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WHEAT CLEANING AND ITS EFFECT ON U.S. WHEAT EXPORTS

by

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ABSTRACT

This analysis shows that there could be net gains to the U.S. wheat industry if all U.S. export wheat were to be cleaned to a dockage level between 0.35 to 0.40 percent. These results are based on survey results of major importers of U.S. wheat, and a model of world wheat trade. Larger benefits to the U.S. wheat industry would be possible from cleaning only wheat destined to countries that demand higher quality U.S. wheat. However, these gains in export revenue from selling cleaner wheat could be offset if other exporters, especially Canada, responded in ways that would maintain their market share.

Keywords: wheat, grain quality, trade model

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On average, the United States exports about 55 percent of its wheat crop and supplies roughly 40 percent of the wheat traded on the world market. Even though the United States is the world's largest wheat exporter, it faces stiff competition from a number of other wheat exporters that use a variety of policy tools, locational advantages and quality difference to promote the sales of their grain on world markets. Much attention has been focused on the agricultural and trade policies of competing wheat exporting countries and the effects on world trade. The United States, itself, has relied heavily on targeted export subsidies through the Export Enhancement Program (EEP) and credit subsidies to maintain or expand its share in many markets. Almost ignored in the controversy surrounding the discussion of export restitutions, EEP, and price discrimination by marketing boards is the growing importance of quality as a source of competition.

This report discusses the increasing importance of quality as a source of competition among wheat exporters, and examines in more detail wheat cleanliness as an important component of wheat quality increasingly demanded by importers. Using a world wheat model that incorporates importers' demands for diverse wheat characteristics, this report calculates the net benefit of cleaning U.S. export wheat to levels comparable to that of export competitors, that is, Canada and Australia, who currently provide the cleanest wheat to their import customers. As explained below, this report builds on a project recently completed by the Economic Research Service (ERS) that examined many of the same wheat cleaning issues.

The next section discusses grain quality and the role of cleanliness as quality-determining characteristic. The second section discusses the ERS study and summarizes results that are explicitly used in this report for further analysis. The third section describes a theoretical model of wheat import demand, and the fourth section describes how the theory is operationalized into a computable partial equilibrium model of world wheat trade that incorporates much of the information and analysis provided by the ERS study. The fifth section presents results, and the sixth section summarizes major conclusions.

The Growing Importance of Grain Quality

Quality concerns of importers have had little effect on the overall U.S. share of the world market, although they have occasionally been very significant in some country markets. These concerns are becoming more important, however, as

liberalization of grain markets, already under way, are changing the basis of competition in world grain markets.

Wheat market liberalization comes from two sources. The first source is the elimination and/or relaxation of state trading regimes. The Philippines, Brazil and South Korea have eliminated their state trading agencies in the past 8 years and a number of other countries, including Russia, Pakistan, Taiwan, Morocco and Japan, have made or contemplated major changes in their import regimes in the past year. Millers and those responsible for importing wheat in state-controlled systems typically do not share the same objective concerning the quality of the imported wheat. To millers, wheat quality factors such as cleanliness, protein levels, gluten consistency, etc. usually rank in importance along side price. State traders, on the other hand, are not likely to value quality as much as millers. State trade officials must typically balance millers' interests against constraints that may include conserving foreign exchange and foreign policy concerns.

The second source of liberalization is the potential for the elimination or reduction of export subsidy programs including EEP and GSM-102 payments over the next 5 or 10 years as part of a comprehensive trade liberalization agreement. Without these powerful financial incentives, the United States would have to place greater emphasis on the fundamental advantages of its grain marketing system and address the quality demands of its foreign customers.

Two of the major competing suppliers, Canada and Australia, have marketing boards which act as exclusive agents for their producers. As the sole buyers of wheat for export in their respective countries, they can mandate quality purchase standards to their producers. Grain boards pay producers from their total receipts for the year after all operating costs are deducted. Thus, the grain board passes along the full costs of its transactions. These boards have the capability of cutting the price to some buyers while charging high prices to others. They can settle a dispute quickly by compensating the buyer and passing the costs along to producers.

For the United States, the question of how to address the growing quality demands of importers is very complex. The United States produces and exports 5 major classes of wheat including hard red winter (HRW), hard red spring (HRS), soft red winter (SRW), western white (WW) and durum. The strength of U.S. competitiveness is a well-developed transportation and storage system which can ship large volumes of a variety of wheat classes to any part of the world at any time of the year. Quality control for U.S. exports rests primarily with the buyer and seller. The Federal Grain Inspection Service (FGIS) acts mainly as an official information source at the time of export. It

sets grain standards for export and inspects all shipments to determine if they meet contract specifications at loading, but does not place any requirements on what a willing buyer and a willing seller can exchange.

Federal Grades and Standards

There has been much debate over the role of the federal government in setting grades and standards for grain. Traders have generally argued for minimal government involvement (Hill, 1990). In their view, the objective of grain grades is solely to facilitate orderly marketing of grain. By describing the physical and biological characteristics, grades help traders group all grain into uniform lots for efficient entry into marketing channels. Traders are less concerned over the factors that define standards than they are over the disruption in marketing that would result in switching to another set of factors.[1] Implicit in their arguments is the notion that foreign purchasers can always contract directly with the trader for quality characteristics that they demand. The problem, as perceived by traders, is that foreign customers typically are not willing to pay appropriate price premiums corresponding to the set of quality factors they desire.

Producers and others have argued for a more active government presence. In their view, grades and standards should serve as a source of information on end-use value and storage characteristics. Grades and standards lower the transactions costs of arranging sales between buyers and sellers. A lack of standardized information reflecting the value of the grain for its end use in current grades leads to marketing inefficiencies that underlie foreign complaints about the quality of U.S. grain. Although buyers and sellers can theoretically negotiate premiums on quality characteristics, the cost of deviating from currently defined grades and standards is, in general, too high for the typical importer to make. Thus, producer groups believe that much of the impetus for improving quality must come from changes in Federal grades and standards or, at the very least, from mandated reporting of quality characteristics not now included in the grades and standards.

No one expects a change in grades and standards to be a panacea. Wheat quality at export is affected by weather conditions, varieties planted, and farming practices as well as the condition of facilities and practices for storing and transporting grain. A change in grades will, at best, help establish incentives in

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[1]They are also concerned that grades and standards may require testing which will slow up the loading and certification of grades.

the marketing and production system to encourage higher quality standards; it will not insure that quality premiums which buyers may be willing to pay will be sufficient to cover the costs of providing that added quality.

Wheat Cleanliness and the ERS Wheat Quality Study

International and domestic policy developments have made the identification of quality premiums difficult. A quality attribute that has received a tremendous amount of attention, primarily because it can be effectively addressed through a change in wheat grades and standards, is the cleanliness of wheat. Both Canada and Australia clean their grain to levels far cleaner than necessary to meet most contract requirements. Because their export grain is marketed through monopsonistic marketing boards, maintaining the highest quality characteristics (especially related to cleanliness or low levels of dockage and foreign material) has been relatively easy to accomplish. For the United States, dockage is measured and reported by FGIS for all shipments and limits may be specified in a purchase contract if the buyer chooses, but it is not a grade-determining factor. Dockage levels in commercial sales of U.S. wheat are, consequently, 0.6 to 0.8 percent compared to 0.2 to 0.3 percent for Canadian and Australian wheat. Inclusion of dockage limits as a wheat grade-determining characteristic would effectively require more cleaning of U.S. wheat for export. The economic issue is whether the benefits of this change would cover the additional costs.

The U.S. Congress, through the Food, Agriculture, Conservation, and Trade Act of 1990 (FACT), Section XX, decided to focus on a narrow but tractable part of the grain quality debate. It required a comprehensive commodity-by-commodity study of the economic costs and benefits of cleaning grain destined for export. Commodities to be studied include wheat, corn, soybeans, sorghum, and barley. The FACT requires that the FGIS establish or amend grain grades and standards to include "economically and commercially practical levels of cleanliness" for grain meeting the requirements of U.S. No. 3 or better. In order to satisfy the requirement that a study be done, the FGIS entered into a research agreement with the ERS to analyze the technical constraints and net economic benefits associated with enacting the changes. The first commodity studied was wheat.

