	1	1	100%
				Ecuador	1	2	50%
				Philippines	1	2	50%
				Somalia	1	2	50%
				West Germany	1	2	50%
				Peru	1	4	25%
				Portugal	1	4	25%
				Chile	1	4	25%
				Tunisia	1	6	17%

Appendix Table 1. (cont.) Segments for U.S. Durum Wheat, 1986-94

Segment 3		Total	Percent
	Years in	Years	of the time
Countries	Segment	Importing	in Segment
Belgium	5	9	56%
Tunisia	4	6	67%
Algeria	4	9	44%
El Salvador	3	7	43%
Poland	3	9	33%
Peru	2	4	50%
Honduras	2	9	22%
Costa Rica	2	9	22%
Venezuela	2	9	22%
Ethiopia	1	1	100%
Somalia	1	2	50%
West Germany	1	2	50%
Yugoslavia	1	2	50%
Ecuador	1	2	50%
Morocco	1	3	33%
Netherlands	1	3	33%
Portugal	1	4	25%
Israel	1	4	25%
Finland	1	5	20%
Cyprus	1	5	20%
Panama	1	9	11%

Appendix Table 2. Segments for U.S. Hard Red Spring Wheat, 1986-94

Segment 1				Segment 2			
Countries	Years in Segment	Total Years Importing	Percent of the time in Segment	Countries	Years in Segment	Total Years Importing	Percent of the time in Segment
South Korea	9	9	100%	Panama	7	9	78%
Taiwan	9	9	100%	Dominican Republic	7	9	78%
Hong Kong	8	9	89%	China	6	7	86%
Singapore	8	9	89%	Cyprus	6	8	75%
Japan	8	9	89%	Venezuela	6	9	67%
Malaysia	8	9	89%	Honduras	6	9	67%
Thailand	7	9	78%	Togo	6	9	67%
Philippines	7	9	78%	Colombia	5	8	63%
New Zealand	4	4	100%	Trinidad	5	9	56%
Indonesia	4	5	80%	Belgium	5	9	56%
Norway	3	5	60%	Italy	5	9	56%
UK	2	4	50%	Costa Rica	5	9	56%
Netherlands	2	7	29%	Benin	4	5	80%
Italy	2	9	22%	Malta	4	8	50%
Martinique	1	1	100%	Netherland Antilles	4	8	50%
Other Pacific Islands	1	1	100%	El Salvador	4	9	44%
Israel	1	3	33%	Guatemala	4	9	44%
Brazil	1	3	33%	Surinam	4	9	44%
Senegal	1	3	33%	Belize	4	9	44%
Nigeria	1	4	25%	West Germany	3	3	100%
Canary Islands	1	5	20%	St. Vincent	3	5	60%
USSR	1	6	17%	Finland	3	5	60%
Netherland Antilles	1	8	13%	Haiti	3	6	50%
Barbados	1	9	11%	Cameroon	3	6	50%
Belgium	1	9	11%	USSR	3	6	50%
Jamaica	1	9	11%	Netherlands	3	7	43%
				Ecuador	3	7	43%
				Jamaica	3	9	33%
				Ghana	3	9	33%
				Sri Lanka	3	9	33%
				Barbados	3	9	33%
				Lesotho	2	2	100%
				Portugal	2	2	100%
				Sudan	2	2	100%
				Guyana	2	2	100%
				Guadeloupe	2	3	67%
				Nicaragua	2	4	50%
				Liberia	2	4	50%
				Mexico	2	5	40%
				South Africa	2	5	40%
				Grenada	2	5	40%
				Tunisia	2	7	29%
				Morocco	2	8	25%
				Thailand	2	9	22%
				Philippines	2	9	22%
				Bulgaria	1	1	100%
				Spain	1	1	100%
				Mozambique	1	1	100%
				Namibia	1	1	100%
				Turkey	1	1	100%
				Slovenia	1	1	100%
				Ireland	1	1	100%
				Congo	1	1	100%
				Sierra Leone	1	2	50%

