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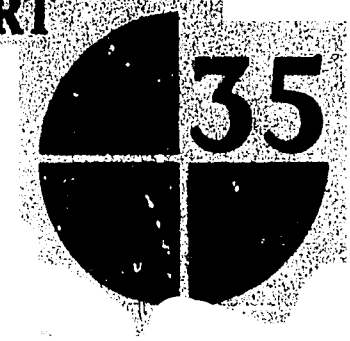

POLICY OPTIONS FOR THE GRAIN ECONOMY OF THE EUROPEAN COMMUNITY: IMPLICATIONS FOR DEVELOPING COUNTRIES

Ulrich Koester

November 1982

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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FOREWORD

Actions of the developed countries strongly affect the environment within which the developing countries make their food policy. During the next few decades, imports of cereals by developing countries, which are already large, may increase threefold. The vulnerability of developing countries to fluctuations in the prices and availability of cereals is likely to increase as their domestic production fluctuates more widely.

The International Food Policy Research Institute has produced a small number of studies examining those aspects of developed-country actions and policies that have a particularly powerful influence on the food policy environment of developing countries. These have included analyses of the Soviet Union's prospective grain imports, the effect of OECD country restrictions on entry to their own markets, on the agricultural export potential of developing countries, and the effect of European Community policies on grain supply and price availability. This work by Ulrich Koester gives particular attention to policy measures by the European Community that might stabilize global grain supplies and prices and to the size of prospective exports of grain from the European Community, which has particular importance because grain imports of Third World countries are likely to be large during the next few decades.

Koester's analysis is of particular value to IFPRI's continuing effort to understand the sources of instability in grain supplies to Third World countries and to find ways to reduce that instability and its effects on low-income countries and people.

John W. Mellor

Washington, D.C.
November 1982

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1

SUMMARY

Because of its importance in production and trade, prospects for the European Community (EC) grain economy are of special interest to developing countries. However, the future contribution of the EC toward solving the world food problem will depend to a large extent on political decisions within the EC.

This study analyzes four policy options for the EC grain economy from the developing countries' points of view. The first option is for past policies of high protection to continue. Production, consumption, and net trade are projected to 1985 and 1990. The EC net surplus of wheat would rise from 11.4 million metric tons in 1980 to 11.9 million in 1985 and 17.3 million in 1990. For total grain the surplus would increase from 3.0 million metric tons in 1980 to 11.5 million in 1985 and 25.3 million in 1990. The EC compensated for only 1.8 percent of the grain deficit of developing countries in 1980 but might provide for 12-15 percent in 1985. The high-protection EC grain policy is under increasing internal and external pressure.

The second policy option assumes complete liberalization of EC grain trade. This would not only directly affect world grain prices, production, and trade but would indirectly affect markets closely related to the grain market. World grain production would be about 0.9 percent lower, mainly due to a 3.3 percent drop in barley production. World prices would go up about 9.6 percent for wheat, but only 2.2 percent for maize. Developing countries in total would lose up to 0.04 percent of GNP in welfare, whereas developed countries would gain about 0.02 percent of GNP. These losses for developing countries might be somewhat compensated for by indirect effects. EC grain trade liberalization would open EC markets to imports of processed grain products, pork, and poultry. But the market for cereal substitutes, especially for cassava, would probably be wiped out. This would be mainly to the disadvantage of Thailand and Indonesia. Of these two policy options, the first seems more favorable to most developing countries.

The effects of EC grain policy on the stability of the world grain market are analyzed under the third and fourth policy options. It appears that the EC could contribute more to stability without changing the degree of protection for EC grain producers. Hence, these options mainly assume a modification of the present policies concerning the relation of variability in domestic grain prices to variability in production, the relation of EC and world market grain price ratios, and carryover stocks.

Grain production in the EC tends to fluctuate more than in the rest of the world, despite internal price stability. Nevertheless, reducing the share of EC grain production in world grain production by lowering EC grain prices would probably destabilize world grain production. However, the study indicates that the EC could contribute to stabilizing world grain production by allowing producer prices to vary with production. Such a policy would help reduce instability in the area harvested in the EC.

EC price ratios have been totally disconnected from world market price ratios. World market prices for individual types of grain would be less volatile if price ratios in the EC were allowed to change with those on the world market. The policy of fixed price ratios results in a loss of welfare in the EC, according to a feed-value arbitrage model. The study suggests a policy modification that would permit the EC to avoid such losses and also to help stabilize world market prices.

The seasonal pattern of EC grain prices only reflects EC storage costs for grain and therefore does not contribute to stabilizing the seasonal pattern of the world market. It is recommended that the EC substitute intrayear trade for intrayear storage. This can be done by allowing for intraseasonal arbitrage between the EC and the world market, even with protection for EC grain producers.

Because there are no incentives for private carryover stocks in the EC, its stocks are totally determined by official decisions. In nearly all years from 1968/69 to 1980/81, the ratio of EC wheat carryover stocks to

those of the rest of the world was less than the production ratio. Even this slight potential for stabilizing the world wheat market has not been used adequately. Changes in EC stocks were correlated more with fluctuations in EC production than with world production or prices. EC storage policy also did not work to the advantage of the EC itself because there is no incentive for private exporters to export at times when the differential between EC and world market grain prices is lowest. A policy change is suggested that would provide private incentives for more rational storage and trading activities.

2

INTRODUCTION

The grain market is the most important agricultural market in temperate climates. That is not because grain is the main crop in those climates, but because there is a close relationship between grain prices and other agricultural product prices. First, grain is important for producing pork, poultry, eggs, beef, and milk. The revenue from these products and from grains accounts for about 66 percent of the EC's total agricultural revenue. Second, grain competes with other agricultural products for land. So grain prices determine the allocation of land to these products and, therefore, their prices.

Keeping in mind the dominance of the grain market in European agriculture, it is understandable that the EC needed several years to negotiate a common grain market. The historical decision was finally made in December 1964, seven years after the Rome treaty establishing the EC was signed. The agreed-upon unification of EC grain prices scheduled for July 1, 1967, asked for a reduction in West German grain prices of 12-13 percent, and an increase in the grain prices of the other member countries. The Federal Republic of Germany accepted the cut in grain prices in spite of the lobbying of its farmers, hoping that a common agricultural market would have positive effects for the Community as a whole and for West Germany as well.

However, expectations that the Common Agricultural Policy (CAP) would encourage integration have not been fulfilled. After the devaluation of the French franc and the revaluation of the German mark in 1969, common prices, the essential part of a common market, were abolished. Since then, national agricultural prices have differed widely because of special border regulations within the Community. These regulations, called monetary compensatory amounts (MCAs), actually have the same function as tariffs. Therefore, it is questionable whether the Common Market in a pure sense still exists. Nevertheless, common decisions crucial for the EC grain economy are made annually by the Council of Agricultural Ministers. So far, the decisions of the Council have been directed mainly toward solving domestic farm problems and have neglected the external effects on the EC's trading partners.

The EC developed from a principal importing region to one of the top three grain exporters. This is not because the number of member countries increased from the original 6 in 1957 (West Germany, France, Italy, the Netherlands, Belgium, and Luxembourg) to 10 in 1982 (Denmark, the United Kingdom, and Ireland joined the Common Market in 1973; Greece followed in 1982). The EC began exporting mainly as a consequence of protectionism. In normal years world market prices for grain are far less than EC prices. As EC grains are competitive on the world market only if export subsidies are paid, some trading partners have asked that the EC grain policy be reoriented. The EC itself might consider the external effects of its policies more in the future than it did in the past because of internal budgetary problems.

Projections of the world grain economy indicate that developing countries will experience growing food deficits. Because of the EC's importance as an exporter of grain, the annual decisions of the EC Council of Agricultural Ministers regarding grain prices, intervention rules, and other determinants of market forces may strongly affect the food situations of developing countries in the decade ahead. Therefore, this paper analyzes several policy options the Council might consider and examines their implications for developing countries.

Chapter 3 presents projections for 1985 and 1990 that assume that the EC grain price policy does not change significantly. Complete liberalization of the EC grain economy is assumed in Chapter 4, and the effects of such a policy on world grain production and prices and on the welfare and foreign exchange of individual developing countries are estimated. The spillover effects on markets for cereal substitutes, meat, and processed grain products are also analyzed.

EC policies that may contribute to instability in grain markets are examined in Chapters 5 and 6. Policy options that involve

only marginal changes from the present policy are explored. It is assumed that the present degree of protection for EC grain producers is determined by domestic political pressure groups and can be changed only slightly. However, even with this protection, options for liberalizing EC grain trade and storage activities are available that will have positive effects on welfare and contribute to stabilizing the world grain market. Policies are recommended that allow not only for higher efficiency in the EC grain economy from the EC's point of view but that also have stabilizing effects on the world market.

Internal and external EC grain trade is affected by monetary and exchange rate policies. Some technical aspects of these policies and their relation to a highly protective agricultural policy in a common market are analyzed in Appendix 1.

The EC experience is that domestic high protectionism stimulates the demand for trade preferences by developing countries. Actually, the EC uses trade preferences to buy goodwill for pursuing protective policies in some markets. The effects of such trade preferences on the grain market are also examined in Appendix 2.

3

THE EC AND THE WORLD GRAIN ECONOMY

The EC, the United States, the Soviet Union, and the People's Republic of China produce about 60 percent of the world's wheat and total grains (Table 1). Although the EC's share of world production has increased but slightly since 1967 when the EC common grain market went into operation, total EC grain exports rose from 6.8 percent of world grain exports in 1967/68 to 10.1 percent in 1980/81 (Table 2).

The impact of the EC grain economy may be much higher than production and export figures indicate. In all but one year since 1968 (Table 3), EC grain prices were far higher than world market prices. This implies that EC exports are only competitive on the world market if EC exporters receive the difference between the two prices. Consequently, changes in production and in EC grain policy may affect world market prices much more than they would in a liberalized grain economy. It is obvious that the developing countries have a vested interest in the prospects of the EC grain economy.

Past Development

The EC grain economy is largely determined by the Common Grain Market Regulation that came into force on July 1, 1967.

Table 1—Shares of world grain production, selected countries, selected years, 1967/68-1981/82

Grain/Country	1967/68	1968/69	1969/70	1973/74	1974/75	1975/76	1979/80	1980/81	1981/82
					(percent)				
Wheat									
European Community[a]	10.6	9.9	10.2	11.1	12.7	10.9	11.0	11.8	11.8
United States	13.8	12.9	12.7	12.5	13.6	16.5	13.8	14.7	16.8
U.S.S.R.	26.1	28.4	25.8	29.5	23.5	18.9	21.4	22.4	19.5
China, People's Republic of	9.4	7.6	8.7	9.4	10.6	11.7	14.8	12.3	12.7
Coarse grains									
European Community[a]	6.7	6.8	6.7	9.6	10.0	9.2	9.1	9.3	8.8
United States	29.5	28.1	28.0	17.9	24.0	28.7	32.2	27.3	32.3
U.S.S.R.	11.2	12.0	12.5	15.1	15.9	10.2	10.9	11.1	10.0
China, People's Republic of	11.7	10.8	10.2	9.5	10.5	10.7	11.2	11.4	10.6
Total grains									
European Community[a]	8.1	8.0	7.9	10.1	11.0	9.8	11.4	10.2	9.9
United States	24.0	22.4	22.7	21.4	20.2	24.4	25.5	22.6	26.6
U.S.S.R.	16.4	18.1	17.1	20.2	18.7	13.3	14.0	14.3	15.5
China, People's Republic of	10.9	9.6	9.7	9.5	10.5	11.0	12.5	11.7	11.4

Sources: U.S. Department of Agriculture, Foreign Agricultural Service, *Foreign Agriculture Circular—Grains*, various issues (Washington, D.C.: USDA, various years); International Wheat Council, *World Wheat Statistics, 1972/1973*; and International Wheat Council, *Review of the World Wheat Situation, 1971/72* (London: International Wheat Council, various years).

[a] The European Community had 6 members between 1967/68 and 1969/70; 9 members between 1973/74 and 1980/82; and 10 members in 1981/82. The 1981/82 figures are projections.

Table 2—Shares of world grain exports, selected countries, selected years, 1967/68-1981/82

Grain/Country	1967/68	1968/69	1969/70	1973/74	1974/75	1975/76	1979/80	1980/81	1981/82
					(percent)				
Wheat									
European Community[a]	7.4	10.0	7.3	8.3	10.8	12.8	12.0	14.9	13.5
United States	40.2	32.1	32.2	52.6	43.3	47.6	43.1	44.8	46.9
Canada	17.9	18.5	18.9	18.1	16.8	18.3	17.4	17.2	17.0
Australia	11.1	14.2	16.1	11.2	13.4	12.9	17.2	11.8	12.0
Coarse grains									
European Community[a]	6.2	7.3	9.0	7.5	6.1	5.8	5.0	5.7	4.1
United States	53.0	44.1	48.6	57.3	56.1	65.8	71.0	69.4	65.8
Canada	2.6	1.6	4.3	3.8	4.9	6.5	4.8	4.4	5.0
Australia	1.2	2.5	3.1	3.5	4.5	4.8	4.1	2.3	2.3
Total grains									
European Community[a]	6.8	8.8	8.0	7.8	8.4	9.1	8.2	10.1	8.6
United States	45.8	37.5	39.4	55.1	49.7	57.3	58.1	57.9	56.8
Canada	11.3	10.9	12.5	10.5	10.9	12.0	9.0	9.4	11.3
Australia	6.8	8.9	10.4	7.1	8.9	8.6	9.0	5.9	7.7

Sources: U.S. Department of Agriculture, Foreign Agricultural Service, *Foreign Agriculture Circular—Grains*, various issues (Washington, D.C.: USDA, various years). The 1967/68-1969/70 European Community figures are from International Wheat Council, *World Wheat Statistics, 1972/1973* (London: International Wheat Council, various years); and International Wheat Council, *Review of the World Wheat Situation, 1971/72* (London: International Wheat Council, various years).

[a] The European Community had 6 members between 1967/68 and 1969/70; 9 members between 1973/74 and 1980/82; and 10 members in 1981/82. The 1981/82 figures are projections.

[b] EC-6 export data for 1967/68-1969/70 from International Wheat Council.

This regulation almost completely disconnected the EC grain economy from the world market for grain. Domestic grain prices are allowed to vary between the target price and the intervention price (Figure 1). Target prices indicate the prices authorities would like to see prevail on the market, but they imply no direct commitment to enforce these preferences by domestic intervention. Intervention prices are minimum wholesale prices and enforced by direct intervention in the market. Target prices can be equivalent to actual market prices only if domestic self-sufficiency is less than 100 percent. If it is less, domestic EC market prices are determined by the offer price of foreign sellers. However, imports are allowed only at threshold prices, which are entry prices set high enough to guarantee target prices in the EC region with the largest grain deficit, which is Duisburg, West Germany. The difference between threshold prices and world market prices at the import harbor with the lowest c.i.f. offer prices by third countries is made up by variable levies. Thus, imports can only enter the EC at threshold prices independent of world market prices. For exports, the difference between domestic prices and world market prices is compensated for by export restitutions.

These three EC grain prices—target, intervention, and threshold—are negotiated annually by the Council of Agricultural Ministers. As there is no well-defined rule for setting prices, the EC grain economy depends heavily on political considerations. This means that EC grain prices are political prices. The political environment seems to have favored EC grain producers in the past. The rate of nominal protection for EC grain is high—in most years, more than 50 percent—and it fluctuates widely (Table 3).

The nominal rate of protection presented in Table 3 has been somewhat overstated for wheat and barley, since the EC became an exporter of these grains. The shift from

Table 3—World market and European Community threshold prices for wheat, barley, and maize, 1968-81

Year	Wheat			Barley			Maize		
	World Market Price[a]	EC Threshold Price	Nominal Rate of Protection	World Market Price[b]	EC Threshold Price	Nominal Rate of Protection	World Market Price[c]	EC Threshold Price	Nominal Rate of Protection
	(U.S. $/metric ton)								
1968	63.10	115.17	0.83	58.4	92.83	0.59	54.7	93.10	0.70
1969	63.40	115.17	0.82	47.8	96.22	1.01	53.8	97.66	0.82
1970	59.76	115.17	0.93	48.1	97.28	1.02	61.5	98.72	0.61
1971	67.36	115.17	0.71	64.2	97.28	0.52	60.0	98.72	0.43
1972	64.79	125.59	0.94	56.6	109.24	0.93	59.2	106.39	0.80
1973	104.37	140.00	0.34	87.9	123.02	0.40	84.5	120.85	0.43
1974	173.23	154.97	-0.11	139.2	137.26	-0.01	138.1	134.68	-0.02
1975	145.92	179.08	0.23	145.1	157.87	0.09	146.5	156.96	0.07
1976	147.84	184.91	0.25	142.4	163.64	0.15	131.6	163.51	0.24
1977	110.19	205.38	0.86	125.8	181.46	0.44	118.4	182.17	0.54
1978	121.27	239.43	0.97	108.3	215.18	0.99	123.0	199.81	0.62
1979	164.90	274.37	0.66	113.0	244.05	1.16	122.6	244.73	1.00
1980	199.15	296.07	0.49	161.3	264.23	0.64	141.6	264.89	0.87
1981	210.63	284.32	0.35	178.6	253.10	0.42	180.8	253.82	0.40

Source: Commission of the European Community. *The Agricultural Situation in the Community*; various issues (Brussels: Commission of the European Community, various years).

Notes: EC stands for European Community. The EC threshold price is the average threshold price of the year corrected by quality differences, taking into account the coefficients of equivalence applied by the EC. The nominal rate of protection is the difference between the EC threshold price and the world market price, divided by the world market price.

[a] c.i.f. Rotterdam, Red Winter.

[b] c.i.f. Rotterdam, USA III.

[c] c.i.f. Rotterdam, USA Yellow Corn III.