There were two parts, a domestic component and an international component, to the ERS study. The domestic component measured the cost of cleaning U.S. export wheat to a 0.35-0.4 percent ending dockage level, and where in the marketing chain it was most efficient to perform the cleaning. The goal of the international component of the study was to assess premiums that foreign buyers were willing to pay for cleaner wheat and/or any increase in U.S.

wheat exports.

The Trade Modeling Perspective

This paper is not a part of the formal ERS study prepared for FGIS because it is based on a modeling framework which could not be constructed in time to be fully incorporated into the report for Congress. This paper does build on work already completed at ERS and supporting institutions. It analyzes the benefits and costs of cleaning U.S. export wheat from the framework of a model of world wheat trade. The structure of the model and many of the parameter values used therein are based on the in-depth analyses of foreign wheat markets conducted as part of the wheat component of the Grain Quality study.

The trade model perspective affords various advantages in defining the explicit goals for the study. These benefits include:

- Support for results from an economically consistent and empirically based modeling system;
- Ability to distinguish between short (wheat production fixed) and medium term (production adjusts to price changes) effects;
- Ability to analyze the targeting of the export of cleaner wheat to those markets that demand cleaner wheat and are willing to pay for it; and
- Ability to analyze the effect of cleaner U.S. export wheat on export competitors (that is, Canada), and to draw out implications of a competitive Canadian response.

The next section discusses in more detail insights from the ERS study. The ERS study provides three critical elements to this paper. First, the surveys provide extensive descriptive information useful in specifying wheat import demand in the model. Second, the domestic component of the ERS study provides an estimate of the increase in costs due to wheat cleaning prior to export shipment. In modeling terms, this information is incorporated as an upward shift in the U.S. excess supply schedule for wheat. Third, it provides estimates of changed wheat purchasing behavior if it were the case that cleaner U.S. wheat (comparable to Canadian and Australian levels) were provided to a particular importer included in the survey. This information is interpreted either as a price premium willing to be paid for cleaner U.S. wheat or as an increase in purchases of U.S. wheat at constant prices.

THE ERS STUDY

Although broad wheat quality issues have been of interest, the ERS study has focused primarily on wheat cleanliness. Wheat cleanliness refers to levels of dockage and foreign material (FM). Dockage is non-millable material that can be removed through cleaning because the weight and/or size of the material (such as weed seeds, chaff, stems, and stones) is different from wheat. FM, on the other hand, is non-millable material that is more costly to remove because of similarities of weight, size, and shape to wheat.

Domestic Component of the ERS Study

Winter wheat cleaning was analyzed by Adam and Anderson of Oklahoma State University (1991). Spring wheat cleaning was analyzed in four reports by researchers at North Dakota State University: Scherping, Cobia, Johnson, and Wilson (1992); Johnson, Scherping, and Wilson (1992); Johnson and Wilson (1992); and Wilson, Scherping, and Johnson (1992).

There are both costs and domestic benefits to cleaning wheat prior to export. The largest cost factor in removing non-millable material is wheat loss, accounting for up to 85 percent of total cleaning costs. Domestic benefits result from the sales of screenings from the cleaning process and from savings in transportation and storage costs. For winter wheat, sub-terminal elevators were found to be the least-cost location for additional cleaning, costing about 3.8 cents/bushel (bu). After considering the domestic benefits, the net cost of cleaning winter wheat was calculated at 1.6 cent/bu. For spring and durum wheat, country elevators were found to be the least-cost location: 1.9 cents/bu. Taking into account benefits from cleaning (0.3 cents/bu), the net cost of cleaning was calculated at 1.6 cents/bu, the same as for winter wheat. It was determined that white wheat can be efficiently cleaned at the country elevator level (4.3 cents/bu less the benefit 0.8 cents/bu for a net cost of 3.5 cents/bu) or the export elevator (3.7 cents/bu but with benefits of only 0.2 cents/bu, for the same net cost of 3.5 cents/bu).

International Component

ERS selected 18 countries that import wheat as case studies. Countries included in the study were selected on the basis of their share of purchases on the world wheat market.[2] In 1992

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[2]The three major exceptions to this criterion were Algeria, which was excluded because of political unrest in early 1992, and Togo and Ghana, which were added to provide some coverage of Sub-

these 18 countries accounted for 58 percent of world wheat imports and 63 percent of U.S. sales. Table 1 lists these countries. Table 1 also summarizes the factors in those countries that affect wheat market structure, and summarizes implications for U.S. wheat exports.

Based on survey results, Pick et al. (1993) analyzed the relative importance that importers and foreign millers attach to wheat quality characteristics and how exporters were perceived to perform relative to those characteristics. They found that U.S. wheat fared worse than Canadian wheat in all quality characteristics included in the survey. The presence of non-millable material was the characteristic that most differentiated U.S. wheat from Canadian wheat. The other most important characteristics where U.S. wheat fell short were price, and gluten and protein quality.

The surveys are a source of estimates of how much demand for U.S. wheat would change if the wheat were cleaned prior to export. Table 2 summarizes survey results regarding the expected demand expansion, either in terms of a percentage increase in imports or in terms of a willingness to pay price premium. Countries that might expand their imports of U.S. wheat are Italy, Brazil, Venezuela, China, Japan, the Philippines, Ghana, and Togo. The last two columns show the expected volume expansions, based on either a 1989/90 July-June crop year (the model's base as explained below) or on a 1991/92 July-June crop year (which corresponds to when the surveys were done). In both cases, the aggregate increase in demand for U.S. wheat is about 1.5 percent, relative to total U.S. wheat exports. The objective of the modeling effort, described below, is to estimate the net gains (expanded export revenue less net cleaning costs) emanating from the expanded demand summarized in this table.

A THREE-STAGE THEORY OF WHEAT IMPORT DEMAND

The country surveys indicate that wheat is far from being an homogenous commodity (as is well known to most agricultural economists). To capture the contribution of the surveys, one needs a structure that can translate that information into a workable modeling context. This section, therefore, describes a theoretical model of wheat import demand that jointly underlies the organization of the surveys and the model used in this paper. The following section continues the process by describing the translation of the theoretical model into an operational one.

The demand for wheat differs from country to country, depending primarily on the end uses intended for the wheat. The surveys

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Saharan Africa.

Table 1
Market Structure and Competitiveness in Foreign Wheat Markets

Countries	Factors Affecting Market Structure and Competitiveness	Implications for U.S. Wheat Exports
Venezuela	o No domestic production o Distribution pattern: 70% - high protein; 20% - durum; 10% - soft o Import market share sensitive to Canadian marketing strategies o High storage costs, poor facilities	o Most U.S. exports are high protein wheat o Primary competitor is Canada o Strong price competition o There exists a minimum level of U.S. shipments to cover winter months.
Brazil	o 30% of market demands high protein wheat o Declining domestic production due to cuts in subsidy payments o 5 year Long Term Agreement with Argentina (1988-93) for 2 MMT o Tariff preference for Argentine wheat o Criteria ranking for high protein sourcing: price, quality	o U.S. competes with Canada for high protein market. o Argentine wheat substitutes for declining domestic wheat; little opportunity for increased U.S. exports in lower protein market. o GSM program is important.
Italy	o Imports high protein wheat with good gluten characteristics for blending with domestic and EC wheat o Imports durum wheat with preference for Canadian durum because of color; U.S. durum used in dessert pasta o Imported wheat is priced close to EC threshold price	o Main U.S. competitor is Canada o Intrinsic characteristics are paramount o U.S. and Canadian durum not readily substitutable o High price stresses importance of quality characteristics
Former Soviet Union	o Millers pay fraction of import cost and do not influence buying decisions or source determination o Foreign exchange is major constraint	o Availability of credit (GSM) and price competitiveness (EEP) are of primary importance o Argentina is relatively unimportant competitor because cannot offer credit terms.
Morocco	o Government buying authority generally imports only common wheat. o Domestic production relies on rainfall, therefore, it is highly variable o EC has had a tradition presence, but moisture levels are high; Very little Canadian wheat has been imported in past. o Strong price competition between the U.S. and EC	o U.S. durum exports are not typically high. o EEP is important.
Tunisia	o Government sets wheat prices and controls imports. Imports vary with domestic production. o Durum wheat is usually 60 percent of production. There is a preference for EC durum. o "Panseasonal" and "panterritorial" prices discourages storage investments. o Preferred blending ratio of domestic U.S.-EC wheat is: 20-40-40 o Nonetheless, price competition among exporters is strong for given year.	o U.S. durum market share is low. o Encourages the importation of wheat. o EEP and PL-480 are important for U.S. market share.