Appendix Table 2. (cont.) Segments for U.S. Hard Red Spring Wheat, 1986-94

Segment 1				Segment 2 Cont.			
Countries	Years in Segment	Total Years Importing	Percent of the time in Segment	Countries	Years in Segment	Total Years Importing	Percent of the time in Segment
				Yemen	1	2	50%
				Ivory Coast	1	2	50%
				Israel	1	3	33%
				French West Indies	1	3	33%
				Brazil	1	3	33%
				Senegal	1	3	33%
				Gabon	1	4	25%
				UK	1	4	25%
				Lee Wind Islands	1	4	25%
				Nigeria	1	4	25%
				Norway	1	5	20%
				Canary Islands	1	5	20%
				Algeria	1	7	14%
				Singapore	1	9	11%
				Malaysia	1	9	11%
				Hong Kong	1	9	11%
				Japan	1	9	11%

Appendix Table 2. (cont.) Segments for U.S. Hard Red Spring Wheat, 1986-94

Segment 3				Segment 4			
Countries	Years in Segment	Total Years Importing	Percent of the time in Segment	Countries	Years in Segment	Total Years Importing	Percent of the time in Segment
Sri Lanka	6	9	67%	Belize	5	9	56%
Tunisia	5	7	71%	Barbados	5	9	56%
Morocco	5	8	63%	Ethiopia	4	5	80%
Bangladesh	4	4	100%	Trinidad	4	9	44%
Burkina	4	4	100%	Surinam	4	9	44%
Gabon	3	4	75%	Ghana	4	9	44%
Ecuador	3	7	43%	El Salvador	4	9	44%
Algeria	3	7	43%	Guatemala	4	9	44%
Malta	3	8	38%	Lee Wind Islands	3	4	75%
Jamaica	3	9	33%	Canary Islands	3	5	60%
Uzbekistan	2	2	100%	Grenada	3	5	60%
Poland	2	2	100%	Algeria	3	7	43%
Niger	2	2	100%	Honduras	3	9	33%
Peru	2	3	67%	Venezuela	3	9	33%
Nicaragua	2	4	50%	Costa Rica	3	9	33%
Liberia	2	4	50%	Egypt	2	3	67%
Finland	2	5	40%	French West Indies	2	3	67%
Mexico	2	5	40%	St. Vincent	2	5	40%
South Africa	2	5	40%	Haiti	2	6	33%
USSR	2	6	33%	Netherlands	2	7	29%
Cameroon	2	6	33%	Netherland Antilles	2	8	25%
Colombia	2	8	25%	Dominican Republic	2	9	22%
Ghana	2	9	22%	Panama	2	9	22%
Iceland	1	1	100%	Togo	2	9	22%
Yugoslavia	1	1	100%	Jamaica	2	9	22%
South Pacific Islands	1	1	100%	Belgium	2	9	22%
Mali	1	1	100%	Italy	2	9	22%
Mauritania	1	1	100%	Nepal	1	1	100%
Iraq	1	1	100%	Kenya	1	1	100%
Kuwait	1	1	100%	Russia	1	1	100%
Ivory Coast	1	2	50%	Albania	1	1	100%
Zaire	1	2	50%	Lebanon	1	1	100%
Yemen	1	2	50%	East Germany	1	1	100%
India	1	2	50%	Zaire	1	2	50%
Senegal	1	3	33%	India	1	2	50%
Egypt	1	3	33%	Sierra Leone	1	2	50%
Israel	1	3	33%	Peru	1	3	33%
Brazil	1	3	33%	Guadeloupe	1	3	33%
Nigeria	1	4	25%	Nigeria	1	4	25%
Indonesia	1	5	20%	UK	1	4	25%
Ethiopia	1	5	20%	South Africa	1	5	20%
Benin	1	5	20%	Mexico	1	5	20%
Norway	1	5	20%	Cameroon	1	6	17%
Haiti	1	6	17%	China	1	7	14%
Cyprus	1	8	13%	Ecuador	1	7	14%
Netherland Antilles	1	8	13%	Cyprus	1	8	13%
Guatemala	1	9	11%	Colombia	1	8	13%
Togo	1	9	11%	Morocco	1	8	13%
El Salvador	1	9	11%	Malta	1	8	13%
Costa Rica	1	9	11%				
Surinam	1	9	11%				
Belgium	1	9	11%				