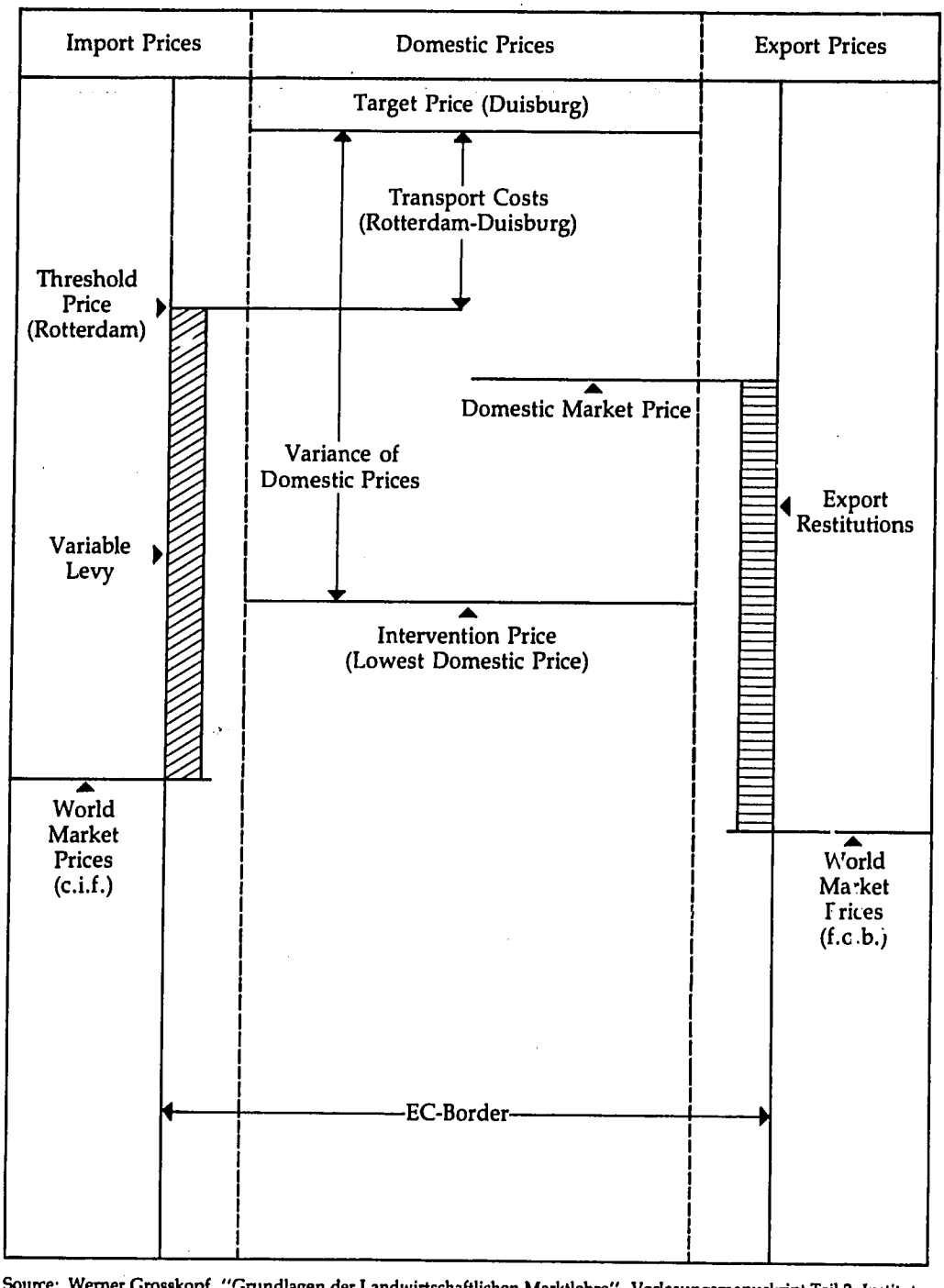
importing to exporting makes a part of the nominal rate of protection redundant. An export situation implies that prices within the EC are about equal to intervention prices, which, however, are considerably less than threshold prices. The price differential was 25.5 percent for wheat and 17.7 percent for barley in 1980/81. Consequently, even if threshold prices were made somewhat lower, there would be no imports, so a part of the official rate of protection is redundant.

Unfortunately, the quantification is not at all straightforward. When the EC imported grain, EC prices were always lowest near the ports where the imports entered the EC. The shift to a surplus has affected the regional price pattern strongly. It may well be that EC prices are highest near the ports, depending on regional supply and demand. Actually, in Italy, which is still a grain-importing country, prices are much higher than intervention prices and about equal to threshold prices. Thus, a lowering of threshold prices for wheat by even 10-20 percent would not make imports competitive in most of the EC outside Italy. Threshold prices for barley could probably be lowered by 10 percent without making imports competitive.

To test the relationship between EC prices (p^E) and world market prices (p^W), regressions were run for soft wheat, barley, and maize, assuming both arithmetic linear and logarithmic linear functional forms. A careful interpretation of this result is needed. Both variables, p^E and p^W, are determined by a trend. Hence, it is not possible to test the functional relationship of the two with such an approach. However, this is not the objective of the test, which was made to determine the statistical relation between the variables over time.

All results indicate that the absolute increase of EC prices was greater than that of world market prices (Table 4). The price differential widened gradually. However, the relative change of EC prices was slightly less than that of world prices. This demon-

Figure 1—The price system of the grain market of the European Community



Source: Werner Grosskopf, "Grundlagen der Landwirtschaftlichen Marktlehre", Vorlesungsmanuskript Teil 2, Institute of Agricultural Economics, University of Göttingen. (Mimeographed, no year.)

Table 4—Regression results for the relationship between European Community threshold prices and world market prices, 1967/68-1980/81

Grain/Function	Constant	Regression Coefficient	$\bar{R}^2$
Soft wheat			
Arithmetic linear	51.548	1.075 (5.55)	0.70
Logarithmic linear	1.954	0.678 (6.19)	0.74
Barley			
Arithmetic linear	41.761	1.116 (4.63)	0.61
Logarithmic linear	1.813	0.699 (5.58)	0.70
Maize			
Arithmetic linear	28.25	1.226 (4.93)	0.64
Logarithmic linear	1.391	0.786 (6.11)	0.74

Sources: The figures for the world market price of wheat are from International Wheat Council, *Review of the World Wheat Situation*, various reports (London: International Wheat Council, various years); the figures for the world market price of barley are from Food and Agriculture Organization of the United Nations, *Trade Yearbook*, various issues (Rome: FAO, various years); the figures for the world market price of maize are from Commission of the European Community, *The Agricultural Situation in the Community*, various issues (Luxembourg: Commission of the European Community, various years).

strates a gradual decrease in the nominal rate of protection.

Due to favorable economic conditions, the growth of EC grain production surpassed expectations. Table 5 shows that projections made in the 1960s and early 1970s generally underestimated production growth and overestimated domestic consumption.

The underestimates of production were due mainly to incorrect projections of yields per hectare. Even though average EC grain yields were considerably higher than world yields before the EC, absolute increases in yields for individual cereals were also much higher, whereas the percentage increases were at least as high (Table 6). However, the increase in average yields varied among the EC member countries.

The overestimation of EC consumption was probably due to an incorrect assumption about the conversion of grain to meat. It was widely taken for granted that the amount of feedgrain needed to produce one unit of a certain meat is fairly stable over time. However, EC grain consumption data do not support this hypothesis.

Figure 2 shows that use of feedgrain increased only marginally if at all, but meat production increased considerably. This is partly explained by increased use of cereal substitutes as feed, especially cassava, which began in the 1970s. Imported cassava and soya have been considered perfect substitutes for grain in a wide range of feedstuffs. Such substitution depends largely on relative prices. According to a World Bank study, cassava prices must be at least 20 percent less than cereal and soybean meal prices to ensure maximum substitution.[1]

The EC experience allows us to draw two important conclusions for developing countries:

First, it may be misleading to predict developing countries' import needs for feedgrain on the basis of their expected meat consumption and production.

Second, the increase in freight rates over the last decade has widened the gap between c.i.f. import prices and f.o.b. export prices for grain. For example, from 1961 to 1965 export prices from Kansas City for No. 2 hard red wheat were about U.S. $70 per ton and freight rates between the East Coast and India were U.S. $11.3 per ton or 16.1 percent.[2] In 1980 the corresponding figures were about U.S. $140 and U.S. $49.7 per ton or 35.5 percent. This indicates that it may well pay to use feedgrain in exporting countries but not in importing countries. Such a pattern

[1] T. James Goering, *Tropical Root Crops and Rural Development*, World Bank Staff Working Paper No. 324 (Washington, D.C.: International Bank for Reconstruction and Development, 1979), p. 4.

[2] International Maize and Wheat Improvement Center, *World Wheat Facts and Trends* (Mexico City: International Maize and Wheat Improvement Center, 1981), p. 10.

Table 5—Projected and actual production, consumption, or trade of the six-member European Community, 1975 and 1980

Variable/Crop	Projection	Actual
	(million metric tons)	
	Sorenson and Hathaway (projections to 1975)	FAO
Production		
Wheat	32.926	32.903
Barley	20.761	17.743
Oats	3.841	6.415
Maize	10.577	14.099
	Blakeslee (projections to 1975)	United Nations
Exports of wheat and rye	2.653	8.350
Imports of other grains, excluding rice	3.150	8.425 8.289[a]
	USDA 1971 (projections to 1980)	United Nations
Production		
Wheat	35.9-36.0	42.5
Coarse grains	44.8-46.9	48.7
Consumption		
Wheat	32.1	31.7
Coarse grains	33.4	
	USDA 1970 (projections to 1980)	USDA
Consumption		
Wheat and rice	27.475-27.834	31.161 (wheat only)
Coarse grains	62.679-64.941	
All grains	90.154-92.775	
	FAO (projections to 1980)	USDA/ Eurostat
Production		
Germany, Federal Republic of		
Wheat	7.520	8.156
Barley	7.585	8.[illegible]
Oats	3.200	2.65[illegible]
Maize	1.300	0.672
France		
Wheat	16.320	23.436
Barley	14.000	11.758
Oats	0.700	1.927
Maize	10.880	9.515
United Kingdom		
Wheat	4.950	8.200

Sources: The Sorenson and Hathaway projections are from Vernon L. Sorenson and Dale E. Hathaway, *The Grain-Livestock Economy and Trade Patterns of the European Economic Community with Projections to 1970 and 1975*, Institute of International Agriculture, Food-Nutrition, and Rural Development (East Lansing, Mich.: Michigan State University, 1968). The FAO data accompanying them are from Food and Agriculture Organization of the United Nations, *Production Yearbook*, various issues (Rome: FAO, various years). The Blakeslee projections are from Leroy L. Blakeslee, Earl O. Heady, and Charles F. Framingham, *World Food Production, Demand, and Trade Aims* (Ames, Iowa: Iowa State University Press, 1973). The United Nations data accompanying them are from United Nations, Department of International Economic and Social Affairs, Statistical Office of the United Nations, *Review of the Agricultural Situation in Europe at the End of 1977* (New York: FAO/ECE, 1978). The USDA 1971 projections are from U.S. Department of Agriculture, Economics, Statistics, and Cooperatives Service, *World Demand Prospects for Grain in 1980, with Emphasis on Trade by the Less Developed Countries*, Foreign Agricultural Economic Report No. 75 (Washington, D.C.: USDA, 1971). The actual UN figures are from United Nations, Department of International Economic and Social Affairs, Statistical Office of the United Nations, *Review of the Agricultural Situation in Europe at the End of 1980* (New York: FAO/ECE, 1981), except for the wheat figure which is from U.S. Department of Agriculture, Foreign Agricultural Service, *Foreign Agriculture Circular—Grains*, FG-4-81 (Washington, D.C.: USDA, January 28, 1981). The USDA projections are from U.S. Department of Agriculture, Economics, Statistics, and Cooperatives Service, *Growth in World Demand for Feed Grains Related to Meat and Livestock Products and Human Consumption of Grain*, Foreign Agricultural Economic Report No. 63 (Washington, D.C.: USDA, July 1970). The USDA wheat figure accompanying them is from U.S. Department of Agriculture, Foreign Agricultural Service, *Foreign Agriculture Circular—Grains*, FG-4-81 (Washington, D.C.: USDA, January 28, 1981). The FAO projections are from Food and Agriculture Organization of the United Nations, *Agricultural Commodity Projections, 1970-1980* (Rome: FAO, 1971). The actual wheat and maize figures are from USDA, Foreign Agricultural Service, *Foreign Agriculture Circular—Grains*, FG-4-81 (Washington, D.C.: USDA, January 28, 1981). The actual barley and oats figures are from Eurostat, *Crop Production*, 2-1981.

Notes: FAO is the Food and Agriculture Organization of the United Nations; USDA is the U.S. Department of Agriculture. The six members of the European Community were Belgium and Luxembourg, France, the Federal Republic of Germany, Italy, and the Netherlands.

[a] This import figure is the difference between consumption and production. The data for this calculation come from FAO food balance sheets.

Table 6—Yields in the world and the nine-member European Community, 1965-67 and 1977-79

Year	Wheat				Barley			
	World	EC	EC Yields as a Percentage of the World's	Variance of Yields Among EC Members	World	EC	EC Yields as a Percentage of the World's	Variance of Yields Among EC Members
	(quintals/hectare)		(percent)		(quintals/hectare)		(percent)	
1965	12.3	29.9	243.1	49.4	15.3	33.2	217.0	52.6
1966	14.2	27.5	194.0	45.8	16.3	31.8	195.0	47.0
1967	13.5	33.2	246.0	48.6	16.5	36.2	219.0	55.1
1977	16.6	51.0	307.0	85.7	18.4	39.8	216.0	55.3
1978	19.0	43.4	228.0	100.1	20.7	41.4	200.0	38.8
1979	17.8	42.3	238.0	79.9	17.6	40.6	231.0	38.1

Year	Maize				Oats			
	World	EC	EC Yields as a Percentage of the World's	Variance of Yields Among EC Members	World	EC	EC Yields as a Percentage of the World's	Variance of Yields Among EC Members
	(quintals/hectare)		(percent)		(quintals/hectare)		(percent)	
1965	22.9	35.7	156.0	44.0	15.5	26.2	169.0	49.3
1966	23.4	40.2	172.0	26.5	16.0	26.7	167.0	52.2
1967	25.0	39.6	158.0	34.1	16.6	30.1	181.0	62.3
1977	29.1	57.4	197.0	164.8	17.3	31.8	184.0	68.0
1978	30.8	57.5	187.0	177.5	18.2	37.5	206.0	83.9
1979	32.7	56.4	172.0	95.9	16.0	34.3	214.0	96.1

Source: Calculations based on data from Food and Agriculture Organization of the United Nations, *Production Yearbook*, various issues (Rome: FAO, various years).

Note: EC stands for European Community.

of feed use can only minimize feeding costs in importing countries if there are adequate supplies of individual ingredients. The return to developing countries would probably be high if they used this knowledge of feed use to their advantage.

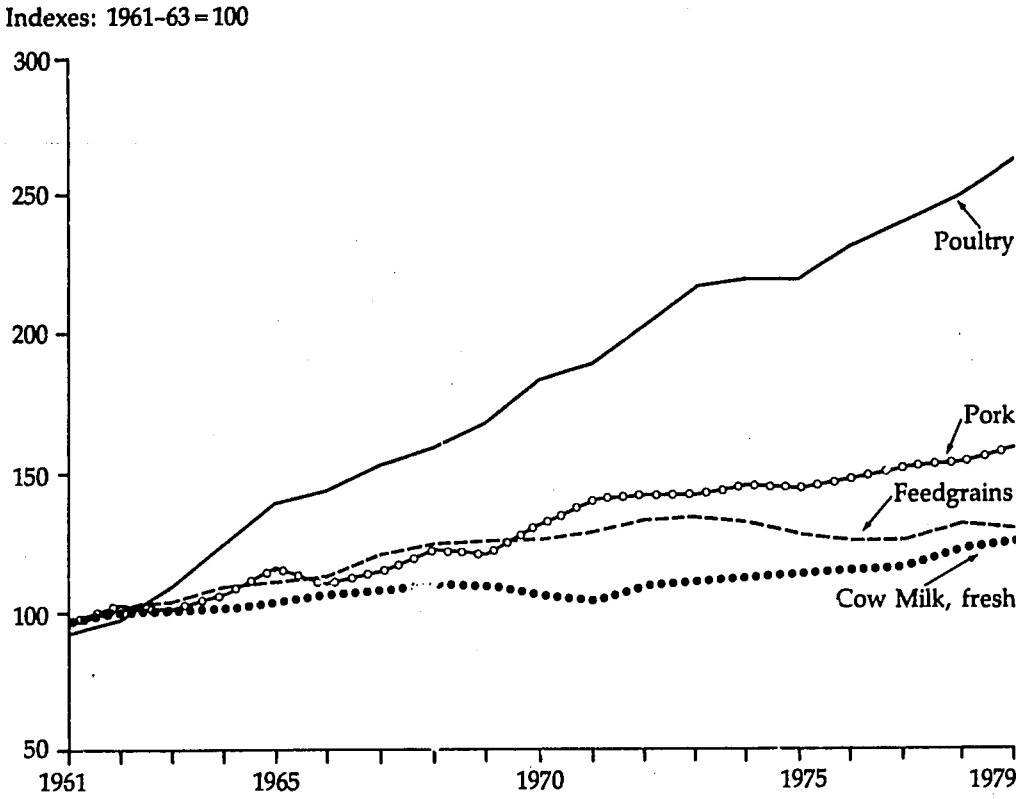
EC Projections for 1985 and 1990

The development of the EC grain economy depends to a large extent on political decisions, particularly concerning grain prices and ratios that are set annually by the Council of Agricultural Ministers. It is the opinion of the author that there is no method for making reasonable predictions of EC grain prices. Josling and Pearson quite correctly assume that the budget constraint of the EC may lead to lower grain prices. Although the budget constraint cannot be denied, the consequences for prices are questionable for several reasons.[3]

First, the EC managed to increase milk prices despite a higher surplus for milk than for grain. By introducing the coresponsibility levy, they at least partly circumvented the

[3] Ulrich Koester, "The Chances for a Thorough Reform of the EC's Common Agricultural Policy," *Intereconomics* (January/February 1981): 7-11.

Figure 2—Production of poultry, pork, cow milk, and use of feedgrains, nine-member European Community, 1961–79



Source: Food and Agriculture Organization of the United Nations, *FAO Production Yearbook* (Rome: FAO, 1979).

budget constraint. The coresponsibility levy was officially described as a producer tax. However, it turned out to be a consumer tax on milk and milk products. The Council agreed on an increase of producer prices. It then introduced the levy, which reduced the price increase for producers but not for consumers. By the virtue of this instrument, the officials found a loophole with which to increase the budget. This game may be played on the grain market as well.

Second, a rational application of the budget constraint would require lower prices for all agricultural products. But grain calculations run with a sector model for Germany show that lower agricultural prices would result in increased grain production because of a shift to less labor-intensive production activities.[4] Such a shift in the supply curve for grain could offset the production effects of an above-average decrease in the price of grain.

Third, it is quite likely that lower agricultural prices result in additional subsidies by individual member countries. At present, national governments spend twice as much on agriculture as the EC.[5] Lower prices may increase the tendency for agricultural policy in the EC to become nationalized. For example, before the last elections the French

[4] Siegfried Bauer, *Quantitative Sektoranalyse als Entscheidungshilfe für die Agrarpolitik. Ein dynamisches Analyse-und Prognosesystem für die Landwirtschaft in der Bundesrepublik Deutschland (DAPS)* (Berlin: Dunker and Humblott, 1979).