Continuation of Table 1
Market Structure and Competitiveness in Foreign Wheat Markets

Countries	Factors Affecting Market Structure and Competitiveness	Implications for U.S. Wheat Exports
Ghana	o Consumers demand only high-raised loaves. Implies that only high-protein wheat is imported. o Supplier choice determined by aid and prices. o With liberalization of import regime, servicing will be more important determinant of supplier choice.	o U.S. exports restricted to HRS and HRW. o Canada is competitor. No significant EC presence. o PL-480 and EEP are important U.S. policy tools.
Togo	o Consumers favor French-style bread and pastries. High-raised loaf (popular in Ghana) is smaller share of market. o At least 20 percent of imports are transshipped to other African countries. o Supplier choice determined by (1) trade servicing/personal relationships, (2) price, and (3) quality	o U.S. hard wheat less demanded. EC has market share. o However, demand for U.S. wheat not solely determined by Togo consumer preferences. o EEP is important, but may be more useful in competing against Canada rather than EC.
Egypt	o White wheat is staple crop o Government has monopoly in domestic procurement and importation. Goal is food security. Wheat consumption is subsidized. o Preference for Australian ASW: government willing to pay a price premium. o Remaining imports are soft wheat. Competition is primarily on the basis of price and credit availability.	o Strong preference for white wheat, domestically grown. o U.S. wheat not strongly competitive with ASW o U.S. competes with the EC. EEP, GSM, and PL-480 are important.
Yemen	o Ministry of Supply and Trade (MST) responsible for importing wheat and flour. Imports are determined by price and credit. Domestic wheat is preferred. o Local tastes for bread determine wheat demand: tanour (flat): 40-45 percent; ragif (pita): 15-20 percent; roti (French): 40 percent. Soft wheat is preferred.	o Main U.S. competitors in soft wheat market are Australia and the EC.
Pakistan	o Wheat is staple crop. Domestic wheat is preferred for Atta flour: semi-hard, white, low moisture, protein in 12-13 percent range. o Imports vary with size of domestic crop. o Credit and price are determining factors for supplier choice.	o Variable demand for U.S. Western White (WW). o Low gluten of WW implies blending with domestic wheat. o GSM and PL-480 preserve U.S. market presence.
Sri Lanka	o Proportion of demand for imported wheat is 50-50 hard and soft varieties. o Chief variables affecting imports are price and credit.	o U.S. can reliably supply types. o U.S. is dominant supplier because of EEP and PL-480.

Continuation of Table 1
Market Structure and Competitiveness in Foreign Wheat Markets

Countries	Factors Affecting Market Structure and Competitiveness	Implications for U.S. Wheat Exports
Japan	o Japanese Food Agency makes sourcing choices. Primary concern is food security. Diversification among sources favored.	o Market share balance implies policy-induced low substitutability of U.S. wheat with that of Canada and Australia.
	o Domestic wheat is soft wheat with poor gluten characteristics. Blended with ASW to produce noodles.	o U.S. wheat does not compete with domestic wheat.
	o Consumers prefer WW for confectionery flour.	o No demand for soft wheat from the EC.
Korea	o Milling wheat has many end-uses. Millers are quality conscious.	o Although U.S. has had dominant market share, competition from Australia and Canada appears to be growing.
	o Complaints about U.S. wheat relate to variable protein levels.	
	o Australian wheat is perceived as having favorable characteristics.	
	o Feed wheat is very volatile -- depends on relationship to price of corn.	o Market shares can vary year-to year.
Taiwan	o Uniform pricing system to millers regardless of landed price centers attention on quality characteristics.	o Imports of U.S. wheat favored.
	o Long-standing trade relationships are important.	
	o HRS is used to feed shrimp.	
China	o Urban and rural wheat markets are distinct. Urban wheat consumption utilizes 20 percent of domestic production. Imports supplement domestic wheat in urban market.	
	o There is a preference for high protein wheat from Australia and Canada to blend with U.S. and domestic wheat.	o U.S. exports mostly SRW that competes directly with EC and domestic wheat.
	o Government purchasing agency (CEROILS) is price sensitive but considers quality characteristics.	o EEP is necessary to remain competitive.
	o Canadian wheat has a transport rate advantage over the U.S. Chinese do not permit imports of U.S. WW from Western ports.	
Philippines	o No domestic production	
	o Wheat imports compete with rice.	
	o Private sector imports wheat - only one mill imports Canadian wheat.	o U.S. has traditional market presence but price-consciousness requires EEP for U.S. to remain competitive.
	o Millers base import decisions primarily on price. Quality factors include protein and moisture.	
	o There is a preference for hard wheat - 70 percent of consumption.	o Primary U.S. competitor is Canada.

Continuation of Table 1
Market Structure and Competitiveness in Foreign Wheat Markets

Countries	Factors Affecting Market Structure and Competitiveness	Implications for U.S. Wheat Exports
Indonesia	o Wheat imports regulated through BULOG. Adjustable quota used to control prices. o Flour prices are highly regulated and do not reflect differing costs of imported wheat. o Food use of wheat imply following flour consumption: high protein, 30-35 percent (HRW); medium protein, 60-65 percent (preferred blend: 40 percent, ASW; 40 percent, CWRS; 20 percent, Saudi); low protein, 5 percent for biscuits (ASW). o Australian wheat has transport advantage. U.S. harmed by increased competition from Canada and new entrants: Argentina, Saudi Arabia, and Turkey.	o Government control implies price sensitivity. o Small U.S. market share threatened by lower-priced competition.

Table 2 -- Additional Benefits from Cleaning Wheat

Country	Increase in Imports from U.S. (percent)	Price Premium Willing to Pay (Dollar/mt)	Volume Trade Expansion: 1989/90 Base (1000 mt)	Volume Trade Expansion: 1991/92 Base (1000 mt)
Italy	37-49%	4-8	216	176
Brazil	15%	-	20	99
Venezuela	20-30%	4	180	93
China	1%	-	56	62
Japan	-	2	17	22
Philippines	-	1	5	8
Ghana	30-35%	5	15	26
Togo	10%	5	5	7
Total	-	-	514	493

"-"=not applicable

Source: Estimated by survey respondents.

that were described above, and in table 1, provide an understanding of demand relationships in each of the countries. It is necessary, however, to provide a theoretical structure in which descriptive data can be conceptually organized for purposes of specifying the model used in the analysis.

Here it is convenient to utilize a modeling structure described by Hjort (1988) where the demand for wheat is separated into three stages. In the first stage, the importer determines how much wheat needs to be imported to satisfy domestic end-use demand for wheat. In the second stage, the importer determines what class(es) of wheat will most "efficiently" satisfy wheat import demand determined in the first stage. In the third stage, the importer determines from which supplier to purchase the class of wheat determined in the second stage. Figure 1 is a schema of this structure. A fuller description of the theoretical model constitutes the remainder of this section.