Appendix Table 3. Segments for U.S. Hard Red Winter Wheat, 1986-94

Segment 1				Segment 2			
Countries	Years in Segment	Total Years Importing	Percent of the time in Segment	Countries	Years in Segment	Total Years Importing	Percent of the time in Segment
Taiwan	9	9	100%	Israel	6	9	67%
Bangladesh	6	8	75%	Norway	5	6	83%
South Korea	6	9	67%	Hong Kong	5	9	56%
Thailand	6	9	67%	Japan	4	9	44%
Japan	5	9	56%	Indonesia	3	7	43%
Hong Kong	4	9	44%	China	3	8	38%
Malaysia	3	3	100%	Colombia	3	8	38%
Finland	3	5	60%	Belize	3	9	33%
Sri Lanka	3	9	33%	South Korea	3	9	33%
Sierra Leone	3	9	33%	Peru	3	9	33%
Kuwait	2	2	100%	Sri Lanka	3	9	33%
Singapore	2	3	67%	Portugal	2	3	67%
Philippines	2	3	67%	Iraq	2	5	40%
Indonesia	2	7	29%	Cyprus	2	6	33%
Oman	1	1	100%	Haiti	2	6	33%
Other South Asia	1	1	100%	Chile	2	7	29%
Senegal	1	1	100%	Dominican Republic	2	9	22%
Malta	1	1	100%	Honduras	2	9	22%
Djibouti	1	1	100%	Thailand	2	9	22%
Netherlands	1	1	100%	Bolivia	2	9	22%
Belgium	1	1	100%	Kenya	2	9	22%
Cameroon	1	1	100%	Estonia	1	1	100%
New Zealand	1	2	50%	Tanzania	1	1	100%
Costa Rica	1	3	33%	Surinam	1	2	50%
Russia	1	3	33%	El Salvador	1	3	33%
Yemen	1	3	33%	India	1	3	33%
Egypt	1	6	17%	Poland	1	3	33%
Norway	1	6	17%	Philippines	1	3	33%
Sudan	1	8	13%	Costa Rica	1	3	33%
Tunisia	1	9	11%	Nicaragua	1	4	25%
Bolivia	1	9	11%	South Africa	1	4	25%
				Malawi	1	4	25%
				Finland	1	5	20%
				Venezuela	1	5	20%
				Zimbabwe	1	6	17%
				Togo	1	6	17%
				Turkey	1	6	17%
				Brazil	1	6	17%
				Egypt	1	6	17%
				USSR	1	6	17%
				Benin	1	7	14%
				Sudan	1	8	13%
				Mexico	1	8	13%
				Algeria	1	9	11%
				Zaire	1	9	11%
				Sierra Leone	1	9	11%
				Guatemala	1	9	11%
				Tunisia	1	9	11%
				Jordan	1	9	11%
				Ecuador	1	9	11%