[5] Ulrich Koester, "Controlled Nationalization of Agricultural Policy in the EC," *Intereconomics* (March/April 1981): 61-65.

government paid special subsidies to farmers without consulting the EC Commission.

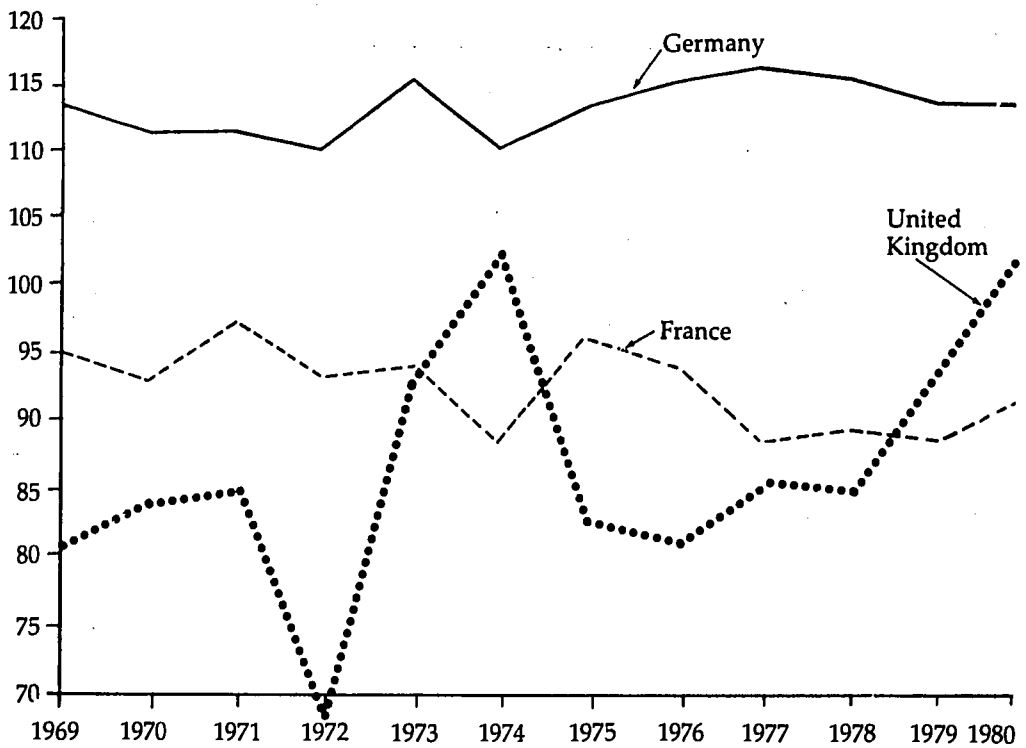
Fourth, a prediction of future EC grain prices would not help much unless national prices could also be predicted. There has always been a significant divergence between national and EC prices due to exchange rate variations and MCAs (Figure 3). A prediction of national prices must be based on a prediction of variations in national exchange rates and MCAs. Such projections have been made by Josling and Pearson.[6] However, if predicted and actual exchange rates are compared for 1982, a divergence of 55 percent appears for the German mark against the U.S. dollar. This clearly indicates that there is no reasonable basis for predicting exchange rates and, hence, national grain prices.

This study applies the same procedure to these problems as other studies that have dealt with EC trend projections. This may be acceptable because the main determinants of production changes in the past seem to have been technological progress and structural changes in agriculture that are not predictable. The procedure assumes that the effect of these variables on production is constant over time.

Projections of grain consumption in the EC should distinguish between grain used for human consumption and that used for

Figure 3 — Development of national wheat prices in selected countries of the European Community, 1969–80

National Price as a Percentage of the European Community Price.



Source: Commission of the European Community, *The Agricultural Situation in the Community*, various issues, (Brussels: Commission of the European Community, various years).

[6] Timothy E. Josling and Scott R. Pearson, *Developments in the Common Agricultural Policy of the European Community*, Foreign Agricultural Economic Report 172 (Washington, D.C.: U.S. Department of Agriculture, 1982).

feed. As indicated above, the procedure of assuming a constant relationship between meat production and use of feedgrain is—at least for the EC—not acceptable. The most important determinant for use of feedgrain seems to be the price ratios between grain and soya and cassava. The fairly high use of soya and cassava in the past was due to relatively high EC grain prices and low tariffs on imports of cassava (6 percent) and soya (10-15 percent). As EC prices of these products are determined mainly by political decisions that are impossible to predict, it has been assumed that past policy will continue.

Trend projections are a reasonable procedure if the main determinants of the endogenous variable are constant over time. This assumption would be realistic only if the variables affecting production and consumption could not be treated separately as if they were determined by the same trend. But they can. Production is determined by area cultivated and yields whereas total consumption is determined by consumption per capita and population. Following this basic idea, projections were made for area, yields, and consumption per capita for individual grains for EC member countries.

In general, the estimates with the most significant fit were for yields and area cultivated. It is assumed that the total area for grain in individual countries may change only slightly over time as it has in the past. The European production pattern is largely determined by the structure of family farms. As labor is a fairly fixed factor in the short and medium term, there is only a slow shift to the labor-extensive grain crop.

The projections for wheat production distinguish between soft and hard (durum) varieties. All other known projections neglect this distinction. However, as Appendix 3, Table 37, shows, yields differ considerably and the allocation of land to soft and durum wheat changes over time.

As pointed out earlier, projections of consumption for individual grains are less reliable than projections of production. Therefore, it is not reasonable to apply a pure trend analysis. Domestic use of grain for feed has not changed continuously as there have been wide price fluctuations for imports of cereal substitutes, especially soya. Consequently, more domestic grain has been used for feed in years when the prices of cereal substitutes have been high. To avoid a bias, years in which consumption was far above average have been excluded from the data base.

Projected production and consumption are presented in aggregate form in Table 7 and on a country basis in Appendix 3, Tables 37-44. Projected data for both the 9 and 10 country EC are given in Table 7 to facilitate comparisons with other studies. The projections indicate that wheat production in 1990 is likely to be 13-14 percent higher than in 1980, even with a decline in cultivated area. The increase of about 1.7 percent per year in average yields of soft wheat for the EC-9 is plausible even with present technology. Variation in yields among farms, regions, and member countries indicates that average yields would be much higher if present technology were applied by all farms.

Most recent projections by other researchers for 1985 exceed those of this study (Table 8). Both the IFO and CLEO studies projected higher increases in yields and a slower decrease in area cultivated with soft wheat.[7] They predict that the EC-9 will produce 50.2 million tons of soft wheat in 1985 compared to the 47.5 million tons projected in this study. The aggregate of soft and durum wheat would be more than 3.1 million tons higher in 1985 if IFO and CLEO's projections hold true. However, the projections of wheat production surpass those prepared by institutions outside the EC. The U.S. Department of Agriculture (USDA) predicted only 42.1-48.6 million tons of EC wheat production in 1985.[8] This low estimate is mainly due to underestimation for the newer EC countries: the United Kingdom, Ireland, and Denmark. USDA predicts production of 5.0-6.2 million tons for the three countries in 1985, but actual production in 1980 was 9.07 million tons. This clearly shows that the USDA model did not adequately account

[7] B. Meinunger and E. Mohr, "Entwicklung des EG-Agrarmarktes, Projektionen bis 1985 und Analyse Alternativer Massnahmen für den Problemmarkt Milch," *IFO-Studien zur Agrarwirtschaft* 17 (München: IFO, 1979); Commission of the European Community, *A Systematic Approach to Agricultural Forecasts 1985, for the European Community of Nine* (Brussels: Commission of the European Community, 1981). The former is known as the IFO report and the latter is the CLEO report.

[8] U.S. Department of Agriculture, Economics, Statistics, and Cooperative Service, *Alternative Futures for World Food in 1985*, vols. 1 and 2, Foreign Agricultural Economic Report No. 149 (Washington, D.C.: USDA, 1978).

Table 7—Grain production, consumption, and net trade for 1980 and projected to 1985 and 1990

Crop	1980		1985		1990	
	EC-9	EC-10	EC-9	EC-10	EC-9	EC-10
			(million metric tons)			
Wheat						
Production	51.9	54.8	52.8	55.3	59.3	61.8
Consumption	40.5	42.3	41.5	43.4	42.6	44.5
Net trade	11.4	12.5	11.3	11.9	16.7	17.3
Barley						
Production	40.3	41.2	48.1	49.7	56.2	58.4
Consumption	35.5	36.7	38.2	39.7	40.9	42.7
Net trade	4.8	4.5	9.1	10.0	15.3	15.7
Oats						
Production	6.1	6.2	6.3	6.3	6.0	6.1
Consumption	6.6	6.7	5.9	6.0	5.4	5.5
Net trade	-0.5	-0.5	0.4	0.3	0.6	0.6
Maize						
Production	16.6	17.9	24.4	25.2	32.0	32.9
Consumption	29.5	31.4	32.9	35.9	36.5	41.2
Net trade	-12.9	-13.5	-8.5	-10.7	-4.5	-8.3
Total grain						
Production	114.9	120.9	131.6	136.5	153.5	159.2
Consumption	112.1	117.1	118.5	125.0	125.4	133.9
Net trade	2.8	3.0	13.1	11.5	28.1	25.3

Sources: Calculations based on data used for Alberto Valdés and Joachim Zietz, *Agricultural Protection in OECD Countries: Its Cost to Less-Developed Countries*, Research Report 21 (Washington, D.C.: International Food Policy Research Institute, 1980).

Notes: EC stands for European Community. The EC-10 includes Greece. Consumption is defined as domestic disappearance; net trade is defined as production minus consumption. Total grain does not include rye and rice.

for the supply response to higher producer prices following the entrance of these countries into the EC.

The World Bank projects EC-9 wheat production to 44.5 million tons in 1985 and 50 million in 1990,[9] whereas FAO projects 44.5-50 million for 1985.[10] Both projections are considerably smaller than those presented in this study, probably because soft and durum wheat were aggregated and the data base was inadequate.

The EC grain economy will continue to be significant for the world food situation (Table 9). The net wheat exports of the EC rose 9.5 million metric tons from 1972-74 to 1980. The wheat deficit of developing countries increased by 13.1 million metric tons during the same period. Hence, the EC covered nearly 60 percent of the increase in the wheat gap. The EC wheat surplus increased considerably more than the wheat deficit of African countries from 1972-74 to 1979/80. By 1985, the EC wheat surplus will be more than 25 percent of the deficit of the developing countries compared with 22 percent in 1979/80.

The EC deficit in coarse grain will disappear by 1985. By increasing production much more than consumption, the EC will make more coarse grain available for the rest of the world.

Few projections are available for the

[9] International Bank for Reconstruction and Development, *Price Prospects for Major Primary Commodities*, Report No. 814/80 (Washington, D.C.: IBRD, January 1980).

[10] Food and Agriculture Organization of the United Nations, *Agricultural Commodity Projections 1975-1985* (Rome: FAO, 1979).

Table 8—Projections of the grain economy of the European Community to 1985

Estimator/EC Group	Year of Estimation	Wheat: Production	Wheat: Consumption	Wheat: Exports	Wheat: Imports
		(1,000 metric tons)			
USDA	1978				
Alternative I					
EC-6		37,195		874	...
United Kingdom, Denmark, and Ireland		5,866		...	4,300
EC-9		43,061	46,487	...	3,426
Alternative IA					
EC-6		38,504		3,142	...
United Kingdom, Denmark, and Ireland		6,238		...	3,498
EC-9		44,742	45,098	...	356
Alternative II					
EC-6		32,810		...	...
United Kingdom, Denmark, and Ireland		5,421		...	5,214
EC-9		38,231	43,445	...	5,214
Alternative III					
EC-6		42,432		7,269	...
United Kingdom, Denmark, and Ireland		6,186		...	3,296
EC-9		48,618	44,645	3,973	
Alternative IV					
EC-6		30,940		...	...
United Kingdom, Denmark, and Ireland		5,010			5,961
EC-9		35,950	41,911	...	5,961
FAO (EC-9)	1979				
Basic projection		46,110	41,050	9,640	4,580
Supplementary projection		46,330	40,440	9,510	3,620
World Bank (EC-9)	1980	44,500	43,100	1,400	...
Uhlmann (EC-9)	1973				
I		48,228	n.a.	n.a.	n.a.
II		51,773	n.a.	n.a.	n.a.
III		52,973	n.a.	n.a.	n.a.
IFO (EC-9)	1979	53,900	38,000	15,900	...
		56,400	40,000	16,400	
CLEC (EC-9)		48,149	39,638	8,511	...

Estimator	Year of Estimation	Coarse Grains: Production	Coarse Grains: Consumption	Coarse Grains: Exports	Coarse Grains: Imports	Total Grain Production	Total Grain Consumption
		(1,000 metric tons)					
USDA	1978						
Alternative I							
EC-6		62,647		...	5,963		
United Kingdom, Denmark, and Ireland		22,734		...	1,463		
EC-9		85,381	92,807	...	7,426		
Alternative IA							
EC-6		64,863		...	2,476		
United Kingdom, Denmark, and Ireland		23,503		314	...		
EC-9		88,366	90,528	...	2,162		

Table 8—Continued

Alternative II							
EC-6		60,187		...	10,114		
United Kingdom, Denmark, and Ireland		22,608		...	2,843		
EC-9		82,795	95,752	...	12,957		
Alternative III							
EC-6		69,157		5,039	...		
United Kingdom, Denmark, and Ireland		92,382	85,377	7,005	...		
Alternative IV							
EC-6		59,775		...	11,041		
United Kingdom, Denmark, and Ireland		23,225		1,966	...		
EC-9		92,382	85,377	7,005	...		
Alternative IV							
EC-6		59,775		...	11,041		
United Kingdom, Denmark, and Ireland		22,279		...	3,562		
EC-9		82,034	96,637	...	14,603		
FAO (EC-9)	1979						
Basic projection		67,260	81,950	7,350	22,040		
Supplementary projection		70,680	83,100	9,110	21,530		
World Bank (EC-9)	1980	n.a.	79,500	...	25,000		
Uhlmann (EC-9)	1973						
I						130,402	
II		n.a.	82,214	n.a.	n.a.	125,127	125,427
III						134,305	
IFO (EC-9)	1979	n.a.	n.a.	n.a.	n.a.		122,000
						133,135	126,000
CLEO (EC-9)		n.a.	n.a.	n.a.	n.a.	133,584	128,432

Sources: The USDA figures are from U.S. Department of Agriculture, Economics, Statistics, and Cooperatives Service, *Alternative Futures for World Food in 1985*, vols. 1 and 2, Foreign Agricultural Economic Report No. 149 (Washington, D.C.: USDA, 1978): the FAO figures are from Food and Agriculture Organization of the United Nations, *Agricultural Commodity Projections 1975-1985* (Rome: FAO, 1979); the World Bank figures are from International Bank for Reconstruction and Development, *Price Prospects for Major Primary Commodities*, Report No. 814/80 (Washington, D.C.: IBRD, 1980); the Uhlmann figures are from F. Uhlmann, "Getreideerzeugung und-verbrauch in einer erweiterten EWG—Vorschatzung bis 1985" (Arbeitsunterlagen 1973 Nr. 1, Instituts für Landwirtschaftliche Marktforschung der Forschungsanstalt für Landwirtschaft, Braunschweig-Volkenrode, 1973); the IFO figures are from B. Meinunger and E. Mohr, "Entwicklung des EG-Agrarmarktes, Projektion bis 1985 und Analyse alternativer Massnahmen für den Problemmarkt Milch," *IFO-Studien zur Agrarwirtschaft* 17 (München: IFO, 1979); and the CLEO figures are quoted in the IFO report and are from Commission of the European Community, *A Systematic Approach to Agricultural Forecasts, 1985, for the European Community of Nine* (Luxembourg: Commission of the European Community, 1981).

Notes: USDA stands for the U.S. Department of Agriculture; EC for the European Community; and FAO for the Food and Agriculture Organization of the United Nations. Where n.a. appears, the figure was not available.

Table 9—Trade balance of grain, selected regions, 1972-74, 1979/80, and 1985

Region/Grain	1972-74	1979/80	1985	Change 1972-74 – 1985
		(million metric tons)		
European Community				
Wheat	+2.4	+9.9	+11.3	+9.5
Coarse grains	-10.5	-8.8	+1.8	+12.3
Africa				
Wheat	-4.1	-7.8	-6.4 to -8.4	-2.3 to -4.3
Coarse grains	-1.8	-2.7	-5.9 to -7.8	-4.1 to -6.0
Developing countries				
Wheat	-32.7	-45.8	-26.1 to -44.1	-6.6 to -11.4
Coarse grains	-0.6	-15.7	-58.8 to -63.6	-58.2 to -63.0

Sources: The European Community wheat and coarse grains figures for 1979/80 are from data used for Alberto Valdés and Joachim Zietz, *Agricultural Protection in OECD Countries: Its Cost to Less-Developed Countries*, Research Report 21 (Washington, D.C.: International Food Policy Research Institute, 1980); the European Community wheat and coarse grains figures for 1985 are projections based on the same data. The wheat and coarse grains figures for Africa and for developing countries are from Food and Agriculture Organization of the United Nations, *Agricultural Commodity Projections 1975-1985* (Rome: FAO, 1979), and Food and Agriculture Organization of the United Nations, *Commodity Review and Outlook: 1980-81* (Rome: FAO, 1981).

Notes: This trade balance is production minus consumption; positive figures indicate exports; negative figures stand for imports.

world grain situation in 1990. Paulino projects a severe increase in the grain deficit of developing countries by 1990.[11] An increase in the EC grain surplus from 2.8 million metric tons in 1980 to 28 million metric tons in 1990 would exceed the deficit of Sub-Saharan Africa, but would be less than that of all African countries.

[11] Leonardo Paulino, "A General View of the World Food Situation," in *Food Situation and Potential in the Asian and Pacific Region* (Taipei: Food and Fertilizer Technology Center, June 1980); reprinted by the International Food Policy Research Institute.

4

LIBERALIZING THE EC GRAIN ECONOMY

Effects on the World Market

Complete removal of EC trade barriers for grain would have a decided impact on prices, production, and trade of both the EC and developing countries, according to calculations made in this study. Such an action would also affect product markets closely connected to the grain market, especially cereal substitutes such as cassava and soybeans, and pork, poultry, wheat flour, and other processed grain products.

The model and data bases used to evaluate the effects of complete liberalization are the same as those presented by Valdés and Zietz.[12] They, however, assumed a 50 percent reduction in trade barriers by OECD countries.