Stage 1

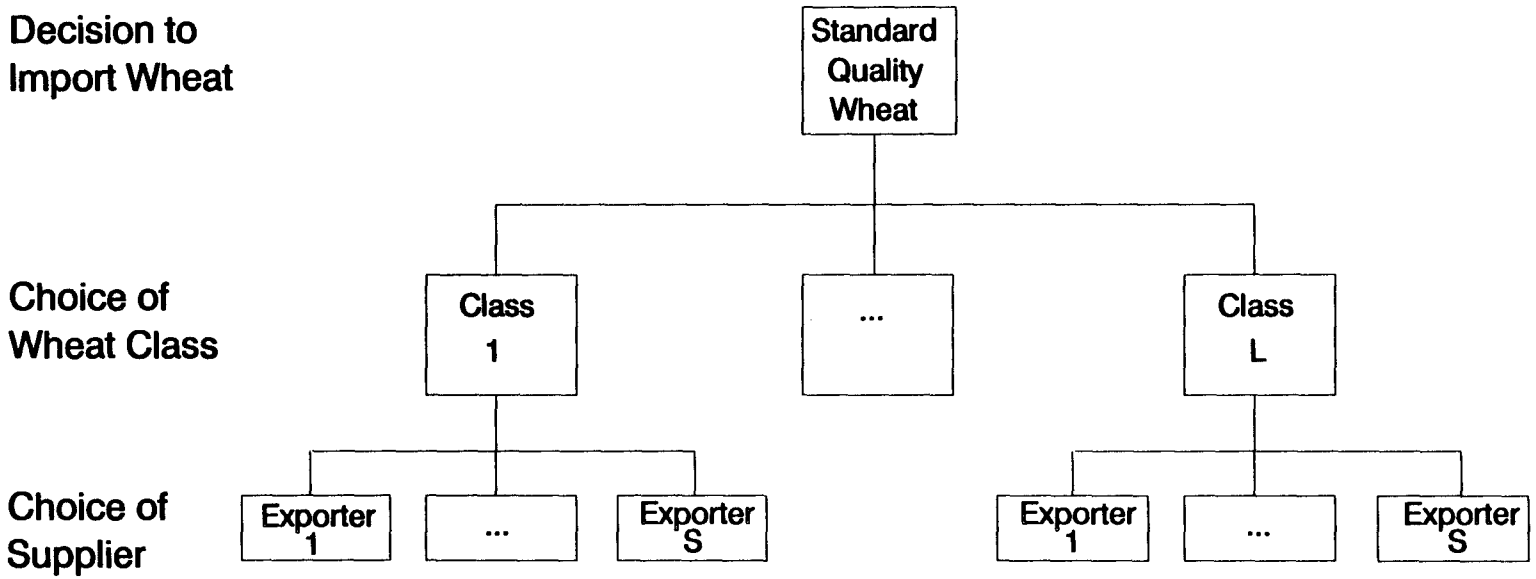
In the first stage, importers determine total wheat needs. There are several steps associated with this stage. First, there is a determination of the availability of domestic wheats. Then, there is a determination of demand for wheats of various characteristics by millers and perhaps feed manufacturers. This information determines excess demand for different wheat characteristics.

The next step of the first stage is to determine the availability of concessional terms for wheat importers. The importer's goal is the maximization of import quantities of wheat that are donated or obtained noncommercially such that demand for wheat characteristics and expenditure allocation from exporters are satisfied. The residual demand (or demand for "stage 1" wheat) is that which is to be purchased in the commercial market at market prices to satisfy remaining demand after donations for wheat characteristics.

For the next two stages, it is assumed that there exists some level of substitution among wheat classes and suppliers so that it is possible to aggregate across characteristics to obtain a quality standard (referred to as "standard quality wheat" below) that can be satisfied by the importation of wheats of different classes from different suppliers. In other words, the importing agent can determine the classes of wheat that will satisfy excess demands, given rates of substitution between the "standard quality wheat" and wheat classes from export suppliers.

Figure 1

Three-Stage Demand for Wheat



Stage 2

In the second stage, the importer determines level of wheat class imports that will satisfy "stage 1" demand. Weak separability is assumed: that is, the marginal rates of substitution among wheat classes are independent of the determination of "stage 1" demand. The goal of the importer is to minimize the cost of fulfilling the aggregate demand for wheat. This goal holds for both private and state traders. The solution to the optimization problem shows the mix of wheats that will satisfy demand for wheat quality characteristics.

Stage 3

In the third stage, the importer determines the exporters to fulfill class level wheat demand. Weak separability is again assumed: the marginal rates of substitution between suppliers of wheat are independent of quantities of other classes of imported wheat. Factors that influence supplier-specific quality characteristics are potentially many but in particular include spatial/timing characteristics; political and trade ties; policy goals, including supply assurance and diversification objectives.

The formal goal is the maximization of class i importing agent's utility given the choice of multi-sourced class i wheat and given the expenditure constraint from stage 2. The solution is the compensated demand that depends on the quantity of class i imports plus the price of all within-class wheats.

MODELING FRAMEWORK

The modeling framework is a modified (explained in next paragraph) version of SWOPSIM. (Roningen, Sullivan, and Dixit, 1991). SWOPSIM is a static, partial equilibrium, nonspatial modeling framework. Supply and demand are functions of own and cross prices. Trade is the difference between domestic supply and demand. Domestic incentive prices depend on the level of consumer and producer support and on world prices denominated in local currency. Price transmission elasticities regulate the extent to which domestic prices change when world prices change. World markets clear when net trade of a commodity across all regions sums to zero.[3]

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[3]In order to avoid confusion, the reader is reminded that SWOPSIM is a modeling framework and not a formal model of agricultural trade used for trade liberalization analysis. Because SWOPSIM was originally developed at ERS for trade liberalization

In order to make the modeling framework consistent with the theory of differentiated wheat demand, the framework must be modified because the SWOPSIM structure assumes product homogeneity. The framework is modified by a procedure attributable to Armington (1969). The Armington procedure provides a straight-forward method of calculating own and cross price elasticities between classes of wheat sourced from differing wheat exporters and domestic sources (as illustrated in figure 1).[4]

The Armington framework assumes that the wheat import agent's utility function takes on a specific constant elasticity of substitution (CES) form:

$$U^i = [\sum_j \beta_j^i * (M_j^i)^{-q_i}]^{-\frac{1}{q_i}} \qquad (1)$$

where i indexes wheat classes, j indexes wheat source countries, M represents wheat import levels, q is a substitution parameter and β is a constant incorporating non-price demand factors. Solution of the maximization problem (using M^i as a proxy for unobservable U^i and letting p represent price) is:

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analysis, many confuse the trade liberalization model (that is, ST86) with the framework. As referenced below, however, some of the same parameters used in the trade liberalization model are also used in the model constructed for the analysis in this report.

[4]Armington restrictions have been tested in international wheat and cotton markets by Alston and others (1990). In particular, the validity of stringent Armington homotheticity (embedded in the CES utility index) and separability assumptions (see theory section) are put into serious question. From a practical point of view, it does not seem likely that wheat import market shares change only in response to relative wheat price changes (excepting exogenous demand shifts associated with cleaner wheat) as implied by the CES specification. The most serious implication noted by Alston et al. is that estimates of own price import elasticities will be biased upward (that is, they will be less negative than they should be.) This is due to missing explanatory variables (substitute goods in particular) whose effects are picked up in the own price term. Although this effect is serious for those performing estimation, it is not directly applicable to this work because the Armington structure is superimposed on already-estimated demand elasticities from the SWOPSIM trade liberalization data base.

$$M_j^i = (\beta_j^i)^{\sigma_i} * \left(\frac{p_j^i}{p_i}\right)^{-\sigma_i} * M^i \qquad (2)$$

where

$$\sigma_i = \frac{1}{1 + q_i} \qquad (3)$$

Equation 2 cannot be directly incorporated into SWOPSIM. Based on the three stages of the theoretical model, own and cross price elasticities can be derived, however. The necessary elements are an own price elasticity of demand for standard quality wheat (stage 1), elasticities of substitution corresponding to wheat classes (σ, stage 2) and to wheat suppliers of particular classes (σ_i, stage 3), and consumption and/or import shares.