Appendix Table 3. (cont.) Segments for U.S. Hard Red Winter Wheat, 1986-94

Segment 3				Segment 4			
Countries	Years in Segment	Total Years Importing	Percent of the time in Segment	Countries	Years in Segment	Total Years Importing	Percent of the time in Segment
Ethiopia	9	9	100%	Honduras	7	9	78%
Morocco	9	9	100%	Benin	6	7	86%
Guyana	7	8	88%	Dominican Republic	6	9	67%
Algeria	7	9	78%	Peru	6	9	67%
Ecuador	7	9	78%	Belize	6	9	67%
Jordan	7	9	78%	China	5	8	63%
Mexico	6	8	75%	Colombia	5	8	63%
Mauritania	5	5	100%	Zaire	5	9	56%
Sudan	5	8	63%	Guatemala	5	9	56%
Mozambique	4	4	100%	Cyprus	4	6	67%
Burkina	4	5	80%	Kenya	4	9	44%
Zimbabwe	4	6	67%	Kyrgyzstan	3	3	100%
Brazil	4	6	67%	Georgia	3	3	100%
Turkey	4	6	67%	Lebanon	3	3	100%
Tunisia	4	9	44%	Albania	3	3	100%
Bolivia	4	9	44%	Nigeria	3	4	75%
Zambia	3	3	100%	Chile	3	7	43%
Liberia	3	3	100%	Tunisia	3	9	33%
Malawi	3	4	75%	Israel	3	9	33%
Haiti	3	6	50%	Turkmenistan	2	2	100%
USSR	3	6	50%	Tajikistan	2	2	100%
Togo	3	6	50%	Armenia	2	3	67%
Zaire	3	9	33%	India	2	3	67%
Kenya	3	9	33%	Panama	2	4	50%
Sierra Leone	3	9	33%	South Africa	2	4	50%
Guatemala	3	9	33%	Venezuela	2	5	40%
Swaziland	2	2	100%	USSR	2	6	33%
Uzbekistan	2	2	100%	Egypt	2	6	33%
Moldova	2	2	100%	Togo	2	6	33%
Pakistan	2	2	100%	Indonesia	2	7	29%
Uganda	2	2	100%	Sierra Leone	2	9	22%
Mali	2	2	100%	Sri Lanka	2	9	22%
Yugoslavia	2	3	67%	Bolivia	2	9	22%
Poland	2	3	67%	Canary Islands	1	1	100%
Nicaragua	2	4	50%	Spain	1	1	100%
Panama	2	4	50%	Trinidad	1	1	100%
Iraq	2	5	40%	Angola	1	1	100%
Venezuela	2	5	40%	Byelarus	1	1	100%
Egypt	2	6	33%	New Zealand	1	2	50%
Chile	2	7	29%	Rwanda	1	2	50%
Bangladesh	2	8	25%	Bulgaria	1	2	50%
Syria	1	1	100%	Russia	1	3	33%
Bosnia	1	1	100%	El Salvador	1	3	33%
Mongolia	1	1	100%	Yugoslavia	1	3	33%
Latvia	1	1	100%	Yemen	1	3	33%
Gabon	1	1	100%	Singapore	1	3	33%
Other West Africa	1	1	100%	Nicaragua	1	4	25%
Ukraine	1	1	100%	Finland	1	5	20%
Uruguay	1	1	100%	Iraq	1	5	20%
Saudi Arabia	1	1	100%	Burkina	1	5	20%
Somalia	1	1	100%	Turkey		6	17%
Romania	1	1	100%	Zimbabwe	1	6	17%
Ghana	1	1	100%	Brazil	1	6	17%
Congo	1	1	100%	Haiti	1	6	17%
Surinam	1	2	50%	Sudan	1	8	13%
Rwanda	1	2	50%	Guyana	1	8	13%
Bulgaria	1	2	50%	Mexico	1	8	13%
Costa Rica	1	3	33%	Jordan	1	9	11%
Russia	1	3	33%	Ecuador	1	9	11%
Portugal	1	3	33%	Thailand	1	9	11%
Armenia	1	3	33%	Algeria	1	9	11%
El Salvador	1	3	33%				
Yemen	1	3	33%				
Nigeria	1	4	25%				
South Africa	1	4	25%				
Sri Lanka	1	9	11%				
Dominican Republic	1	9	11%				