As in the report by Valdés and Zietz, a domestic supply and demand elasticity of 0.4 is assumed for all countries except the EC and the four major exporters—the United States, Canada, Australia, and Argentina. A supply elasticity of 1 and a demand elasticity of 0.2 is assumed for all of these countries, except Argentina, for which the demand elasticity is assumed to be 0.4. This modification seems reasonable because Valdés and Zietz investigated a liberalization of trade for all products, whereas this study deals only with EC grain markets. Liberalization of a few products would affect price ratios among products much more than an across-the-board liberalization because supply and demand responses would be more intense. The assumption of a unitary supply elasticity agrees with a recent study about the supply reaction of farmers in the EC, which found long-run elasticities of about 1 for all EC countries.[13]

World market prices for millet and sorghum would be affected only slightly by EC grain trade liberalization, as the EC is not a significant producer or consumer of those crops (Table 10). World market prices for oats and barley would go up the most—19.7 and 14.3 percent. Maize prices would increase only 2.2 percent and wheat prices, about 9.6 percent.[14]

The price changes in world markets would affect world grain trade significantly. In general, lower EC prices and higher world prices would lead to more intensive integration of the EC and world grain economies, and a marked increase in total grain trade. The export volume for oats would be up 153.3 percent; for barley, 59.7 percent; for rye, 23.4 percent; and for wheat, 18.6 percent (Table 10). Export volumes of maize, millet, and sorghum would change only slightly in line with the small price changes.

There would be significant changes in interregional grain trade with EC grain trade liberalization (Table 11 and Appendix 3, Table 45). Imports of developed countries would drop nearly 1 million metric tons or 4.2 percent, while those of developing countries would fall 6.8 million metric tons or 19.8 percent. Exports of low-income Asian countries would increase about 15,000 metric tons. Hence, the change in the grain deficit would be nearly the same as the change in imports. This implies a 39.5 percent reduction in the grain deficit for this area. The imports of high-income North African and Middle Eastern countries would decrease by 1.6 million metric tons, which would be only marginally compensated for by an increase of 261,000 metric tons in exports. Consequently, the grain deficit of these countries would drop by 1.9 million metric tons, or 32

[12] Alberto Valdés and Joachim Zietz, *Agricultural Protection in OECD Countries: Its Cost to Less-Developed Countries*, Research Report 21 (Washington, D.C.: International Food Policy Research Institute, 1980).

[13] J. Marc Boussard, "The Elasticity of the Supply of Agricultural Products in Relation to Their Price: Estimation by Factor Shares in Some EEC Countries," Washington, D.C., 1981. (Mimeographed.)

[14] Alexander H. Sarris and J. Freebairn, "Endogenous Price Policies and Their Impact on the Level and Variability of International Commodity Prices," paper presented at the Agricultural Trade Consortium Meeting in Berkeley, Cal., December 1981. The authors estimate a 9.1 percent increase in wheat world market prices with a somewhat different set of elasticities.

Table 10—Effects on world grain markets of removing European Community tariffs on grain

Grain	1975-77			After Tariffs Removed			Change		
	Export Volume	World Market Price	Export Value	Export Volume	World Market Price	Export Value	Export Volume	World Market Price	Export Value
	(1,000 metric tons)	(U.S. $/ metric ton)	(U.S. $ million)	(1,000 metric tons)	(U.S. $/ metric ton)	(U.S. $ million)		(percent)	
Wheat	52,987	167	8,848.83	62,847	183	11,752.39	18.6	9.6	32.8
Barley (unmilled)	1,149	154	1,193.35	12,373	176	2,177.65	59.7	14.3	82.5
Maize (unmilled)	51,019	138	7,040.62	55,401	141	7,811.50	8.6	2.2	10.9
Rye	368	146	53.73	454	159	72.19	23.4	8.9	34.4
Oats (unmilled)	1,140	137	156.18	2,888	164	473.63	153.3	19.7	203.3
Millet	278	182	50.60	281	183	51.42	1.1	0.5	1.6
Sorghum	10,442	124	1,294.81	10,604	124	1,314.90	1.6	0.6	1.6

Sources: Calculations based on data used for Alberto Valdés and Joachim Zietz, *Agricultural Protection in OECD Countries: Its Cost to Less-Developed Countries*, Research Report 21 (Washington, D.C.: International Food Policy Research Institute, 1980).

Table 11—Effects of a reduction of European Community tariffs on world trade in grain

Region	Change in Imports		Change in Exports	
	Absolute	Relative	Absolute	Relative
	(1,000 metric tons)	(percent)	(1,000 metric tons)	(percent)
Developed countries	-986.19	-4.2	17,506.69	17.2
Developing countries	-6,828.49	-19.8	1,889.13	12.4
Sub-Saharan Africa				
Low income	-93.41	-9.9	24.77	13.8
High income	-65.24	-5.4	1.80	20.0
Asia				
Low income	-3,157.62	-39.1	15.53	50.1
High income	-386.31	-7.9	22.92	1.1
North Africa/Middle East				
Low income	-373.26	-11.2	3.63	5.3
High income	-1,640.63	-26.9	261.39	130.7
Latin America				
Low income	-4.11	-4.9		
High income	-1,105.90	-11.1	1,764.01	14.0

Sources: Calculations based on data used for Alberto Valdés and Joachim Zietz, *Agricultural Protection in OECD Countries: Its Cost to Less-Developed Countries*, Research Report 21 (Washington, D.C.: International Food Policy Research Institute, 1980).

Note: A positive sign indicates an increase; a negative sign indicates a decrease.

percent. Only high-income Latin American countries that lacked a grain export surplus in the base period (1975-77) would increase their exports much more than they would reduce their imports. Their grain surplus would go up by about 2.9 million metric tons, or 109 percent.

Appendix Tables 46-48 show the quantitative effects of EC tariff reductions for individual types of grain. Developing countries would be most affected by changes in the wheat market due to the greater changes in the price of this cereal.

Total grain production might drop by about 1 percent, with lower EC production offsetting increases in other countries that would result from higher prices (Table 12). Most of the drop would be in barley since the EC produces about 25 percent of the world total, compared to only 12 percent of wheat and 5 percent of maize. Higher world market prices for grain would also significantly affect the foreign exchange and the welfare of individual regions and countries (Table 13). Welfare effects would be negative for countries and regions that imported in the base period and would continue to be so with higher prices. Only countries and regions that had a grain surplus in the base period would definitely gain in welfare. The welfare effect on countries that imported in the base period but would export with higher world market prices would depend on the size of the deficits and surpluses.

Foreign exchange effects of EC liberalization would be positive for most countries, including importers who had more than 0.43 self-sufficiency for cereals in the base period. Given domestic supply and demand elasticities of 0.4, a degree of self-sufficiency of 0.43 results in an import demand elasticity of −1. Hence, import expenditures for cereals would go down for most developing countries. These countries as a group would have an increase of about U.S. $1.2 billion in their foreign exchange.

Changes in welfare would be significant in only a few countries (Table 13). Together, developing countries would lose 0.4 percent of GNP, and developed countries would gain 0.02 percent. The most significant negative changes would occur in Bangladesh, −1.2 percent of GNP; Egypt, −0.3 percent; Morocco, −0.2 percent; Yemen, −0.17 percent; Mali, −0.12 percent; and Argentina, −0.17 percent. Among developed countries, changes in welfare would be most significant for Australia and Canada.

Effects of Grain Trade Liberalization on Other Products

Because of the close relationships among prices of grain and other agricultural products, the effects of a given level of protection in the grain market are widespread. These effects would occur even if the EC set up special market organizations for grain-related products and took the price relationships among products into account.

The production costs of pork, eggs, poultry, and processed grain products, for example, depend to a great extent on prices

Table 12—Changes in grain production caused by a liberalization of grain trade by the European Community

Grain	European Community Production	Production of Major Exporters	Production in the Rest of the World	Total
		(percent)		
Wheat	−40.0	9.0	3.6	−0.02
Maize	−40.0	2.0	0.8	−0.00
Barley	−36.8	14.3	0.6	−3.30
Wheat, maize, and barley	−38.8	6.3	2.5	−0.90

Sources: Calculations based on data used for Alberto Valdés and Joachim Zietz, *Agricultural Protection in OECD Countries: Its Cost to Less-Developed Countries*, Research Report 21 (Washington, D.C.: International Food Policy Research Institute, 1980).

Table 13—Effects of a liberalization of European Community grain trade on the foreign exchange and welfare of other countries

Countries	Change in Foreign Exchange	Change in Welfare	Change in Welfare as a Percentage of GNP
	(U.S. $1,000)		
Developed countries	3,978,828	747,765	0.02
Australia	480,321	186,421	0.18
Austria	18,179	-225,808	-0.47
Canada	1,051,039	311,645	0.16
Japan	-63,626	-137,765	-0.02
New Zealand	16,150	554	0.00
Norway	14,812	-5,525	-0.02
Sweden	115,026	27,645	0.04
Switzerland	1,722	-20,823	-0.03
United States	2,345,204	611,421	0.03
Developing countries	1,187,114	-362,696	-0.04
Sub-Saharan Africa			
Low income	10,422	-7,813	-0.03
Angola	-36	-1,670	-0.08
Cameroon	-269	-578	-0.02
Guinea	204	-20	0.00
Kenya	6,334	117	0.00
Madagascar	31	3	0.00
Malawi	357	-35	0.00
Mali	288	-14	0.00
Mozambique	618	-1,857	-0.12
Niger	307	-58	-0.01
Ruanda	17	-57	-0.01
Tanzania	2,658	-963	-0.03
Uganda	212	-136	0.00
Upper Volta	59	-209	-0.03
Zaire	210	-2,336	-0.07
High income	-4,916	-16,140	-0.03
Ghana	-176	-1,721	-0.04
Ivory Coast	-644	-1,682	-0.03
Nigeria	-3,013	-9,467	-0.03
Senegal	-676	-1,729	-0.08
Zambia	-406	-1,541	-0.06
Asia			
Low income	462,466	-165,348	-0.10
Bangladesh	-3,423	-91,416	-1.20
Burma	124	12	0.00
India	347,602	-51,604	-0.05
Indonesia	6,023	-13,122	-0.03
Nepal	97	10	0.00
Pakistan	124,702	-7,756	-0.05
Sri Lanka	-614	-1,471	-0.05
High income	19,682	-47,740	-0.05
Hong Kong	-1,182	-2,511	-0.02
Philippines	-2,161	-10,252	-0.05
South Korea	17,767	-32,768	-0.12
Malaysia	-3,024	-6,618	-0.06
Thailand	8,282	4,410	0.02
North Africa/Middle East			
Low income	21,481	-42,298	-0.20
Afghanistan	2,551	-141	-0.01
Egypt	15,859	-36,799	-0.31
Sudan	3,685	-2,261	-0.05
Yemen	-615	-3,097	-0.17
High income	264,606	-68,078	-0.03
Algeria	20,070	-20,071	-0.11
Iran	112,422	-16,694	-0.02
Iraq	22,290	-9,172	-0.05
Morocco	23,673	-20,332	-0.21
Saudi Arabia	1,133	-1,512	0.00

Table 13—Continued

Syria	25,570	-1,087	-0.02
Tunisia	14,767	-5,251	-0.10
Turkey	44,740	6,041	0.01
Latin America			
Low income	-514	-1,219	-0.11
Haiti	-514	-1,219	-0.11
High income	413,826	-14,059	0.00
Argentina	279,969	78,945	0.17
Bolivia	224	-1,400	-0.04
Brazil	61,476	-35,408	-0.02
Chile	15,297	-10,467	-0.09
Colombia	1,735	-6,524	-0.04
Dominican Republic	-1,044	-2,353	-0.06
Ecuador	628	-3,444	-0.06
El Salvador	-261	-1,229	-0.05
Guatemala	1,469	-1,221	-0.02
Mexico	56,215	-6,740	-0.01
Peru	2,261	-11,707	-0.08
Venezuela	-4,142	-12,507	-0.04
World without the European Community	...	385,069	0.01

Sources: Landwirtschaftskammer Schleswig-Holstein. *Erzeugergemeinschaften, Beratungs—und Kontrollmengen für Schweine in Schleswig-Holstein, Stand, Ergebnisse, Auswertungen*, various issues. (Kiel: Landwirtschaftskammer Schleswig-Holstein, various years); Bundesministerium für Ernährung, Landwirtschaft und Forsten, *Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten*, various issues (Frankfurt: Bundesministerium für Ernährung, Landwirtschaft und Forsten, various years).

Notes: ECU stands for European Currency Unit. The regulation giving preference to Moroccan hard wheat was number 1520 in 1976; the one giving preference to Turkish grain was number 1180 in 1977. The ACP countries were given preferences in regulation 706 of 1976 and regulation 435 of 1980. Finally, the preferences for grain from Tunisia and Algeria were established by regulations 1513, 1519, and 1526 of 1976 and 1251 of 1977.

[a] The ACPs are the countries of Africa, the Caribbean, and the Pacific that signed the Lomé Convention.

for grain. Hence, these markets also must be protected if domestic producers are to compete with foreign suppliers. Consequently, the EC has set up market organizations for pork, eggs, and poultry. These organizations would be neutral to the competitiveness of domestic producers only if the differences in feeding costs for domestic and foreign producers were compensated for. In the following, the pork market organization, which is analogous to that for poultry and eggs, is examined to determine whether distortion in production, consumption, and trade has occurred. The relationship between EC and third-country pork prices, which is determined by the EC border regulations, has been analyzed. These regulations are in principle comparable to the variable levy system applied in the grain market. However, they are much more sophisticated as there is no world market for pork. Because an acceptable world market price for pork is not available, a hypothetical "world offer price" has been calculated. This price is increased by an amount equivalent to two or three times the levy to make it equal the EC entry price, which is the price for foreign suppliers. The calculation is as follows.

The basic assumptions are that 5.46 kilograms of cereals are needed to produce 1 kilogram of pork;[15] the additional costs for protein equal 15 percent of the grain costs; and the other costs are a constant, Z. Hence, the third-country offer price is assumed to be:

$$p_0^W = 5.46\, p_G^W + 0.15\, p_G^W + Z, \qquad (1)$$

[15] See Manfred Köhne, *Getreidepreis, Einkommens-oder Kostenfaktor für die Landwirtschaft?* (Bonn: MFI Schriftenreihe, 1978), p. 40.

where

p_G^W = the world market price for grain (a 1 kilogram grain basket contains 0.4 kilogram of barley, 0.35 kilogram of maize, and 0.25 kilogram of oats), and

p_0^W = the hypothetical offer price for pork.

The EC entry price is equal to the offer price plus the levy. The levy consists of at least two components: the variable levy and a percentage markup (preferential bonus).

To calculate the variable levy it is assumed that 4.2 kilograms of grain are needed to produce 1 kilogram of pork, so that

$$R = (p_G^E - p_G^W)\ 4.2\,, \qquad (2)$$

where

R = the variable levy,

p_G^E = the EC price for grain (a 1 kilogram grain basket contains: 0.4 kilogram of barley, 0.2 kilogram of corn, 0.1 kilogram of oats, 0.2 kilogram of rye, and 0.1 kilogram of sorghum),

p_G^W = the world market price for grain (a 1 kilogram grain basket contains: 0.4 kilogram barley, 0.2 kilogram of corn, 0.1 kilogram of oats, 0.2 kilogram of rye, and 0.1 kilogram of sorghum).

To calculate the preferential bonus, the levy is increased by 7 percent of the third country's offer price in order to give domestic pork producers an additional preference. Hence, the EC entry price for pork is:

$$\begin{aligned} p^{EW} = {} & 5.46\ p_G^W + 0.15\ p_G^W + Z \\ & + 4.2(p_G^E - p_G^W) \\ & + 0.07(5.46\ p_G^W + 0.15\ p_G^W + Z) \qquad (3) \end{aligned}$$

or

$$p^{EW} = 6\,p_G^W + 1.07\,Z + 4.2(p_G^E - p_G^W). \qquad (4)$$

Lastly, an additional levy will be imposed on imports of pork if the actual offer price is lower than the hypothetical offer price.

Equation (4) clearly shows that the competing price for pork of third countries does not only depend on the differential of grain prices in the EC and on the world market, but also on the coefficients that are supposed to correspond to grain; that is, the grain/pork ratio. It holds that the higher the grain price, the higher the entry price. The EC assumes a grain/pork ratio that is unrealistically high. This leads to additional protection of EC pork producers. It is not realistic to assume that EC producers need 4.2 kilograms of grain to produce 1 kilogram of pork. Actual use of grain is much lower, about 3.4-3.5 (Table 14). This difference accounts for an effective rate of protection of about 20 percent. The formula for calculating the developing-country offer price and the levy is based on the assumption that pork is solely produced on the basis of grain. This might be true for countries outside the EC, but it definitely is not true for the EC. Because prices have been high for grain and low for soya and cassava, the latter have been substituted. The actual share of grain in pork feed for selected regions is also given in Table 14. This gives rise to additional protection of nearly 100 percent for EC pork producers.

It has been noted that it is impossible for a market organization for pork to be completely neutral about competitiveness. This is true mainly because under the regulations one must assume that specified quantities of individual inputs are used to produce pork and that the composition of inputs is dependent on prices and, therefore, varies. These shortcomings become more evident when the protection of the EC grain economy is quite high.

The market mechanism just described also works for exports. In this case, an export restitution has to be paid. The amount of the restitution is calculated in the same way as the levy. This may help to explain why EC exporters may be very competitive on the world market, as they have been for poultry and more recently for eggs (see Table 15).

Liberalization of the EC grain economy would imply deregulation of the pork and poultry markets and would significantly change trade flows for these products. The EC, which is now self-sufficient in these products, would probably become a significant importer. This would give other countries a chance to increase production of these products.

The EC share of world wheat flour exports has been rising and reached 64 percent in

Table 14—Feed-meat ratios in pork production, 1968/69-1980/81, and the share of grain in pork and poultry compound feed, Schleswig-Holstein, 1955/56-1980/81

Year	Feed Per Kilogram of Meat	Share of Grain in Feed
	(kilograms)	(percent)
1955/56		56.7
1960/61		52.5
1968/69	3.52	
1969/70	3.44	
1970/71	3.52	51.9
1971/72	3.47	
1972/73	3.53	54.6
1973/74	3.50	56.4
1974/75	3.51	53.9
1975/76	3.48	52.3
1976/77	3.46	52.3
1977/78	3.51	49.6
1978/79	3.48	51.8
1979/80	3.46	53.1
1980/81	3.44	54.2

Sources: Landwirtschaftskammer Schleswig-Holstein. *Erzeugergemeinschaften, Beratungs—und Kontrollmengen fur Schweine in Schleswig-Holstein. Stand, Ergebnisse, Auswertungen*, various issues. (Kiel: Landwirtschaftskammer Schleswig-Holstein, various years); Bundesministerium für Ernährung, Landwirtschaft und Forsten, *Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten*, various issues (Frankfurt: Bundesministerium für Ernährung, Landwirtschaft und Forsten, various years).