The elasticities are derived in stages. The first stage corresponds to the own-price demand elasticity for standard quality wheat. The second stage refers to the demand for classes of wheat. Calculation of own and cross price elasticities are based on the Armington specification. Define the following:

η = demand elasticity for standard quality wheat
η_{ii} = own price demand elasticity of class i wheat
η_{ih} = cross price demand elasticity of class i wheat with respect to class h wheat
S_h = expenditure share of class h wheat imports

The own price demand elasticity for class i wheat can be shown to equal:

$$\eta_{ii} = -(1-S_i)*\sigma + S_i*\eta \qquad (4)$$

The cross price demand elasticity of class i wheat with respect to class h wheat can be shown to equal:

$$\eta_{ih} = S_h*(\sigma + \eta) \qquad (5)$$

For the third stage, define additional own and cross price elasticities as follows:

$\eta_{i,jj}$ = own price demand elasticity of class i wheat from exporter j
$\eta_{i,jm}$ = cross price demand elasticity of class i wheat from exporter j with respect to exporter m

$S_{i,m}$ = expenditure share of class i wheat imports from supplier m

Values for these elasticities can be calculated based on equations resembling equations 4 and 5, and given within-class elasticities of substitution between wheat suppliers and appropriate expenditure share data:

$$\eta_{i,jj} = -(1-S_{i,j})*\sigma_i + S_{i,j}*\eta_{ii} \quad (6)$$

$$\eta_{i,jm} = S_{i,m}*(\sigma_i + \eta_{ii}) \quad (7)$$

$$\eta_{i,jm} = S_{h,m}*\eta_{ih} \text{ where } h \neq i \quad (8)$$

Data Requirements

The data source for supply, trade flows, and export prices was the International Wheat Council (IWC, 1992). The IWC also published transport rates for selected trade routes and some subsidy data for the United States and the European Community (EC). The transport data, however, were far from complete; therefore, they were supplemented with data from Maritime Research, Inc. Also, the USDA was a more complete source of data for U.S. wheat class trade flows, export enhancement program (EEP) subsidies, and PL-480 wheat sales and donations.

Elasticity values used in this research come from (or are based on) two differing sources. The first source is the ERS SWOPSIM model: supply and demand elasticities (Sullivan, Roningen, Leetmaa, and Gray, 1992) and price transmission elasticities (Sullivan, 1990).

The values of the remaining elasticities were inferred by the authors of this report based on a review of the surveys. These are the elasticities that measure the degree to which wheat classes from differing suppliers substitute for a country's standard quality wheat. Equations 4-8 were used to calculate own and cross price elasticities that are inputted into the model.

Table 3 shows the countries/region in the model, the SWOPSIM country codes associated with each country/region, the net trade position of each country/region (wheat net exporter or importer), whether the country was part of the ERS survey (importers only), and sources for survey results. There are six wheat exporters and the wheat from each is assumed to be different from that of the other exporters. (The exporter country codes are used to refer to

Table 3 -- Countries and Regions in World Wheat Model

Country/Region	Code	Exporter (EX) or Importer (IM)	IN or OUT of Survey	Researchers
United States	US	EX	OUT	
Canada	CN	EX	OUT	
European Community	EC	EX	OUT	
Australia	AU	EX	OUT	
Argentina	AR	EX	OUT	
Saudi Arabia	SA	EX	OUT	
Venezuela	VE	IM	IN	Setia & Dusch
Brazil	BZ	IM	IN	Mc Clain & Dusch
Mexico, Cent. Am., & Carib.	CA	IM	OUT	
Other Latin America	LA	IM	OUT	
Italy	IT	IM	IN	Plunkett
Other Western Europe	WE	IM	OUT	
Former Soviet Union	SV	IM	IN	Sheffield
Eastern Europe	EE	IM	OUT	
Morocco	MR	IM	IN	Ackerman
Tunisia	TN	IM	IN	Lent
Other North Africa	NA	IM	OUT	
Ghana	GH	IM	IN	Missiaen & Smith
Togo	TG	IM	IN	Missiaen & Smith
Other Sub-Saharan Africa	AF	IM	OUT	
Egypt	EG	IM	IN	Parker & Shapouri
Yemen	YM	IM	IN	Johnson & Parker
Pakistan	PK	IM	IN	Landes & Ash
Sri Lanka	SL	IM	IN	Landes & Ash
Other Near East	NE	IM	OUT	
Japan	JP	IM	IN	Caplan & Webb
South Korea	SK	IM	IN	Raney & Morgan
Taiwan	TW	IM	IN	Huang & Lin
China	CH	IM	IN	Colby, Crook, & Lin
Philippines	PH	IM	IN	Levin & Lin
Indonesia	DO	IM	IN	Magiera
Other Far East	FE	IM	OUT	
Rest-of-World	RW	IM	OUT	

the wheat from each of the exporters.) Wheat produced in other countries (including the importing countries) is labeled merely as "wheat".

Tables 4-8 show the model's organization of wheat consumption in each of the importing countries/regions. The wheat class categories were mainly inferred from the surveys. For the countries and regions not surveyed, historical wheat import and consumption patterns were relied upon to construct the wheat class categories. The consumption data in the tables are from the IWC and USDA.

Parameter values used in the model are documented in an appendix to this paper. Class and supplier substitution elasticities are largely a function of a country's wheat end use characteristics; that is, they depend on consumption preferences for products that use wheat as an input. The elasticities also are reflective of the preferences of, and the constraints faced by, those who make

Table 4 -- Wheat Classes and Suppliers for 1989/90: Latin America

Country/Region - Wheat Consumption	Wheat Class	Principal Suppliers	Imports from United States
Venezuela	Hard (.93)	US (.82); CN (.18);	HRS (.73); HRW (.04); DURUM (.23);
0.86 mmt	Soft (.07)	US (1.00);	SRW (1.00);
Brazil	Preferred (.95)	DM (.83); AR (.17);	-
7.06 mmt	Hard (.05)	CN (.62); US (.38);	HRW (1.00);
Mexico, Central America, and the Caribbean	Hard (.26)	US (.67); CN (.33);	HRS (.70); HRW (.26); DURUM (.04);
7.03 mmt	Soft (.74)	DM (.78); EC (.13); US (.07); AR (.02);	SRW (.91); WW (.09);
Other Latin America	High Protein (.29)	US (.86); CN (.14);	HRS (.36); HRW (.64);
5.08 mmt	Lower Protein (.71)	DM (.79); AR (.17); US (.02); EC (.02);	SRW (.82); WW (.18);

Notes:
- See Table 1 for supplier codes, except DM = domestic.
- U.S. wheat classes: HRS = Hard Red Spring; HRW = Hard Red Winter; SRW = Soft Red Winter; WW = Western White.
- "-" = not applicable
- The proportions in parentheses following a wheat classification code represent the share of the classification category of the higher-order category.

Table 5 -- Wheat Classes and Suppliers for 1989/90: Europe

Country/Region - Wheat Consumption	Wheat Class	Principal Suppliers	Imports from United States
Italy 9.81 mmt	EC (.91)	DM (.83); Other EC (.17);	-
	Hard (.06)	US (.62); CN (.35); SA (.03);	HRS (1.00);
	Durum (.03)	CN (.51); US (.49);	DURUM (1.00);
European Community (excluding Italy) 53.84 mmt	Domestic (.98)	DM (1.00)	-
	Foreign (.02)	CN (.46); US (.35); SA (.19);	HRS (.57); HRW (.06); SRW (.12); DURUM (.25);
Other Western Europe	Hard (.05)	SA (.41); CN (.39); US (.20);	HRS (1.00);
10.89 mmt	Soft (.95)	DM (.97); EC (.03);	-
Former Soviet Union 107.10 mmt	Wheat (1.00)	DM (.879); US (.042); EC (.041); CN (.033); AR (.005);	HRS (.33); HRW (.49); SRW (.18);
Eastern Europe	Hard (.003)	CN (.74); AU (.15); US (.11);	DURUM (1.00);
39.66 mmt	Soft (.997)	DM (.98); EC (.02);	-

Note: See notes in Table 4.

Table 6 -- Wheat Classes and Suppliers for 1989/90: North and Sub-Saharan Africa

Country/Region - Wheat Consumption	Wheat Class	Principal Suppliers	Imports from United States
Morocco	Durum (.45)	DM (1.00);	-
3.93 mmt	Common (.55)	DM (.68); US (.16); EC (.16);	HRS (.30); HRW (.24); SRW (.46);
Tunisia	Durum (.45)	DM (.53); EC (.43); US (.04);	DURUM (1.00);
1.42 mmt	Common (.55)	EC (.43); US (.38); DM (.19);	HRS (.14); HRW (.22); SRW (.64);
Other North Africa	Durum (.53)	DM (.38); CN (.28); US (.20); EC (.14);	DURUM (1.00);
4.19 mmt	Common (.47)	EC (.48); US (.30); DM (.20); CN (.02);	HRS (.27); HRW (.29); SRW (.44);
Ghana 0.12 mmt	Hard (1.00)	CN (.63); US (.37);	HRS (.93); HRW (.07);
Togo	Hard (.85)	US (.70); CN (.30);	HRS (93); HRW & SRW (.07);
0.08 mmt	Soft (.15)	EC (1.00);	-
Other Sub-Saharan Africa	Domestic (.53)	DM (1.00);	-
7.40 mmt	Hard (.17)	US (.52); CN (.30); SA (.18);	HRS (.04); HRW (.96);
	Soft (.30)	EC (.96); US (.04);	SRW (1.00);

Note: See notes in Table 4.