1979/80 (Table 16). But its share of wheat exports (including wheat flour) was only about 14.5 percent in 1980/81 and 1981/82. This illustrates the effect of misspecified grain input coefficients on trade flows of processed grain products. Both wheat and flour are sold on the world market with payments of export restitutions. Those for wheat flour assume a conversion factor that indicates how much wheat is needed to produce 1 ton of wheat flour. These coefficients change as new wheat varieties are introduced and technological changes in the milling industry are made. However, the EC Commission does not have adequate information to adjust the coefficients accurately, so fixed coefficients are applied.

Table 15—Exports of poultry and eggs, 1973-80

Year	Poultry	Eggs in Shell
	(1,000 metric tons)	
1973	144	40
1974	154	31
1975	136	45
1976	182	37
1977	225	43
1978	190	56
1979	253	66
1980	336	75

Sources: European Community, *Yearbook of Agricultural Statistics* (Luxembourg: Statistical Office of the European Community, various years). The 1980 figures are from H. E. Buckholz et al., "Die Landwirtshaftlichen Märkte an der Jahreswende 1981/82." *Agrarwirtschaft* 30 (No. 12, 1981): 353-416.

Note: Poultry is given in carcass weight, including trimmed fat.

This implies that it is more favorable for private EC exporters to export wheat flour than wheat.

As the above example shows, protection for grain also protects products processed from it. And the EC protects the grain-processing industries as well. There are two levies for imports of processed grain products: a variable levy to compensate for the difference between EC and world market prices for grain and a fixed levy to protect EC processing industries. These can lead to a high degree of effective protection. Hence, liberalizing the EC grain economy also suggests abolishing these levies. This would decrease the profitability of processing industries in the EC, which implies a higher profitability for those in the rest of the world. As a consequence, industries might be relocated to developing countries.

High protection for the EC grain economy has helped to create a new international market for cassava and to develop other markets for products that substitute for cereals used in feed (Table 17). Imports of cassava, bran, citrus pellets, molasses, and corn germ totaled 6.5 million metric tons in 1975 and 13.5 million in 1981.[16] The EC market organizations were designed to improve farmers' income and, possibly, to

[16] See Toepfer International, *Marktbericht* (Hamburg: Toepfer International, December 10, 1981).

Table 16—World wheat flour exports (commercial and aid) by country, selected years, 1965/66-1980/81

Country	1965/66	1970/71	1975/76	1978/79	1979/80[a]	1980/81
	(1,000 metric tons of wheat equivalent)					
United States	2,431	1,408	951	1,464	1,486	1,654
European Community[b]	1,511	1,995	2,911	3,284	4,125	2,466[c]
Australia	577	418	302	111	97	130
Canada	1,157	685	900	825	692	360
Other	136	554	122	6	51	161
Total	5,792	5,060	5,186	5,690	6,451	4,533

Source: International Wheat Council, "Record of Operations," (1959/60 and 1965/66 are on an August/July crop year; thereafter data are on a July/June crop year), quoted in U.S. Department of Agriculture, Foreign Agricultural Service, *Foreign Agriculture Circular—Grains*, FG-45-81 (Washington, D.C.: USDA, December 11, 1981), p. 42.

Note: The years are from July to June, except 1965/66, which is from August to July, and 1980/81, which is from July to May.

[a] These figures, except those for Canada, include durum flour.

[b] The Community contained six countries until February 1973 and nine thereafter.

[c] European Community data are available only through January 1981; they include Greece, beginning on January 1, 1981.

increase the security of domestic food supplies; therefore, they were established only for products produced within the EC. The founders did not consider that domestic users might switch to products that are not grown in the EC but are perfect substitutes for cereals.

Calculations to clarify the substitutability of cereals, cassava, soya, and corn gluten feed are presented below.[17]

The nutrients in selected products, as calculated by Köhne, are presented in Table 18. The amount of cassava and soya that substitutes perfectly for maize in pork pro-

Table 17—Imports of selected cereal substitutes into the European Community, by country of origin, 1973-81

Substitute/ Country	1973	1974	1975	1976	1977	1978	1979	1980	1981
	(1,000 metric tons)								
Tapioca	1,433	2,073	2,222	2,984	3,801	5,976	5,375	4,866	6,000
Thailand	1,281	1,739	1,873	2,786	3,639	5,668	4,529	4,116	
Indonesia	87	260	314	179	144	219	694	372	
China, People's Republic of	0	4	4	7	1	1	51	336	
Corn gluten feed	837	694	930	1,147	1,486	1,685	2,021	2,596	
United States	754	619	861	1,052	1,365	1,567	1,916	2,476	
Soybean meal	2,888	3,264	3,321	4,240	4,130	5,918	6,153	7,175	
United States	2,160	2,498	2,013	2,268	1,543	2,674	2,610	3,618	
Brazil	658	666	1,149	1,702	2,225	2,768	3,155	3,226	

Sources: European Community, *Analytical Tables of Foreign Trade*, vol. A (Luxembourg: Statistical Office of the European Communities, various years): chapters 1-24. The 1981 figure is from Toepfer International, *Marktbericht* (Hamburg: Toepfer International, December 10, 1981).

[17] See Manfred Köhne, *Getreidepreis, Einkommens-oder Kostenfaktor für die Landwirtschaft?* (Bonn: MFI Schriftenreihe, 1978), p. 40.

Table 18—Nutrients of selected feedstuffs

Product/ Feedstuff	Digestible Protein	Total Nutrients
	(percent)	
Pork		
Maize	7.5	80.0
Barley	8.0	71.0
Soya (bruised grain)	39.5	72.0
Cassava pellets	0.3	74.0
Beef		
Barley	8.0	72.0
Soya (bruised grain)	42.0	70.0
Corn gluten feed	21.0	66.0

Source: Manfred Köhne, *Getreidepreis, Einkommens— oder Kostenfaktor für die Landwirtschaft?* (Bonn: MFI Schriftenreihe, 1978), p. 39.

Note: The protein used to produce pork is raw protein.

duction can be found by solving the following two equations (it is assumed that 1 ton of maize contains 75 kilograms of digestible protein and 800 kilograms of total nutrients):

$$3\ X_1 + 395\ X_2 = 75;\ \text{and} \qquad (5)$$

$$740\ X_1 + 720\ X_2 = 800; \qquad (6)$$

where

X_1 = the quantity of cassava needed in order to substitute for 1 metric ton of maize, and

X_2 = the quantity of soya needed in order to substitute for 1 metric ton of maize.

Based on the data given in Table 18:

X_1 = 0.9 metric ton; and

X_2 = 0.18 metric ton.

Hence, 0.9 metric ton of cassava and 0.18 metric ton of soya are needed to compensate for 1 metric ton of maize. Consequently, 1 metric ton of cassava substitutes for 1.11 metric tons of maize. Table 19 presents the substitution values for this and other analogous calculations.

Table 19—Rates of substitution of cereal substitutes

Product/ Original Feed	Substitutes and Rates of Substitution	
	(metric tons/metric ton of original feed)	
Pork		
	Cassava	Soya
Maize	0.90	0.18
Barley	0.77	0.20
	Maize	
Cassava	1.11	0.20
	Barley	
Cassava	1.30	0.26
Beef		
	Corn gluten feed	
Barley	1.90	0.76
	Barley	
Corn gluten feed	0.53	0.40

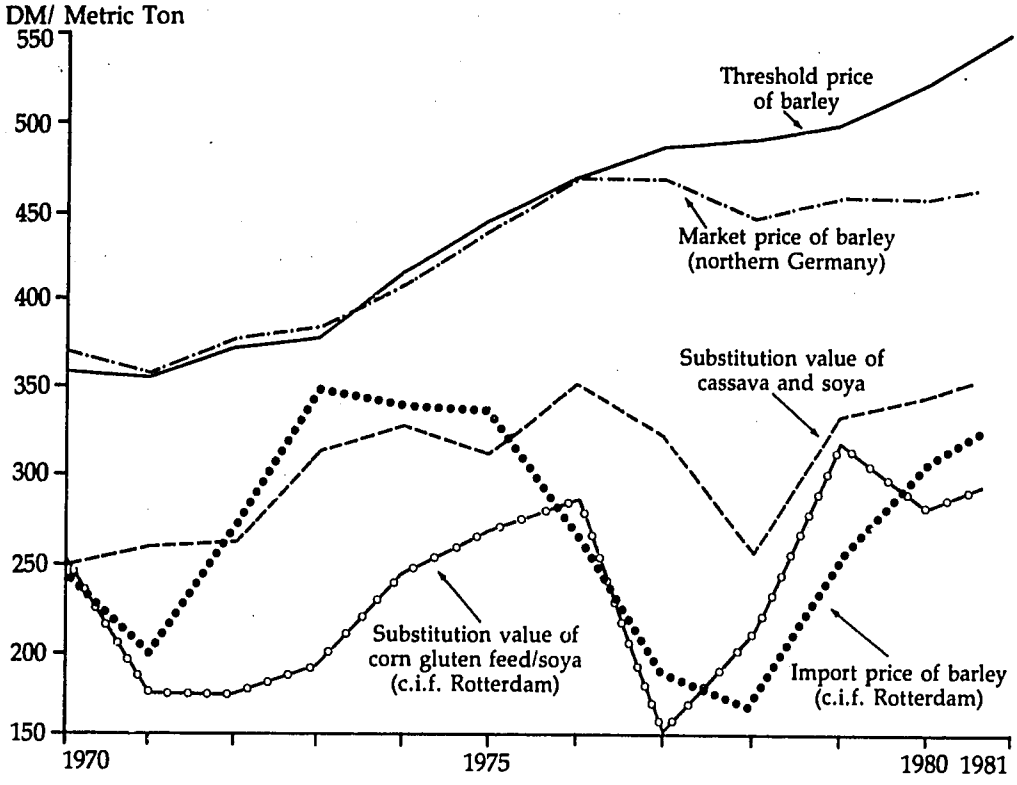
Source: Manfred Köhne, *Getreidepreis, Einkommens— oder Kostenfaktor für die Landwirtschaft?* (Bonn: MFI Schriftenreihe, 1978), p. 41.

The calculations indicate that imports of about 6 million metric tons of cassava in 1981 substituted for 7.8 million metric tons of barley or 6.7 million metric tons of maize. The complementarity between cassava and soya in pork production gave rise to additional imports of 1.2-1.6 million metric tons of soya. It can be taken for granted that the EC would not be a net exporter of barley and cereals in total if there were no imports of cereal substitutes.

These imports also depend on the profitability of those substitutes. The monetary value of the substitutes can be determined by multiplying the quantities derived in the above calculations by current market prices.

Figure 4 presents price trends for the products under consideration. From the individual's point of view, it has paid to feed cassava and soya or corn gluten feed instead of barley in all years since 1970. However, it has not always paid from the macroeconomic point of view because the import price for barley was less than the substitution value of cassava/soya in most of the years. Hence, the EC economy would have been better off importing barley or exporting less instead of importing cassava and soya.

Figure 4—Prices for barley and cereal substitutes, 1970–81



Source: Werner Grosskopf, "Grundlagen der Landwirtschaftlichen Marktlehre", Vorlesungmanuskript Teil 2, Institute of Agricultural Economics, University of Göttingen. (Mimeographed, no year.)

The EC grain market regulations illustrate how protectionism for some products may help to create a new market for others. The world market for cereal substitutes, especially cassava, depends completely on the EC grain market regulations. The main supplier is still Thailand, but the People's Republic of China and Indonesia entered the market recently. The EC imposes a tariff of 6 percent on supply from these destinations. Supply from those countries of Africa, the Caribbean, and the Pacific that signed the Lomé Convention (the ACP countries) may enter the EC market duty free, but only negligible quantities have been received so far. It would be possible to stimulate production of cassava in ACP countries for export to the EC, but this would require investment in domestic milling industries and transport facilities. These investments seem risky, as the exportation of cassava from developing countries depends completely on political decisions of the EC.

Liberalizing the EC grain economy would probably wipe out the world market for cassava and would significantly reduce the markets for soya and corn gluten feed. As far as cassava is concerned, Thailand would be most seriously affected. The impact on the soya market would be felt the most by the United States and South America.

The EC grain trade liberalization has its most important indirect effect, from the developing countries' point of view, on the world market for vegetable oils. The developing countries are already importers of significant amounts of vegetable oils, and their demand for oils can be expected to grow in coming years. Hence, these countries might articulate a greater interest in EC trade liberalization if they only realized how the prices of vegetable oils might change.

The following analysis presents the interrelationship between EC grain trade liberal-

ization and world market prices for soybean oil, the most important vegetable oil.

Price changes for this oil may be caused by changes in either demand or supply. On the demand side, soybean meal, which is complementary to soybean oil in production, soybean oil, and the joint raw-product soybeans must all be considered. On the supply side only changes in the production of soybeans have to be taken into account because they determine the possible supply of both soybean oil and soybean meal.

During the last few years, the EC imported more than 50 percent of world imports of soybean meal and of soybeans but only 12-13 percent of world imports of soybean oil. This indicates that soybean meal and soybeans are substitutes for cereals but not vegetable oils. Hence, EC grain trade liberalization would reduce world demand for soybean meal and soybeans more than world demand for soybean oil. These effects would lead to higher prices for vegetable oils with a given supply curve for soybeans, because the high drop in demand for soybean meal and soybeans would not only curtail the supply of both but of the joint product soybean oil as well.

Changes in supply would enforce the price increase for vegetable oils. The supply curve for soybeans would probably shift to the left. Available studies indicate a high response of acreage allocated to soybeans with respect to price changes of wheat and coarse grain.[18] USDA's grain, oil, and livestock (GOL) model, for example, assumed that soybean area in the United States, which produced more than 60 percent of the world soybeans in 1980/81, would change by −0.78 percent with a 1 percent change in wheat prices, and by −3.0 percent with a 1 percent change in coarse grain prices. Hence, the negative supply response for soybeans in the United States alone could more than compensate for the decline in world demand for soybeans. But the supply response in the second biggest soybean producing country, Brazil, which produced about 19 percent of world soybean production in 1980/81, would go in the same direction. The GOL model assumes that a 1 percent change in the prices of coarse grains would change the area planted with oilseeds by −1.1. percent. This probably indicates higher world market prices for vegetable oils after EC grain trade liberalization. Consequently, the important indirect effect of EC grain trade liberalization would be negative for developing countries.

[18] U.S. Department of Agriculture, Economics, Statistics, and Cooperative Service, *Alternative Futures for World Food in 1985*, vol. 1: *World GOL Model Analytical Report*, Foreign Agriculture Economic Report No. 146 (Washington, D.C.: USDA, 1978); and Raymond J. Schatzer, Roland K. Roberts, Earl O. Heady, and Kison R. Gundal, *An Econometric Response-Simulation Model to Estimate Input Stocks and Expenses, Supply Response, and Resource Demand for Several U.S. Agricultural Commodities*, CARD Report 102T (Ames, Iowa: Iowa State University, July 1981).

5

POLICY OPTIONS FOR EC GRAIN PRICE RATIOS

Insulation of the EC grain economy may contribute in several ways to price instability in world markets.[19] Instability might be caused, in part, by a complete disconnection between domestic and world market price ratios. This is the focus of this chapter. Barriers to trade also may affect the world market. Those effects are examined in Chapter 6.

Instability does not necessarily result from a system of protecting national producers. A protection policy that allows for flexibility in price ratios and provides for appropriate trading activities may help to stabilize world grain prices. It may be argued that a given degree of producer protection is necessary for political reasons. However, this does not justify a policy that insulates national price ratios from world market price ratios nor does it justify inflexible trading and storage activities. The policy recommendations below are based on the premise that the present grain prices of the EC can achieve the noneconomic objectives of EC policy, the main one of which is to provide a "fair" income to farmers. Apart from this, the EC might well introduce more flexibility into the present market organization. This could help stabilize world market prices and leave the EC better off.

Individual types of grain compete for many of the same resources. Hence, an agricultural income objective can be achieved with a given price for grain and various price ratios among individual cereals. Up to now the EC has not accepted world market ratios in determining the price ratios among wheat, barley, maize, and oats. Instead, changes in price ratios were designed to decrease budgetary costs. Since 1976 price ratios have been determined in accordance with the so-called "silo" or "cathedral" model.[20] The model bases price ratios on the feed value of individual cereals. It is argued that this minimizes the budgetary costs of any given set of grain prices.

The approach of the silo model is questionable. Even if its objective of minimizing budgetary costs under the constraint of a given grain price is accepted, the optimal solution might differ from the silo-model approach. Formulating a Lagrange function with the given constraints and differentiating for individual grain prices illustrates this point.[21] According to the solution, domestic price ratios would allow budgetary costs to be minimized if the marginal change in governmental expenditure from a marginal change in individual grain prices were the same for all types of grain. The size of the

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[19] This question has been raised in numerous articles. These include: D. Gale Johnson, "World Agriculture, Commodity Policy, and Price Variability," *American Journal of Agricultural Economics* 57 (December 1975): 823-828; S. Shei and R. L. Thompson, "The Impact of Trade Restrictions on Price Stability in the World Wheat Market," *American Journal of Agricultural Economics* 59 (November 1977): 628-638; Stefan Tangermann, "Agricultural Trade Relations between the EC and Temperate Food Exporting Countries," *European Review of Agricultural Economics* 5 (No. 34, 1978): 201-220; A. C. Zwart and K. D. Meilke, "The Influence of Domestic Pricing Policies and Buffer Stocks on Price Stability in the World Wheat Industry," *American Journal of Agricultural Economics* 61 (August 1979): 434-445; M. D. Bale and E. Lutz, "The Effects of Trade Intervention on International Price Instability," *American Journal of Agricultural Economics* 61 (August 1979): 512-516; and M. D. Bale and E. Lutz, "Price Distortions in Agriculture and Their Effects: An International Comparison," *American Journal of Agricultural Economics* 63 (February 1981): 8-22; Timothy Josling, "Price, Stock, and Trade Policies and the Functioning of International Grain Markets," in *Food Security for Developing Countries*, ed. Alberto Valdés (Boulder, Colo.: Westview Press, 1981), pp. 161-184; and P. Svenberg, "EEC Variable Import Levies and the Stability of International Grain Markets," *Indian Journal of Agricultural Economics* 36 (January-March 1981): 58-86.

[20] The silo model is described in Toepfer International, *The E.E.C. Grain Market Regulation 1980/81* (Hamburg: Toepfer International, 1981).

[21] See Ulrich Koester, "Issues of Future Agricultural Policy in the European Common Market: Comment," *European Review of Agricultural Economics* 1 (No. 4, 1973): 483-491; and Dieter Kirschke, *Wohlstandstheoretische Analyse der Agrarpreispolitik in der EG auf der Grundlage des Konzepts der Zahlungsbereitschaft* (Kiel: Kieler Wissenschaftsverlag Vauk, 1981), p. 157.

change in governmental expenditure depends on the change in domestic and foreign supply and demand, as well as the change in the differential between domestic and world market prices. Hence, coefficients of price elasticities and world market prices determine optimal prices under the given objective function. The optimal condition is given by the following formula:

$$p_i^E/p_j^E = [(1 + 1/\varepsilon_i^R)(1 + 1/\varepsilon_j^E) / (1 + 1/\varepsilon_j^R)(1 + 1/\varepsilon_i^E)] \cdot p_i^W/p_j^W, \quad (7)$$

where

$p_{i,j}^E$ = EC price for grains i and j,

$p_{i,j}^W$ = world market prices for grains i and j,

$\varepsilon_{i,j}^E$ = the excess demand or excess supply elasticity of the EC (i), and

$\varepsilon_{i,j}^R$ = the excess demand or excess supply elasticities of the rest of the world.

Price ratios that correspond to the feed value do not take into account the variables determining the condition for minimizing governmental expenditure.

It is easy to find an optimal price ratio when the objective is clear and the constraints are well-defined. But it is less simple to derive an objective from policies that have already been set. Hence, it cannot be said what objective function may lead to the approval of the silo model. However, the implications of the present policy decision to use the silo model can be analyzed.

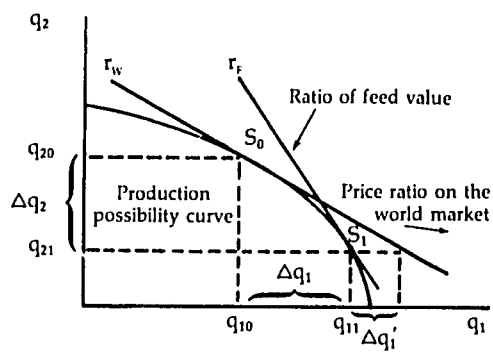
The optimal domestic production pattern depends on the objective function and the constraints. If domestic welfare is to be maximized and international trade is allowed, the optimal domestic production pattern for any two products is given by the equivalence of the marginal rate of transformation in production, the marginal rate of substitution in consumption, and the inverse ratio of world market prices. Using the feed values of individual grains for setting price ratios does not take any of these into account.

It may be argued that demand has been taken care of by considering the marginal rate of substitution in consumption. However, the feed value of grain for meat production is not equivalent to the marginal rate of substitution in consumption of feed-grains. This is because different amounts of various grains are fed to produce different types of meat. Hence, a change in the price ratio for different grains will affect the production pattern of meat and, thus, the marginal rate of feed use.

Even if the marginal rate of feed use were equal to the average rate of feed use, this criterion for setting price ratios would not maximize domestic welfare or minimize governmental expenditures for guaranteeing a given price for grain. For governmental expenditures, the proof was given in equation (7). Figure 5 clarifies the objective of maximizing domestic welfare. It is assumed that the economy has a given production possibility curve that gives all possible combinations of the two types of grain considered (q_1 and q_2) that can be efficiently produced. Given the same price ratio as on the world market, the country would produce q_{10} and q_{20}. With the domestic price ratio equal to the feed value, the country would produce q_{11} and q_{21}. However, the country could trade Δq_2 against $\Delta q_1 + \Delta q_1'$ on the world market. Hence, $\Delta q_1'$ represents the economic costs of having the state S_1 instead of the state S_0.

This analysis clearly shows that the present EC price ratio policy, the silo model, does not favor the EC. The implementation of this policy led to an 8.5 percent increase in EC intervention prices for maize in 1976/77, compared to a 4 percent increase in prices for bread wheat. As maize still has to be imported whereas wheat is exported with given prices, this policy is a movement toward autarchy. It implies that the EC dis-

Figure 5—Feed value of grain as a determinant of relative grain prices



torts world market prices for maize more than for wheat and barley.

Carter and Schmitz argue that high protection for EC wheat may be consistent with an optimal tariff.[22] However, this argument has to be rejected. The EC is now a net exporter of wheat. So if the EC wants to exploit its market power in the world market for wheat, EC wheat prices should not be higher but lower than world market prices.

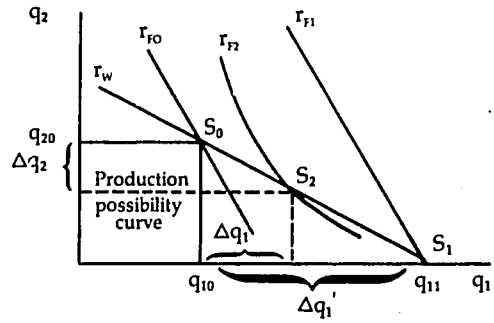
A reorientation of the EC grain price ratio by completely liberalizing intragrain trade between the EC and the rest of the world would substantially increase exports of wheat and imports of maize. The graph in Figure 6 clarifies the argument. A quantification of the potential gains follows.

In Figure 6 it is assumed that the EC production pattern is determined by noneconomic reasons and that substitution in production is not allowed. This means that the production possibility curve is politically determined, as if the two products are limitational. The efficient production point is given by S_0 with production q_{10} and q_{20}. With no trade these quantities will be consumed domestically. The amount of meat that can be produced with q_{10} and q_{20} is indicated by the line r_0^F, which represents equal feed values for possible combinations of q_1 and q_2. It is assumed, in accordance with the official EC policy, that the marginal feed value of q_1 and q_2 is constant. Hence, the curves of equal feed value are straight lines. Of course, there is a family of such curves. The amount of meat that can be produced domestically would increase if it were possible to move to a curve of equal feed value to the right of r_0^F.

Line r^W, the world market price ratio between q_1 and q_2, indicates how many units of q_2 can be traded for one unit of q_1. If the EC offered q_{20}, it could exchange Δq_1. In this case, only product q_1 could be available for consumption domestically. The maximum possible meat production would be given by the equal feed value line r_1^F. This clearly shows that even with current domestic grain production, trade could give rise to an increase in meat production.

Of course, the equal feed value lines might not be linear. It is likely that the

Figure 6—Welfare gain from arbitrage on grain market



marginal rate of substitution with respect to the same feed value declines with an increase in substitution. The curve could have a form as indicated by r_2^F. In this case, Δq_2 should be traded for $\Delta q_1'$. Anyway, as long as the slope of any r^F curve that intersects the r^W curve to the right of S_0 is for a given q_{20} greater than the slope of the r^W curve, trade is beneficial even if the domestic production pattern is constant.

The quantification of the maximum potential gain due to EC intragrain trade is straightforward.[23] Trade in grain pays if net foreign exchange is balanced and a higher total feed value can be realized. Trading Δq_1 for Δq_2 does not affect the balance of foreign exchange. Therefore the gain in feed value (G) has to be quantified:

$$G = f_1 \Delta q_1 - f_2 q_{20}, \qquad (8)$$

where f_1 stands for the feed value of wheat and f_2 stands for the feed value of maize, and $f_1 : f_2 = 1:1.04$. Trading pays if $p_1/p_2 > f_1/f_2$, where p_1 and p_2 are world market prices for wheat and maize. The gain due to trade can be measured in quantities of wheat exported:

$$G = p_1/p_2 \cdot f_2/f_1 \Delta q_1. \qquad (9)$$

The following example makes the meaning of this formula clear:

[22] Colin Carter and Andrew Schmitz, "Import Tariffs and Price Formation in the World Wheat Market," *American Journal of Agricultural Economics* 61 (August 1979): 517-522.

[23] See Dennis L. Chinn, "A Calorie-Arbitrage Model of Chinese Grain Trade," *Journal of Development Studies* 17 (July 1981): 362.

Market	Wheat Price	Maize Price
World	110	100
Domestic	200	208

It is assumed that the domestic price ratio is determined by the ratio of the feed values of wheat and maize, with maize prices 4 percent higher than wheat prices. This corresponds to the price differential the EC Commission wants to set. The world market price ratio between wheat and maize is assumed to be 1.1:1, which corresponds to reality in some years. Selling one unit of domestic wheat on the world market means buying the 1.1 units of maize indicated by this ratio. Importing 1.1 units of maize would be equivalent to 1.04 × 1.1 units of wheat, which is 1.444. Hence, exporting 1 unit of wheat and importing maize results in a surplus of 0.144 units of wheat.

Of course, the gain from the arbitrage can be quantified in monetary terms as well. It is only necessary to multiply the amount of grain, expressed in units of wheat, by the domestic or world market price of wheat (Table 20).

This gain has to be considered an upper limit for several reasons. First, it is assumed that the total amount of wheat used for feed could have been exported at given world market prices. However, world market prices for wheat could go down and those for maize could go up. Second, it is assumed that wheat and maize could substitute completely for each other for feeding purposes. Although this accords with the assumptions underlying the present price ratio policy, it is questionable. The marginal rate of substitution is probably not constant. Finally, the calculations are made with average annual prices, but prices may vary con-

Table 20—Possible gains from trading wheat for maize, 1968/69-1980/81

Year	World Market Prices		Price Ratio on World Market, Wheat/Maize	Use of Wheat in Feeding Animals in the European Community	Gains		
	Wheat	Maize			Units of Wheat	Monetary Units	Total
	(U.S. $/metric ton)			(1,000 metric tons)	(metric ton)	(U.S. $/ metric ton)	(U.S. $ million)
1968/69	63	53.8	1.17	6,911	0.217	13.67	94.47
1969/70	53	61.5	0.86	12,102	-0.106	-5.62	-68.01
1970/71	60	66.0	0.91	12,290	-0.054	-3.24	-39.82
1971/72	60	54.0	1.11	12,116	0.154	9.24	111.95
1972/73	91	73.4	1.24	14,157	0.290	26.39	373.60
1973/74	177	112.4	1.57	11,604	0.633	112.04	1,300.01
1974/75	164	117.4	1.40	12,204	0.456	74.78	912.62
1975/76	152	113.6	1.34	9,477	0.394	59.89	567.58
1976/77	113	106.2	1.06	9,825	0.102	11.53	113.28
1977/78	116	108.7	1.07	10,761	0.113	12.28	132.15
1978/79	141	122.5	1.15	11,899	0.196	27.64	328.89
1979/80	174	141.1	1.23	12,314	0.279	48.55	567.85
1980/81	185	167.1	1.11	12,500	0.154	28.49	356.13

Sources: The figures for the use of wheat in feeding animals for 1968/69-1970/71 are from European Community, *Statistical Yearbook*, various issues (Luxembourg: Statistical Office of the European Community, various years); for 1971/72-1978/79 from Commission of the European Community, *The Agricultural Situation in the Community*, various issues (Luxembourg: Commission of the European Community, various years); for 1979/80-1980/81 from H.E. Buchholz et al., "Die Landwirtschaftlichen Markte an der Jahreswende 1981/82," *Agrarwirtschaft* 30 (Nr. 12, 1981): 353-416. The figures for the world market price of wheat are from International Wheat Council, *Review of the World Wheat Situation*, various reports (London: International Wheat Council, various years); the figures for the world market price of barley are from Food and Agriculture Organization of the United Nations, *Trade Yearbook*, various issues (Rome: FAO, various years); the figures for the world market price of maize are from Commission of the European Community, *The Agricultural Situation in the Community*, various issues (Luxembourg: Commission of the European Community, various years).

Notes: The European Community had 6 members in 1968/69, 9 from 1969/70 to 1980/81, and 10 thereafter. The 1980/81 figure for the use of wheat in feeding animals is an estimate. It is assumed that the feeding ratio of wheat to maize is 1:1.04.

siderably during the year. However, this would support the argument that a fixed price ratio in the EC and variable world market price ratios lead to welfare losses for the EC.

EC grain arbitrage could be implemented easily. Linking EC price ratios to world market price ratios by allowing for arbitrage would not only lead to welfare gains for the EC but would help stabilize world market prices for individual grains. World market price ratios vary with changes in the supply of individual grains. If EC price ratios do not react to these changes in supplies, world market price ratios would vary more than otherwise. Hence, arbitrage could help to stabilize world market price ratios.

Grain traders should be allowed to buy wheat in the EC to sell on the world market and to buy maize on the world market to sell in the EC. This could be done with the given degree of protection. Profitable arbitrage is independent of EC and world market prices. It is possible whenever the EC price ratio is different from that of the world market. To implement an arbitrage system, those traders who want to import maize should get no restitution for exporting wheat and should not pay variable levies for importing maize. A simple example may help to explain the system. The initial situation may be characterized by the following:

	EC	World
	(U.S. $/metric ton)	
Wheat prices	60	40
Maize prices	65	35

Buying wheat in the EC and selling it on the world market results in a loss of U.S. $20 per metric ton. However, importing maize yields a profit of U.S. $30 per metric ton. Hence, arbitrage pays. It will pay as long as the EC price ratio for wheat and maize is smaller than that of the world market and the differential for EC and world market prices is greater than for EC and world market wheat prices.

To avoid a situation in which importing cereals requires intervention because market prices are low, an escape clause could be introduced. Arbitrage should only be allowed if EC market prices are above intervention prices.

Such a system would guarantee that the EC cereal price ratios would be more in line with world market price ratios.[24] They are not at present (Table 21).

The introduction of arbitrage would not add administrative costs. All border transactions are already controlled. Domestic administrative costs could be lowered. At present, intervention authorities have to buy increasing amounts of wheat in order to guarantee wheat intervention prices. These costs could be completely avoided by introducing the arbitrage system.

Price Ratios Among Qualities of Wheat

Under domestic regulations, it is assumed that prices for bread wheat are 15 percent higher than for feed wheat (mass wheat). The EC Commission argues that such a price differential is needed as yields per hectare are about 15 percent lower for bread wheat. However, such reasoning can hardly be economically justified, because even in a closed economy equilibrium price ratios are not given by the ratio of average yields but by the ratio of marginal costs. There is no basis for the assumption that the ratio of average yields is equal to the ratio of marginal costs. In addition, it is questionable whether a yield differential actually exists. In some regions of the EC, such as Germany, there is no significant yield differential—in fact, yields for bread wheat are higher than those for feeding wheat. This phenomenon is mainly due to new wheat varieties.

EC border regulations imply that the EC is both an exporter and importer of individual cereals such as soft wheat and barley (Table 22). If soft wheat and barley can be considered as homogeneous products, such a trade pattern would not be expected. Because of differences in quality, however, it might be reasonable to export one type of wheat or barley and import others. The EC's special

[24] This type of grain arbitrage would not equalize EC price ratios and world market price ratios completely. Transport costs aside, the differences in price ratios as well as the absolute price differential would have to be taken into consideration in carrying out profitable arbitrage of the type proposed.

Table 21—Grain prices in the world market and the European Community, 1968/69-1980/81

Year	World Market						Germany					
	Prices			Price Ratios			Market Prices			Price Ratios		
	Wheat	Barley	Maize	Wheat/ Barley	Wheat/ Maize	Barley/ Maize	Soft Wheat	Barley	Maize	Wheat/ Barley	Wheat/ Maize	Barley Maize
	(U.S. $/metric ton)						(DM/metric ton)					
1968/69	63	54.2	53.8	1.16	1.17	1.01	405.4	349.9	389.1	1.16	1.02	0.88
1969/70	53	55.4	61.5	0.96	0.86	0.90	390.9	347.3	393.1	1.13	0.99	0.88
1970/71	60	54.5	66.0	1.10	0.91	0.83	387.7	344.1	368.6	1.13	1.05	0.93
1971/72	60	54.7	54.0	1.10	1.11	1.01	380.1	336.9	371.2	1.13	1.02	0.91
1972/73	91	63.8	73.4	1.43	1.24	0.87	395.9	344.9	402.0	1.15	0.98	0.86
1973/74	177	113.5	112.4	1.56	1.57	1.01	404.4	360.5	415.7	1.13	0.97	0.87
1974/75	164	142.6	117.4	1.15	1.40	1.21	434.9	404.8	460.8	1.07	0.94	0.88
1975/76	152	155.7	113.6	0.97	1.34	1.37	477.8	447.5	483.3	1.07	0.99	0.93
1976/77	113	124.1	106.2	0.91	1.06	1.17	517.8	469.6	506.2	1.10	1.03	0.93
1977/78	116	109.9	108.7	1.06	1.07	1.01	487.8	431.2	524.3	1.13	0.93	0.83
1978/79	141	108.8	122.5	1.30	1.15	0.89	490.0	438.6	533.3	1.12	0.92	0.83
1979/80	174	126.5	141.1	1.38	1.23	0.90	498.0	449.4	522.5	1.11	0.95	0.86
1980/81	185	140.2	167.1	1.32	1.11	0.84	513.8	459.3	558.5	1.12	0.92	0.82

Sources: The figures for the world market price of wheat are from International Wheat Council, *Review of the World Wheat Situation*, various reports (London: International Wheat Council, various years); the figures for the world market price of barley are from Food and Agriculture Organization of the United Nations, *Trade Yearbook*, various issues (Rome: FAO, various years); the figures for the world market price of maize are from Commission of the European Community, *The Agricultural Situation in the Community*, various issues (Luxembourg: Commission of the European Community, various years); the source for the exchange ratio of Eurodollars and European Currency Units (ECUs) for calculating the world market maize price from 1968/69 to 1976/77 is European Community, *Yearbook of Agricultural Statistics*, various reports (Luxembourg: Statistical Office of the European Community, various years); the source for the monthly exchange rates between ECUs and U.S. dollars for calculating the world market maize price for 1977/78 and 1978/79 is European Community, *Statistics of Foreign Trade* (Luxembourg: Statistical Office of the European Community, 1979 and 1980); the source for calculating the world market maize price for 1979/80 and 1980/81 is Food and Agriculture Organization of the United Nations, *Monthly Bulletin of Statistics*, vol. 4 (Rome: FAO, October 1981); the 1979/80 and 1980/81 figures for the German market price for soft wheat, barley, and maize are from Bundesministerium für Ernahrung, Landwirtschaft und Forsten, *Statistisches Jahrbuch uber Ernahrung Landwirtschaft und Forsten*, various issues (Frankfurt: Bundesministerium fur Ernahrung, Landwirtschaft und Forsten, various years).

Notes: World market wheat is Hard Winter Ordinary, f.o.b. Gulf, and bushels were converted to metric tons with the assumption that 1 metric ton = 36.7 bushels. World market barley is also f.o.b. Gulf, and prices were computed by dividing calculated value by the quantity exported; these data were in calendar years. World market maize is c.i.f. Rotterdam, except for 1979/80 and 1980/81, which are U.S. Yellow Maize, c.i.f. North Sea Ports.

border regulations distort trade flows. Wheat can be used as an example of this.

Most of the wheat the EC imports is of high quality; most of the wheat it exports is of low quality. This would be quite rational if the marginal rate of substitution in the consumption of imported wheat for exported wheat were higher than the ratio of prices of imported wheat to exported wheat. The necessary condition is:

$$\Delta q_A/\Delta q_B < p_B/p_A,$$

where

q_A = quantity of high-quality wheat,

q_B = quantity of low-quality wheat,

p_A = import price of high-quality wheat, and

p_B = export price of low-quality wheat.