Table 7 -- Wheat Classes and Suppliers for 1989/90: Egypt and Western Asia

Country/Region - Wheat Consumption	Wheat Class	Principal Suppliers	Imports from United States
Egypt (imports)	Australian (.26)	AU (1.00);	-
6.94 mmt (.68 of total Egyptian consumption)	Other (.74)	US (.65); EC (.35);	HRS (.02); HRW (.02); SRW (.66); WW (.30);
Yemen 1.09 mmt	Wheat (1.00)	AU (.41); EC (.37); US (.14); CN (.02); DM (.06);	SRW (.51); WW (.49);
Pakistan	Domestic (.88)	DM (1.00);	-
16.31 mmt	Foreign (.12)	US (.67); AU (.24); EC (.05); CN (.04);	WW (1.00);
Sri Lanka	Hard (.50)	US (.89); SA (.10); CN (.01);	HRS (.44); HRW (.56);
0.77 mmt	Soft (.50)	US (.76); EC (.14); AU (.10);	SRW (.66); WW (.34);
Other Near East (imports)	Australia (.25)	AU (1.00);	-
14.62 mmt	Other (.75)	EC (.33); US (.26); CN (.21); AR (.20);	HRS (.03); HRW (.72); DURUM (.04); SRW (.17); WW (.04);

Note: See notes in Table 4.

Table 8 -- Wheat Classes and Suppliers for 1989/90: Far East

Country/Region - Wheat Consumption	Wheat Class	Principal Suppliers	Imports from United States
Japan	High Quality (.79)	US (.56); CN (.29); AU (.15);	HRS (.32); HRW (.40); WW (.28);
6.34 mmt	Lower Quality (.21)	DM (.75); AU (.25);	-
Korea	High Protein (.42)	US (.97); CN (.03);	HRS (.40); HRW (.60);
1.79 mmt	Lower Protein (.59)	US (.78); AU (.22);	WW (1.00);
Taiwan	Hard (.84)	US (.84); CN (.16);	HRS (.49); HRW (.51);
0.82 mmt	Soft (.16)	US (1.00);	WW (1.00);
China (urban sector)	High Protein (.24)	CN (.58); US (.17); AU (.14); AR (.11);	HRS (.49); HRW (.51);
20.71 mmt (0.2 of total Chinese consumption)	Low Protein (.76)	DM (.77); US (.18); EC (.05);	SRW (1.00);
Philippines	Hard (.73)	US (.55); CN (.45);	HRS (1.00);
1.31 mmt	Soft (.27)	US (.87); EC (.08); AU (.03); OTH (.02);	WW (1.00);
Indonesia	Hard (.53)	CN (.39); AR (.29); SA (.17); US (.15);	HRS (.17); HRW (.83);
1.86 mmt	Soft (.47)	AU (.84); US (.08); EC (.08);	WW (1.00);
Other Far East (imports)	Hard (.73)	AU (.44); US (.30); CN (.24); SA (.02);	HRS (.77); HRW (.23);
3.19 mmt (.05 of total consumption)	Soft (.27)	EC (.63); US (.37);	WW (1.00);

Note: See notes in Table 4.

wheat import decisions.

For most countries/regions in the model, the between-class elasticities tend to be low (usually about 0.50), while the between-supplier elasticities tend to be higher (usually about 3.00). There are some notable exceptions, however. In Japan policymakers value supplier diversification, thereby implying a low substitution elasticity. In Egypt and Other Near East there is a strong preference for white wheat from Australia. This preference implies a low substitution elasticity between Australian wheat and that from the United States and the EC. And in Italy, U.S. and Canadian durum wheat do not substitute for each other.

NET BENEFITS OF CLEANER WHEAT EXPORTS

The U.S. benefit of supplying cleaner wheat to import customers consists of the expansion of U.S. wheat exports and/or the willingness of those customers to pay a price premium for cleaner wheat. At issue is whether these benefits be great enough to outweigh the costs of cleaning (about $0.70/mt) and the consequent export-decreasing effect of a higher export price.

Modeling Scenarios

In addition to providing information useful for specification of wheat import demand, the surveys are a source of how much demand for U.S. wheat would change if the wheat were cleaned prior to export as indicated in table 2. Survey results show that demand would be expected to expand in certain "high quality" wheat markets constituted by the following countries: Italy, Brazil, Venezuela, China, Japan, the Philippines, Ghana, and Togo.

A modeling problem is that the survey results are only applicable to the time period in which the survey was taken, that is, spring and early summer of 1992. The model, on the other hand, uses a 1989/90 crop year as its base. The procedure followed to help mitigate this inconsistency was to calculate a volume expansion based on the 1989/90 base and on the 1991/92 base. These two alternative demand expansions present a range over which importers could respond.

It is assumed that the primary effect of improvements in U.S. wheat quality will be to increase U.S. share at the expense of other exporters in those markets that are sensitive to the quality change. Quality changes are expected to have little impact on global demand or on individual country demand for total wheat imports. Therefore, in the modeling scenarios, imports of wheat from competing exporters are reduced to offset the expansion of wheat imported from the United States so as to leave

total imports in each importing country the same, all else constant. This aspect emphasizes that U.S. wheat is substituting for wheat from other exporters rather than there being a generalized expansion in wheat imports in each of these countries.

The four scenarios are:

Scenario A: Clean all export wheat, no expansion in importer demand for U.S. wheat exports (that is, a fixed import excess demand curve);

Scenario B: Clean all export wheat, expansion of demand for U.S. wheat in "high quality" import markets;

Scenario C: Expansion of demand for U.S. wheat in "high quality" import markets, but clean only wheat going to these "high quality" market; and

Scenario D: Same as scenario C except that export competitors respond to maintain either export volume (short term) or market share (medium term) in individual "high quality" markets.

Within each scenario, there is a short term solutions where wheat production is fixed in all countries and a medium term solution where production adjusts to price changes. Each scenario also has two U.S. wheat export expansions--one based on the 1989/90 and one on the 1991/92 crop year. That is, there are four versions of each scenario except for scenario A where there are only two (short and medium term). Table 9 summarizes changes in: (1) export revenue, (2) cleaning costs, and (3) the net benefit of cleaning wheat (the difference between (1) and (2)). Appendix table 6 shows more detailed effects on U.S. export prices, wheat trade volume, and export revenue. (The change in export revenue relative to the baseline is carried over to table 9).

Gains from Cleaning All Export Wheat

If all U.S. wheat exports were cleaned but there were no U.S. export demand expansion (scenario A), overall losses to the U.S. wheat industry (losses in export revenue plus net costs of cleaning) would run from $23 million in the short term to over $27 million in the medium term. Most of this loss comes from the net costs of cleaning. But export revenue is affected as well, especially over the medium term. The export price increases slightly (0.07 percent) in the short run, and more over the medium term (0.22 percent). The volume of U.S. wheat exports is reduced by about 100 thousand metric tons (or .3 percent) over the medium term. There is practically no reduction in the short run. The loss in medium term export revenue, therefore, amounts

Table 9 -- Net Benefits of Cleaning U.S. Export Wheat

Millions of U.S. Dollars

Scenario A: Clean all export wheat, no expansion in importer demand

Time Frame	Change in Export Revenue	Costs of Cleaning Grain	Net Benefit
Short term	0.27	23.47	-23.19
Medium term	-4.04	23.41	-27.46

Scenario B: Clean all export wheat, expansion in "high quality" import market

Trade Expansion Based on 1989/90 Base

Short term	54.86	23.50	31.36
Medium term	49.68	23.53	26.15

Trade Expansion Based on 1991/92 Base

Short term	47.03	23.48	23.54
Medium term	45.75	23.52	22.23

Scenario C: Expansion in "high quality" import market, clean only wheat going to "high quality" market

Trade Expansion Based on 1989/90 Base

Short term	54.53	7.68	46.84
Medium term	52.60	7.71	44.89

Trade Expansion Based on 1991/92 Base

Short term	49.32	7.67	41.64
Medium term	48.84	7.70	41.14

Scenario D: Same as scenario C but export competitors respond.