The marginal rate of substitution in consumption can be determined by the quantities of flour needed for bread making. To bake 100 kilograms of bread, bakeries need about 153 kilograms of flour of A-wheat, 166 kilograms of B-wheat, or 185 kilograms of C-wheat. As the amount of grain needed to produce 100 kilograms of flour is inde-

Table 22—Exports and imports of soft wheat and barley, 1970/71-1979/80

Year	Wheat		Barley	
	Exports	Imports	Exports	Imports
	(1,000 metric tons)			
1970/71	3,167	5,072	2,210	4,557
1971/72	8,503	5,837	6,059	4,236
1972/73	12,293	7,773	6,296	4,237
1973/74	11,763	8,762	6,745	4,856
1974/75	7,470	4,248	2,638	1,248
1975/76	7,448	4,394	4,135	2,053
1976/77	4,297	3,089	1,507	3,368
1977/78	5,245	3,494	4,805	1,258
1978/79	8,624	3,510	5,073	1,085
1979/80	10,797	3,793	4,752	1,003

Source: Commission of the European Community, *The Agricultural Situation in the Community*, various issues (Luxembourg: Commission of the European Community, various years).

Table 23—Export and import prices for wheat, 1972/73-1979/80

Year	Export Price	Import Price	Import Price/ Export Price
	(U.S. $/metric ton)		
1972/73	106	100	0.94
1973/74	185	202	1.09
1974/75	168	204	1.21
1975/76	139	188	1.35
1976/77	n.a.	141	n.a.
1977/78	97	134	1.38
1978/79	127	158	1.24
1979/80	169	200	1.18

Source: International Wheat Council, *World Wheat Statistics, 1981* (London: International Wheat Council, 1981).

Notes: The export prices are f.o.b. Rouen. The import prices are for U.S. No. 2 Dark Northern Spring 141 wheat, c.i.f. Rotterdam. Where n.a. appears, the figure was not available.

pendent of the A to C classification, it can be concluded that it may pay for bakeries to use A-quality wheat if the price for A-wheat is not more than 8 percent above the price for B-wheat. For noodles and pastries, the substitution value of A-quality wheat in terms of B-quality wheat is even higher. This says that it pays for an economy to import A-quality wheat and to export B-quality wheat if the import price for A-wheat at the bakery is not higher than 8 percent of the f.o.b. export price for B-wheat. Such a price ratio can prevail only if the c.i.f. price for A-wheat is less than 8 percent higher than the f.o.b. price for B-wheat.

The time series shown in Table 23 indicate that wheat imports and exports would be profitable for the EC only in exceptional circumstances. As the EC was an exporter and importer of wheat in all periods, wheat trade must have been profitable for private firms. This indicates that the domestic price ratios between different kinds of wheat must have been distorted by governmental interventions. Such a distortion is evident from the border regulations.

To take into account the different qualities of wheat, the EC fixes a threshold price for standard quality wheat equal to the EC entry price. The difference between the threshold price and the lowest offer price at Rotterdam is made up by a levy. Obviously, the EC assumes that the lowest offer price can only be determined for standard quality wheat comparable to EC wheat and not for other qualities. This seems reasonable as the markets for individual qualities of wheat are narrow and individual suppliers may ask for prices that are not justified by the substitution value. To make different qualities comparable, the EC applies coefficients of equivalence.[25] For wheat of higher quality, a constant amount is subtracted from its price to make it comparable to the price of the EC standard. If this hypothetical price is lower than the offer price for the EC standard, it is considered the lowest world market price. The levy is the difference between the EC threshold price and this hypothetical price. If the derived hypothetical price is higher than the offer price for the EC standard-quality wheat, the levy is equal to the price differential between the EC threshold price and the offer price of the standard-quality wheat. The procedure for calculating the levy (L) follows:

Let p_E be the EC entry price (equal to the threshold price), which is a policy variable

[25] See Toepfer International, *The E.E.C Grain Market Regulation 1980/81.*

and, in general, set once a year during the yearly price negotiations. In determining the L, the EC Commission tries to find the lowest world market price (c.i.f. Rotterdam) for a well-defined, standard-quality of wheat (p_S). At the same time a hypothetical price (p_H) is calculated by subtracting a constant amount (α) from the actual offer price (p_Q; c.i.f. Rotterdam) for high-quality wheat. Hence, $p_H = p_Q - \alpha$. If $p_H > p_S$, then $L = p_E - p_S$; if $p_H < p_s$, then $L = p_E - p_H$.

This procedure provides a uniform levy for all varieties of imported wheat. However, it probably distorts the EC price ratio since α has been about the same since the grain market organization began to function. Due to inflation, both the EC and world market prices for grain are much higher than in the 1960s. EC border regulations may make prices for high-quality wheat lower in relation to low-quality wheat in the EC than in the world market. This is more important when the hypothetical price for high-quality wheat is the basis for calculating the levy. Table 24 shows that high-quality wheat is much more expensive on the world market than in the EC. The price differential between high- and low-quality wheat in the EC favors consumption of high-quality wheat in the EC. The application of the present border regulations will necessarily imply a distortion of EC price ratios for different qualities of the same type of grain. However, the distortion could be avoided by altering the regulations.

The levy has to be quantified in absolute and relative terms only for standard-quality wheat. Given a c.i.f. price of U.S. $300 per metric ton and an EC threshold price of U.S. $500 per metric ton, the absolute levy would be U.S. $200 and the relative levy would be 66.67 percent. The c.i.f. price of grain of a different quality may be U.S. $330 per metric ton, 10 percent higher than for grain of standard quality. The price of U.S. $330 per metric ton should be multiplied by the relative levy plus 1; that is 1.66, which results in a price of U.S. $550. Hence, the better-quality grain has a price 10 percent higher than the lower-quality grain in the EC and on the world market as well. No price distortion would occur in applying this procedure.

Administrative feasibility should be no problem. Instead of applying coefficients of equivalence for grain not of standard quality, the new system would specify a relative levy. But, as the absolute levy has to be quantified anyway, it would be simple to specify the relative levy as well.

Seasonal Price Ratios

EC authorities try to influence the seasonal prices for grains by setting monthly intervention differential prices, which are supposed to compensate for monthly storage costs. The result is the seasonal price pattern shown in Figure 7. In evaluating how the present regulation affects the seasonal price ratios, a description of a reference system is given first. It is assumed that this system is a seasonal price pattern that allows domestic welfare to be maximized.

The seasonal price pattern in Figure 7 could be reasonable for a closed economy. The seasonal price pattern in an open economy has to be linked to the pattern of world market prices if domestic welfare is to be maximized. The following makes this interrelationship clear.

For an optimal intertemporal price in a closed economy,

$$p^D_{t+1} + 1 = p^D_t + r, \qquad (10)$$

where p^D_{t+1} is the domestic grain price in period t+1, p^D_t is the domestic grain price in period t, and r is the price of storage for one unit of time, which includes interest costs, wastage, insurance, costs for storage capacities, convenience yield, and so forth.

Equation (10) has to be generalized for an open economy. It should hold that

$$p^D_t = MC_t, \qquad (11)$$

$$p^D_{t+1} = MC_{t+1}, \qquad (12)$$

$$MC_{t+1} = p^D_t + r, \text{ and} \qquad (13)$$

$$MC_{t+1} = p^W_{t+1}, \qquad (14)$$

where MC is the marginal cost of supply, and p^W_{t+1} is the world market price in period t+1.

In a closed economy the marginal cost of supply in period t+1 is always equal to the price of the product in period t plus the

Table 24—Wheat price ratios on the world market and in the European Community, 1971/72-1979/80

Year	World Market Price: Spring Wheat	World Market Price: Winter Wheat	World Market Price: Ratio of Spring to Winter Wheat Prices	Coefficient of Equivalence: Spring Wheat	Coefficient of Equivalence: Winter Wheat
	(European currency units/metric ton)				
1971/72	63.8	57.4	1.11	13.3	4.53
1972/73	86.8	55.5	1.56	13.3	4.53
1973/74	164.4	n.a.	...	13.3	4.53
1974/75	163.6	110.4	1.48	13.3	4.53
1975/76	162.1	124.1	1.31	13.3	4.53
1976/77	126.4	104.8	1.21	13.3	4.53
1977/78	111.9	100.2	1.12	13.3	4.53
1978/79	111.9	116.8	1.02	13.3	4.53
1979/80	143.0	136.5	1.05	13.3	4.53

Year	Corrected Prices: Spring Wheat	Corrected Prices: Winter Wheat	Threshold Price of Winter Wheat	Difference Between Threshold Price and World Market Price: Spring Wheat	Difference Between Threshold Price and World Market Price: Winter Wheat	European Community Price Ratio[a]
	(European currency units/metric ton)					
1971/72	50.5	52.9	104.3	53.8	51.4	1.08
1972/73	73.5	51.0	111.5	38.0	60.5	1.08
1973/74	151.1	...	116.3	-34.8	...	...
1974/75	150.3	105.8	132.9	-17.4	27.1	1.06
1975/76	148.8	119.6	147.5	-1.3	27.9	1.06
1976/77	113.1	108.6	170.7	57.6	62.1	1.10
1977/78	98.6	94.1	186.2	87.6	92.1	1.04
1978/79	105.8	112.3	192.7	86.9	80.4	1.05
1979/80	129.7	125.2	197.5	67.8	72.3	1.01

Sources: The exchange rates for average values per crop year used to calculate world market spring and winter wheat prices are from European Community, *Yearbook of Agricultural Statistics, 1980* (Brussels: Statistical Office of the European Community, 1980), except for the 1974/75 winter wheat figure, which is from Commission of the European Community, *The Agricultural Situation in the Community* (Brussels: Commission of the European Community, 1975), and the 1978/79 and 1979/80 spring and winter wheat prices which were calculated with the exchange rates for each crop year by taking the average of monthly conversion rates taken from European Community, *Monthly External Trade Bulletin*, various issues (Luxembourg: Statistical Office of the European Community, various years). The threshold prices of winter wheat are from Commission of the European Community, *The Agricultural Situation in the Community*, various issues (Brussels: Commission of the European Community, various years).

Notes: All prices are c.i.f. Rotterdam. Spring wheat is U.S. No. 2 Dark Northern Spring 141 wheat; winter wheat is No. 2 Soft Red Winter wheat.

[a] This is the sum of the world market price and the difference between threshold price and world market price for spring wheat divided by the same sum for winter wheat.

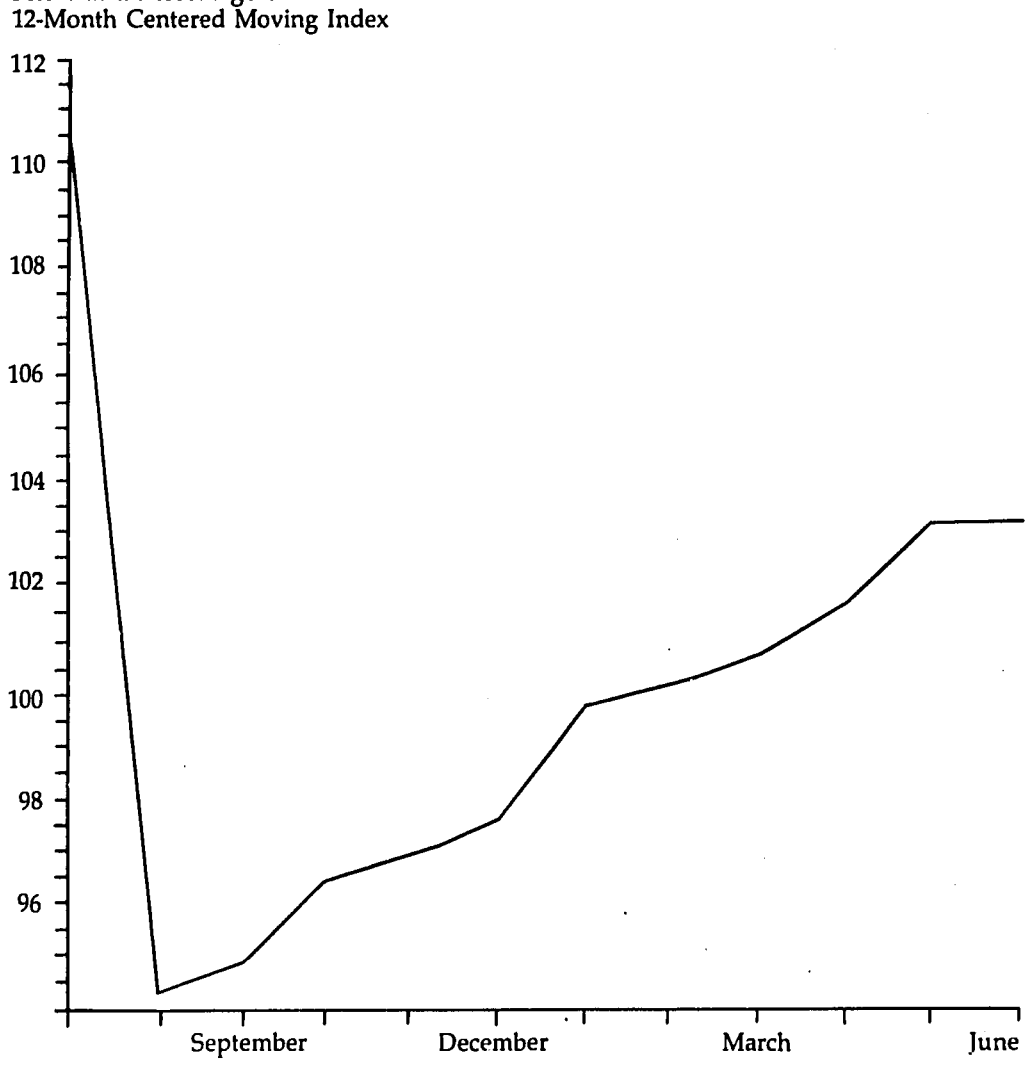
price of storage. But in an open economy it may be reasonable to sell the quantities needed in period t+1 on the world market in period t and buy them in period t+1. Therefore, equation (14) may hold instead of equation (13). Exportation and reimportation within the same year will pay if

$$p_t^D + r > p_{t+1}^{cW} - p_t^{fW}, \qquad (15)$$

where p^{cW} is the import price (c.i.f.), and p^{fW} is the export price (f.o.b.).

If the left side of equation (15) were smaller than the right side, it would pay to import in period t and export in period t+1. Equilibrium implies the identity of the two sides of equation (15). Apart from the difference between c.i.f. prices and f.o.b. prices, the relationship between the domestic and

Figure 7—Seasonal index of German domestic wholesale wheat prices

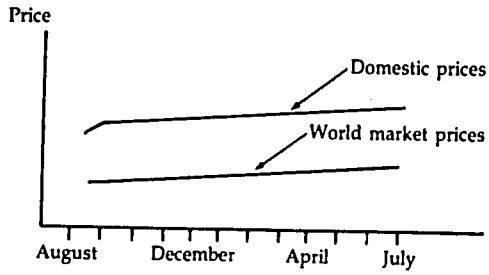


Source: International Wheat Council, *World Wheat Statistics*, various issues (London: International Wheat Council, various years).

world market seasonal price patterns will be close in an optimal situation. Differences in domestic prices for two periods of time should never be greater than the difference between the c.i.f. price in period t+1 and the f.o.b. price in period t. It may turn out that domestic storage is not competitive in all seasons as prices on the world market increase less than is needed to compensate for domestic storage costs. It would then only pay to have minimal domestic working stocks. Most of the crop should be exported after the harvest and reimported later in the year. Hence, the domestic seasonal price pattern could be as in Figure 8.

In Figure 8 it is assumed that the domestic price is higher than the world market price in all months. The difference in the domestic price between the second and first months should equal the difference between the c.i.f. price in the second month and the f.o.b. price in the first month. The differences in

Figure 8—Domestic seasonal price pattern in an open economy



the domestic prices for consecutive months should be equal to the differences in c.i.f. world market prices.

As described above, much of the seasonal price pattern on the EC grain market is determined by stipulated intervention and threshold prices. This price pattern could only be optimal by chance as the variables that determine the optimal pattern in an open economy are not considered. Because of the timing of the world wheat harvest, world seasonal price patterns are not likely to reflect EC storage costs. Because the seasonal pattern of import prices differs considerably from the EC pattern, it would be cheaper to meet domestic market demand with imports in November-June instead of storing grain domestically.

The situation may differ from year to year because of variance in the seasonal pattern of import prices (Table 25). First, there is a high variability in monthly world market prices. Second, in most years the trend of monthly prices over a 12-month period is not positive. This implies that the

Table 25—Instability indexes of monthly prices, 1965-81

Year	Wheat			Maize			Barley		
	Index	Instability Measure	$\bar{R}^2$	Index	Instability Measure	$\bar{R}^2$	Index	Instability Measure	$\bar{R}^2$
				(U.S. $/metric ton)					
1965	1.86	v^x_L, N	0.94	2.13	v^x_{LL}, P	0.64	0.93	v^x_L, P	0.76
1966	2.56	v^x_{LL}, P	0.60	2.79	v	n.s.	1.99	v	n.s.
1967	1.94	v	n.s.	1.75	v^x_{LL}, N	0.53	2.15	v^x_L, N	0.67
1968	2.05	v	n.s.	1.64	v^x_{LL}, N	0.64	1.56	v^x_{LL}, N	0.79
1969	0.69	v^x_L, N	0.87	2.94	v^x_L, P	0.82	1.73	v^x_L, N	0.85
1970	2.57	v	n.s.	2.45	v^x_{LL}, P	0.87	2.33	v^x_{LL}, P	0.77
1971	5.12	v	n.s.	2.18	v^x_{LL}, N	0.62	3.40	v	n.s.
1972	0.65	v	n.s.	2.93	v	n.s.	1.46	v^x_L, P	0.86
1973	7.86	v^x_L, P	0.74	10.63	v^x_{LL}, P	0.85	8.47	v^x_{LL}, P	0.87
1974	12.72	v	n.s.	9.01	v	n.s.	8.55	v	n.s.
1975	7.53	v^x_{LL}, N	0.70	5.30	v^x_{LL}, N	0.78	4.40	v^x_{LL}, N	0.88
1976	4.08	v^x_L, N	0.54	6.66	v	n.s.	4.57	v^x_{LL}, N	0.63
1977	3.62	v^x_{LL}, N	0.85	5.20	v^x_L, N	0.59	7.83	v	n.s.
1978	3.16	v^x_L, P	0.90	6.57	v^x_{LL}, P	0.71	2.62	v	n.s.
1979	5.52	v^x_{LL}, P	0.66	3.00	v^x_{LL}, P	0.94	6.44	v^x_{LL}, P	0.83
1980	4.94	v	n.s.	4.39	v	n.s.	7.06	v^x_{LL}, P	0.57
1981	5.28	v	n.s.	4.95	v	n.s.	4.08	v	n.s.