Trade Expansion Based on 1989/90 Base

Short term	29.35	7.58	21.77
Medium term	28.54	7.59	20.95

Trade Expansion Based on 1991/92 Base

Short term	-2.05	7.46	-9.51
Medium term	.98	7.47	-6.49

to about $4 million. This scenario is the "worst case" scenario where it is assumed that no country is willing to pay the additional costs of cleaning and the United States only loses import customers.

If U.S. export demand expanded as predicted in table 2 (scenario B), export revenue in the quality sensitive markets would increase sufficiently to offset the costs of cleaning and the losses in quality insensitive markets. Over the short term, there is little effect on trade volume, but the price rise amounts to about 0.9 percent. Over the medium term, the total volume of exports increases between 0.14 and 0.18 percent. (Given that expansion in the quality sensitive markets amounts to an expansion of 1.5 percent, much of this expansion is offset by reduced U.S. wheat purchases in the other markets.) More significantly, the export price rises by about 0.7 percent. Considering the medium term price rise when there is no demand expansion, 0.22 percent (Scenario A), increased demand for cleaner wheat adds slightly less than 0.5 percentage points to the price of export wheat.

Given these price and volume changes, along with the net costs of cleaning, short term net gains are calculated in the $23-$31 million range, and medium term gains are between $22 and $26 million.

Gains from Selectively Cleaning Export Wheat

One way to augment the gain from cleaning U.S. export wheat is to clean only that wheat going to those importers that demand it and that are willing to pay a price premium for the cleaner wheat (scenario C). Results show a potential gain of $41 to $47 million in the short term and of $41 to $45 million over the medium term.

In comparison to scenario B, most of these heightened gains are attributable to lowered cleaning costs (less wheat being cleaned). Comparative export revenue gains are larger as well, especially over the medium term. The export price rises by less, about 0.55 percent compared to 0.70 percent; but trade volume increases by more, 0.40 percent compared to about 0.15 percent. There are fewer reduced purchases of U.S. wheat by importers less sensitive to quality concerns.

Scenario C likely overstates the gains from selective cleaning because cleaning cost calculations assume all wheat for export is cleaned. As the throughput of wheat for cleaning declines, costs per unit cleaned likely increase due to lower economies of scale and reduced savings in domestic transport and storage. If only the wheat destined to the quality sensitive markets were cleaned, the net unit cost of cleaning might be expected to be higher than 70 cents/mt. In order to judge the sensitivity of results to this

factor, scenario C was rerun with net cleaning costs assumed to equal $1.05, a 50 percent increase.

Two effects should diminish the gain: higher cleaning costs and reduced export sales because of a higher wheat export price that incorporates the higher net unit cost of cleaning. The first effect reduces the net benefit by about $3.8 million, and the second by about $0.5 million (medium term only). Therefore, the short term gain is between $38 and $43 million; and the medium term gain is between $37 and $41 million. Thus, the higher cleaning cost only slightly reduces the gains from scenario C.

Exporter Competitor Response

Export competitors displaced by the United States may respond by offering export subsidies in those markets where they were displaced (scenario D). If they attempt to counteract U.S. actions, either the U.S. gain is much lower ($22 million in the short term and $21 million in the medium term) or there are relatively large losses(over $9 million in the short term and over $6 million in the medium term).

The only export competitor significantly harmed by the U.S. cleaning is Canada. The top panel of table 10 shows the reduction in Canadian export revenue when the United States selectively cleans export wheat (scenario C -- 1991/92 base). Canada would stand to lose about $25 million in the short term and $37 million over the medium term. The lower panel shows the subsidy cost to Canada of regaining export volume (short term) and market share (medium term). In both cases, it would be fairly expensive: $75 million in the short term and $73 million in the medium term. These amounts are significantly higher than the export revenue losses they suffer. Considered on a unit cost basis, regaining the Italian, Brazilian, Venezuelan, and even the African markets would be costly. This outcome suggests that retaliation by the Canadians in this fashion might not be likely, therefore enhancing the possibility of a U.S. gain from selectively cleaning its wheat for certain high quality markets.

Canada loses initially because there is a shift in preferences toward U.S. wheat. In modeling terms, there is a leftward shift in the excess demand curve for Canadian wheat in those countries where purchases of U.S. wheat have increased. In the modeling scenario, Canada regains initial export volume in the short run and market share in the medium run by offering export subsidies (or hidden price discounts) given the shifts in excess demand curves. The amount of the subsidy in each market depends on the elasticity of demand for Canadian wheat: the lower the value of the elasticity, the more costly it is to recapture the market.

To judge the sensitivity of these results to the elasticity

Table 10 -- Effect of Cleaner U.S. Wheat on Canada

Loss in Canadian Export Revenue from Scenario Benefitting the U.S. the Most

Scenario	Export Price (Dollar/mt)	Trade Volume (1000 mt)	Export Revenue (Million Dollars)	Decrease from Base (Million Dollars)
Base	181.00	17,045	3,085.15	-
Scen. C - short term	179.72	17,028	3,060.33	24.82
Scen. C - medium term	179.68	16,965	3,048.26	36.89

Subsidy Expenditure Necessary To Regain Export Volume (Short Term) and Import Market Share (Medium Term)

Importer	Short Term Unit Subsidy (Dollar/mt)	Vol. of Imports (1000 mt)	Subsidy Cost (Million Dollars)	Med.Term Unit Subsidy (Dollar/mt)	Vol. of Imports (1000 mt)	Subsidy Cost (Million Dollars)
Italy	110.30	367	40.48	111.87	371	41.48
Brazil	71.71	216	15.49	66.43	205	13.61
Venezuela	69.35	143	9.92	66.26	135	8.96
Japan	2.55	1,440	3.67	2.80	1,442	4.04
China	.12	4,257	.51	.15	4,260	.64
Philippines	1.94	433	.84	1.66	432	.72
Ghana	38.21	75	2.87	33.63	72	2.41
Togo	52.79	19	1.00	52.70	19	1.00
Total	-	-	74.78	-	-	72.85

issue, additional "scenario C" and "scenario D" model runs were made with a revised model. The revised model contains own and cross price elasticities of U.S. and Canadian wheat that indicate greater substitution possibilities between the respective wheats. The elasticities of substitution between U.S. hard variety wheat and Canadian wheat were increased by 50 percent in each of the quality-sensitive markets. Results show that without retaliation, Canada loses $35 million in export revenue over the medium term. This amount compares to $37 million in the original model. The cost to Canada of regaining market share over the medium term is calculated to be $66 million. This amount compares to $73 million

in the original model. Unless U.S. and Canadian wheats are perceived to be extremely close substitutes (which is a hypothesis not supported in the importer surveys), then complete retaliation (defined in terms of regaining original market share) may not be likely.

CONCLUSIONS

Quality and the role of government policy in setting standards has been an issue as long as the United States has been exporting grain. This report has examined only one aspect of the current debate, the net benefits of providing for a cleaner export product. There are a number of other quality issues facing U.S. wheat exports, such as tighter control of protein content by class and the measurement and reporting of moisture content. But for all the other important quality issues, there are significant technical impediments associated with the production and marketing of wheat to be addressed in addition to the economic feasibility questions. The wheat cleaning issue is largely one of economics.

The magnitude of the costs and benefits associated with the removal of additional dockage from U.S. export wheat is very small in the scheme of world wheat trade. Exporting country governments spend billions on export subsidies and restitutions; importers, through the imposition of regulations and state trading agencies, have greatly reduced the communication of quality demands to the world market. Quality premiums and discounts are small in a market dominated by pervasive government interference on this scale.

Nevertheless, there are important quality differences in wheat across exporting countries and the level of dockage is the one negative attribute which most differentiates U.S. wheat from the wheat of Canada, Australia and Argentina. A few importing countries reported that they would make small increases in purchases of U.S. wheat if it contained less dockage. Although the benefits are small, the costs are small as well.

This analysis has shown that there are likely to be net gains if all U.S. export wheat were to be cleaned to a dockage level between 0.35 to 0.40 percent. Expansion in dockage-sensitive wheat markets, representing growth in U.S. wheat exports of about 1.5 percent, would cause export revenue to grow between $23 and $31 million in the short term, and between $22 and $26 million in the medium term. Although these amounts may appear to be sizable, relative to total wheat export revenue, they represent increases of only about 0.5 percent. Higher benefits are possible if only wheat destined to the dockage-sensitive import markets is cleaned to the desired level, although additional research should

probably be initiated to see if this option is feasible at reasonable cost levels. Any gain in export revenue is likely to be reduced significantly if Canada decides to recapture the markets lost to the United States. Even so, this analysis has shown that the recapturing of lost Canadian markets could be costly; thereby reducing the probability of a comprehensive Canadian response.

This analysis has ignored two considerations which could have a significant implications for the cost-benefit calculations. First, we have only alluded to a change in grades and standards which would bring about lower level of dockage in U.S. wheat exports. How dockage is incorporated into export grades and standards and the speed at which the change is implemented will affect both the costs and benefits in the short (and possibly the long) term.

Second, the long term trend toward liberalization in the world wheat market will make quality considerations much more important in the world market in the next decade. This analysis has made no attempt to speculate where or how the liberalization will take place or what the effect might be on the demand for less dockage in U.S. wheat. These are major changes which would affect the core of the purchase decision framework of importing countries.

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Appendix Table 1 -- Modeling Parameters: Latin America

Country/ Region	First Stage Second Stage	Elasticity of Substitution	Own-price Demand Elas.	Own-price Supply Elas.	Price Trans-mission Elas.
Venezuela	Hard-Soft	0.5	-0.28	-	1.00
	US-CN	3.0	-	-	
	US	-	-	-	
Brazil	Preferred-Hard	0.5	-0.2	0.38	0.30
	DM-AR	1.0	-	-	
	CN-US	3.0	-	-	
Mexico, Cen. Am. & Carib.	Hard-Soft	0.5	-0.26	0.55	0.50
	US-CN	3.0	-	-	
	DM-EC-US-AR	3.0	-	-	
Other Latin America	High-Low Prot.	0.5	-0.3	0.38	0.70
	US-CN	3.0	-	-	
	DM-AR-US-EC	3.0	-	-	

See Table 3 for supplier codes; Prot. = Protein; DM = Domestic; and "-" = not applicable

Appendix Table 2 -- Modeling Parameters: Europe

Country/ Region	First Stage Second Stage	Elasticity of Substitution	Own-price Demand Elas.	Own-price Supply Elas.	Price Trans-mission Elas.
Italy	EC-Hard-Durum	0.5	-0.20	0.50	0.15
	DM-Other	-	-	-	-
	US-CN-SA	3.0	-	-	-
	CN-US	0.5	-	-	-
EC	DM-Foreign	0.5	-0.37	0.50	0.15
	CN-US-SA	3.0	-	-	-
Other Western Europe	Hard-Soft	0.5	-0.25	0.80	0.15
	SA-CN-US	3.0	-	-	-
	DM-EC	3.0	-	-	-
Former Soviet Union	DM-US-EC-CN-AR	3.0	-0.24	0.23	0.14
Eastern Europe	Hard-Soft	0.5	-0.28	0.25	0.40
	CN-AU-US	3.0	-	-	-
	DM-EC	3.0	-	-	-

See Table 3 for supplier codes; Prot. = Protein; DM = Domestic; and "-" = not applicable

Appendix Table 3 -- Modeling Parameters: North Africa and Sub-Saharan Africa

Country/ Region	First Stage Second Stage Third Stage	Elasticity of Substitution	Own-price Demand Elas.	Own-price Supply Elas.	Price Trans-mission Elas.
Morocco	Durum-Common DM-Foreign US-EC	0.0 3.0 4.0	-0.20 - -	0.30 - -	0.60 - -
Tunisia	Durum-Common DM-EC-US EC-US-DM	0.1 4.0 4.0	-0.21 - -	0.30 - -	0.60 - -
Other North Africa	Durum-Common DM-CN-US-EC EC-US-DM-CN	0.5 4.0 4.0	-0.20 - -	0.30 - -	0.60 - -
Ghana	CN-US	4.0	-0.30	-	0.40
Togo	Hard-Soft US-CN	1.0 2.0	-0.30 -	-	0.40 -
Other Sub-Saharan Africa	DM-Hard-Soft US-CN-SA EC-US	3.0 4.0 4.0	-0.30 - -	0.50 - -	0.40 - -

See Table 3 for supplier codes; Prot. = Protein; DM = Domestic; and "-" = not applicable

Appendix Table 4 -- Modeling Parameters: Egypt and West Asia

Country/ Region	First Stage Second Stage Third Stage	Elasticity of Substitution	Own-price Demand Elas.	Own-price Supply Elas.	Price Trans-mission Elas.
Egypt	DM-Foreign AU-Other US-EC	3.0 0.5 3.0	-0.31 - -	0.30 - -	0.35 - -
Pakistan	DM-Foreign US-AU-EC-CN	0.5 3.0	-0.30 -	0.40 -	0.25 -
Sri Lanka	Hard-Soft US-SA-CN US-EC-AU	1.0 3.0 3.0	-0.30 - -	- - -	0.25 - -
Yemen	AU-EC-US-CN-DM	4.0	-0.30	0.30	0.60
Other Near East	Arabic-Foreign DM-SA AU-Other EC-US-CN-AR	3.0 3.0 1.0 4.0	-0.30 - - -	0.30 - - -	0.60 - - -

See Table 3 for supplier codes; Prot. = Protein; DM = Domestic; and "-" = not applicable

Appendix Table 5 -- Modeling Parameters: Far East and Rest-of-World

Country/ Region	First Stage Second Stage	Elasticity of Substitution	Own-price Demand Elas.	Own-price Supply Elas.	Price Transmission Elas.
Japan	High-Low Qual. US-CN-AU DM-AU	0.5 1.0 1.0	-0.10 - -	0.52 - -	0.40 - -
Korea	High-Low Prot. US-CN US-AU	0.5 1.0 1.0	-0.36 - -	- - -	0.50 - -
Taiwan	Hard-Soft US-CN	0.5 1.0	-0.33 -	- -	0.30 -
China	Rural-Urban High-Low Prot. CN-US-AU-AR DM-US-EC	0.5 0.5 3.0 3.0	-0.30 - - -	0.15 - - -	0.15 - - -
Philippines	Hard-Soft US-CN US-CN-AU-Other	0.5 3.0 3.0	-0.30 - -	- - -	0.50 - -
Indonesia	Hard-Soft CN-AR-SA-US AU-US-EC	0.5 3.0 3.0	-0.30 - -	- - -	0.25 - -
Other Far East	DM-Foreign Hard-Soft AU-US-CN-SA EC-US	0.0 0.5 3.0 1.0	-0.30 - - -	0.40 - - -	0.60 - - -
Rest-of-World	US-EC-AU-SA-Other	3.0	-0.30	-	0.00

See Table 3 for supplier codes; Prot. = Protein; DM = Domestic; and "-" = not applicable

Appendix Table 6 -- Model Results for U.S. Wheat Trade

Scenario	Description	Price (Dollar/mt)	Export Volume (1000 mt)	Export Revenue (Million Dollars)
Base		162.0000	33549	5434.938
Scenario A	Short term	162.1145	33527	5435.213
	Medium term	162.3635	33449	5430.897
Scenario B	1989/90 base Short term	163.5378	33569	5489.800
	Medium term	163.1792	33611	5484.616
	1991/92 base Short term	163.4018	33549	5481.967
	Medium term	163.1206	33599	5480.689
Scenario C	1989/90 base Short term	163.4499	33585	5489.465
	Medium term	162.9026	33686	5487.537
	1991/92 base Short term	163.3142	33581	5484.254
	Medium term	162.8442	33675	5483.778
Scenario D	1989/90 base Short term	162.7923	33566	5464.286
	Medium term	162.5358	33614	5463.478
	1991/92 base Short term	161.9727	33542	5432.888
	Medium term	162.1161	33531	5435.915

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