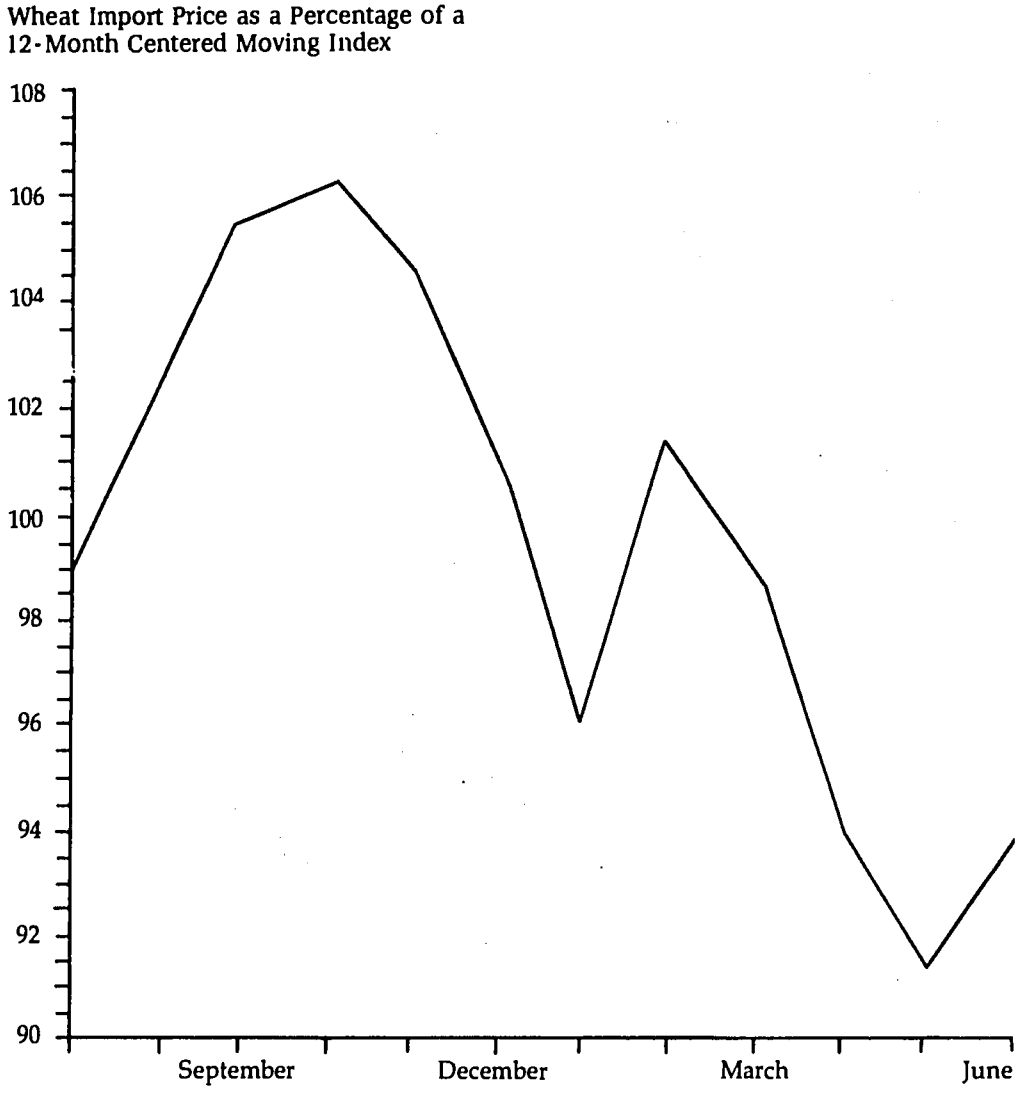
Source: Food and Agriculture Organization of the United Nations, *Monthly Bulletin of Statistics*, various issues (Rome: FAO, various years).

Notes: These are the averages of 12 months ending in July, except for the 1974 index for maize, which is only 11 months, from September to July. v is the coefficient of variation; v^x_L is the corrected coefficient of variation (linear trend); v^x_{LL} is the corrected coefficient of variation (log linear trend); P is the positive trend; and N is the negative trend. Where n.s. appears, the statistic was not significant at the 1 percent level. The wheat is U.S. No. 1 Hard Red Winter, f.o.b. Gulf, until June 1969, and No. 2 thereafter. The maize is U.S. No. L/3 Yellow, c.i.f. North Sea Ports. The barley is Canada Feed No. 1, in store, Thunder Bay.

seasonal pattern of world market prices reflects storage costs less than the timing of harvesting in different parts of the world. Due to the instability in the seasonal pattern of world market prices, Figure 9 is only a general guide to EC policy. Nevertheless, policy instruments that link domestic and world market price patterns will lead to an increase in domestic welfare. Such a linkage also would have stabilizing effects on world market prices and, hence, would be favored in the rest of the world.

By setting monthly intervention prices the EC authorities guarantee specified price differentials from month to month (Table 26). These differentials are supposed to make up for storage costs of private stockholders. So EC authorities should have exact information about the storage price for marginal private stockholders. It seems unlikely that they do.

Figure 9—Seasonal index of wheat import prices



Source: International Wheat Council, *World Wheat Statistics*, various issues (London: International Wheat Council, various years).

Note: The prices are in European Currency Units, c.i.f. Rotterdam.

Table 26—Intervention prices and opportunity costs of capital invested in storing soft wheat in the Federal Republic of Germany, selected years, 1972/73-1980/81

Year/Cost/Country	August	September	October	November	December	January	February	March	April	May	Change in Monthly Prices
			(DM/quintal)					(DM/quintal)			(percent)
1972/73											
Intervention price	38.34	38.73	39.12	39.51	39.90	40.30	40.69	41.08	41.47	41.86	1.02
Monthly increment	...	0.39	0.39	0.39	0.39	0.40	0.39	0.39	0.39	0.39	
Monthly opportunity cost											
United Kingdom	...	−0.07	−0.31	0.06	0.11	0.03	−0.59	0.05	0.06	−0.12	
Federal Republic of Germany	...	0.16	0.20	0.19	0.22	0.19	0.07	0.39	0.51	0.26	
1974/75											
Intervention price	40.27	40.67	41.08	41.48	41.88	42.28	42.69	43.09	43.49	43.89	1.00
Monthly increment	...	0.40	0.41	0.40	0.40	0.40	0.41	0.40	0.40	0.40	
Monthly opportunity cost											
United Kingdom	...	0.23	0.15	−0.11	−0.11	0.14	−0.00	0.21	−0.05	0.04	
Federal Republic of Germany	...	0.31	0.31	0.26	0.29	0.27	0.16	0.16	0.17	0.20	
1977/78											
Intervention price	40.97	41.47	41.97	42.46	42.96	43.46	43.96	44.46	44.96	45.45	1.21
Monthly increment	...	0.50	0.50	0.49	0.50	0.50	0.50	0.50	0.50	0.49	
Monthly opportunity cost											
United Kingdom	...	0.03	0.44	−0.07	0.14	0.14	−0.27	−0.43	0.03	0.05	
Federal Republic of Germany	...	0.14	0.14	0.14	0.12	0.12	0.12	0.13	0.13	0.13	
1980/81											
Intervention price	42.89	43.41	43.92	44.44	44.95	45.47	45.98	46.50	47.01	47.53	1.20
Monthly increment	...	0.52	0.51	0.52	0.51	0.52	0.51	0.52	0.51	0.52	
Monthly opportunity cost											
United Kingdom	...	0.36	0.94	0.14	0.48	1.01	−0.19	0.47	0.58	0.57	
Federal Republic of Germany	...	0.34	0.33	0.33	0.34	0.34	0.40	0.47	0.44	0.47	

Source: Bundesministerium für Ernährung, Landwirtschaft und Forsten, *Statistische Monatsberichte*, various issues (Bonn: Bundesministerium für Ernährung, Landwirtschaft und Forsten, various years).

The price of storage depends not only on actual storage costs, but on the convenience yield as well. Even actual storage costs are not constant because interest rates, the main determinant of storage costs, vary.[26] It is likely that the monthly price intervals set for EC grain prices will differ from the private price of storage. If the intervals are lower, storage by the intervention warehouses will be favored. This happened from 1980 to 1982 when monthly increments did not compensate for even the interest forgone by private stockholding (Table 26). If the intervals are higher, private stockholders would earn a rent and would keep high stocks that would have to be sold to the intervention warehouses or exported near the end of the crop year. Resources would be wasted.

The report system and monetary policy also distort the trade flows between member countries of the EC. The EC produces more wheat and barley than it consumes. In such a situation, market prices would be expected to equal intervention prices in the surplus regions and be above intervention prices in importing areas. In equilibrium the price differential would equal the costs of transporting the products from one region to the other. That is shown in Figure 10. If the reports would allow an intertemporal equilibrium in the surplus region, the price path in the importing region should be above intervention prices. The price differential between the two regions would equal transportation costs at any time if the price is at equilibrium. It is assumed that price line T_0 characterizes such a situation. As private storage costs are determined by the increase in market prices from period to period, it pays to have private stocks in both regions.

Now assume that private storage costs go up because interest rates are higher. The monthly differential for grain prices should be allowed to increase in both regions. However, since the price differential in the surplus region has been set by variations in monthly intervention prices, market prices do not reflect the change in storage costs due to higher interest rates. This would tend to crowd out private storage holders in favor of public stocks.

The situation in the deficit region might be different. The seasonal price pattern line, T_0, would not be directly affected by intervention prices in the initial period. Private storage holders would not be affected if the new price line, T_1, reflects the increased storage costs resulting from interest rates. However, such a situation would not be consistent with an interregional price equilibrium. It could result only if interest rates caused transport and storage costs to increase by the same amount. This would be unlikely since storage costs are usually more sensitive to interest rates than transport costs. Hence, price path T_1 cannot prevail in an equilibrium situation since it would not pay for private storage holders to hold private stocks in the deficit region. The total crop would be sold to the intervention stores after the harvest and market prices would drop to the intervention level even in the importing region. Private intra-EC trade would vanish in favor of state trading. Increased interest rates could not only crowd out private storage holders but also private grain dealers in intra-EC grain trade.

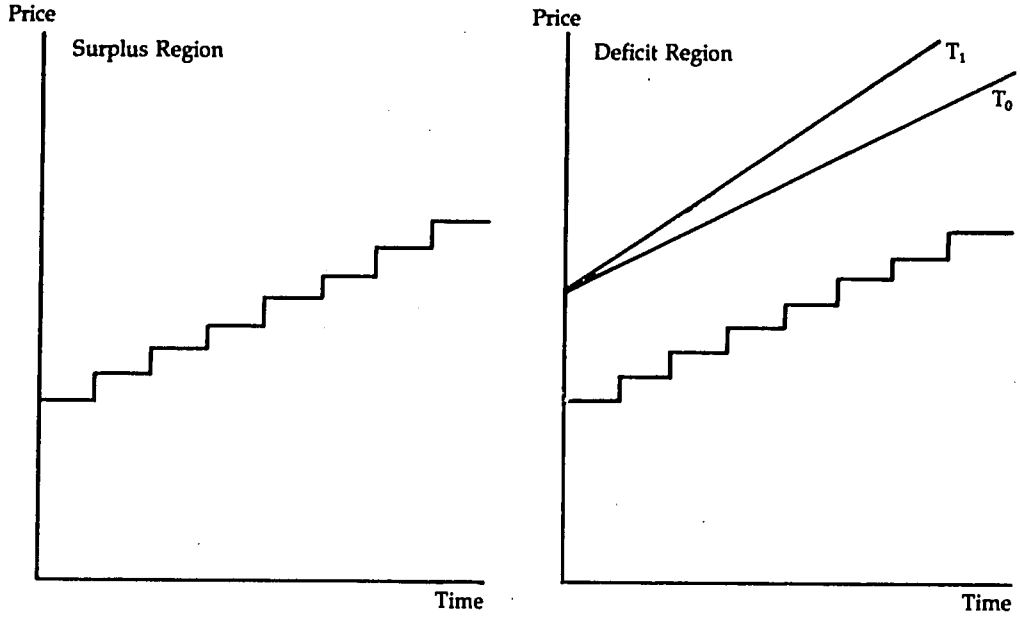
EC and World Market Seasonal Prices

Domestic seasonal prices could be linked to world market prices by allowing arbitrage within a crop year. Exporters could be permitted to export a given quantity of a grain in one month and reimport the same quantity in the same crop year. No export restitutions should be paid nor import levies imposed, so that the EC budget would not be affected. Assume, for example, the following:

Market	Actual Prices in Period t_0	Expected Prices in Period t_1
	(U.S. $/metric ton)	
EC	50	51
World	30	29

[26] German grain dealers gave the following information about monthly storage costs for wheat in October 1981 (the price of wheat was DM 500 per metric ton). Waste (with 16 percent humidity) was 0.1 percent of value, or DM 0.50 per metric ton. Interest, at 1.00-1.16 percent, was DM 5.50-5.85 per metric ton. Storage costs for silo were DM 2.50 per metric ton on land and DM 3.00-4.00 per metric ton at sea. Insurance was DM 0.1 per metric ton. So total costs were DM 8.60 per metric ton on land and 9.60-10.40 per metric ton at sea.

Figure 10—Intertemporal price relationship for two markets in equilibrium



An EC exporter would lose U.S. $20 in period t_0 but would gain $22 by reimporting the same quantity in period t_1. His net gain would always be positive if the price differential in period t_0 were to be less than in period t_1.

Such arbitrage would involve some risk because there is no guarantee that seasonal price changes on the world market would parallel those in the EC. But this type of arbitrage would allow EC grain dealers to deal on the futures markets, which they cannot do now.

6

POLICY OPTIONS FOR EC PRODUCTION, STORAGE, AND TRADE

The contribution of the EC to the periodic shocks the world grain economy has suffered has been given little attention. The world grain economy might be even more volatile with a liberal EC grain economy if EC production were more stable than rest-of-the-world production. As EC's share in world grain production would be smaller with a liberalized EC grain economy than under the present policy, fluctuations in total world grain production might also be greater.

The effect of EC grain policy on world grain production may well depend on which instability index is chosen. Quite often, instability is measured by variance. However, variance is an inadequate measure for the problem under consideration because it does not take into account the influence the EC grain policy has on production. Even if the variance of world production is the same with and without EC liberalized trade, trade shocks as measured by percentage deviations from expected values would differ. Hence, a coefficient of variation corrected by underlying trends is preferable. In the following, a time series is defined as unstable if the data are scattered around a trend line. If all observed data were on the trend line, the time series would be totally stable. But even then the coefficient of variation would indicate some instability. Hence, the coefficient of variation will be corrected by the fitness of the trend regression. This method follows directly the proposal by Cuddy and Della Valle.[27] The index (I) chosen is:

$$I = CV\sqrt{1 - \bar{R}^2}, \qquad (16)$$

where there is a linear trend. For a nonlinear trend the index is:

$$I = CV^2\sqrt{1 - \bar{R}^2}\sqrt{(1 - R_a^2)/(1 - R^2)},$$

where CV is the coefficient of variation and $\bar{R}^2$ is the corrected coefficient of determination, R^2 is the coefficient of determination of the linear trend model, and R_a^2 is the coefficient of determination of the nonlinear trend model.

Before presenting the results of the empirical analysis, the set of conditions that would have to prevail if the present protective EC policy were to stabilize world grain production is derived.

The variance in total world grain production is given by

$$\sigma_W^2 = \sigma_E^2 + \sigma_R^2 + 2r\sigma_E\sigma_R, \qquad (17)$$

where

σ_W^2 = variance of world production,

σ_E^2 = variance of EC production,

σ_R^2 = variance of production by the rest of the world,

σ_E = standard deviation of EC production,

σ_R = standard deviation of production by the rest of the world, and

r = coefficient of correlation.

From equation (17) the coefficient of variation can be derived. This results in:

$$CV_W^2 = s_E^2\, CV_E^2 + s_R^2\, CV_R^2 + s_E\, s_R\, 2r\, CV_E\, CV_R, \qquad (18)$$

where s_E is the share of EC in world production and s_R is the share of the rest of the world in world production.

In the following it is assumed that liberalizing the EC grain economy would affect

[27] See J. D. A. Cuddy and P. A. Della Valle, "Measuring the Instability of Time-Series Data," *Oxford Bulletin of Economics and Statistics* 40 (February 1978), p. 79; P. A. Della Valle, "On the Instability Index of Time-Series Data: A Generalization," *Oxford Bulletin of Economics and Statistics* 41 (August 1979), p. 247.

the shares of the EC and the rest of the world in production, but would not change the coefficient of variation. Hence, equation (18) has to be totally differentiated. This results in:

$$CV_W\, dCV_W = CV_E^2 \cdot s_E \cdot ds_E + CV_R^2 \cdot s_R \cdot ds_R + s_R\, rCV_E\, CV_R \cdot ds_E + s_E\, rCV_E\, CV_R \cdot ds_R. \quad (19)$$

If a reallocation of world grain production from the EC to the rest of the world were to decrease the variability of world grain production, it must hold that

$$d\, CV_W < 0. \quad (20)$$

As $s_E + s_R = 1$, it is always true that

$$ds_E = -ds_R. \quad (21)$$

The necessary condition under which liberalizing the EC grain economy can decrease the fluctuations of world grain production can be derived from equations (19) to (21). This results in:

$$CV_R/CV_E > (s_E CV_E + s_R rCV_R)/(s_R CV_R + s_E rCV_E). \quad (22)$$

If production fluctuations in the EC and in the rest of the world are independent, then r equals 0. In this case, the necessary condition is

$$CV_R^2/CV_E^2 < s_E/s_R. \quad (23)$$

Equations (22) and (23) state the necessary and sufficient conditions for EC trade liberalization to decrease fluctuations in world production.

In carrying out the calculations, deviations from the trend of production by the EC and the rest of the world are correlated in order to determine r. The results were not significant on the 5 percent level for the period 1961 to 1980 (for wheat, r = 0.32; for maize, r = −0.04; for barley, r = −0.24; and for oats, r = 0.32). Due to these results, equation (23) has to be applied instead of equation (22) in order to test whether liberalization of the EC grain economy would help to stabilize world grain production. An overview of the results is given in Table 27.

It turns out that equation (23) is not verified by the data. Hence, it must be concluded that liberalization of the EC grain economy might increase the coefficient of variation in world grain production. This is true even though the coefficient of variation for EC production is higher than for production by the rest of the world for wheat, barley, and maize. Hence, the hypothesis that the shocks the world grain economy receives from time to time are more likely to be smaller with a protectionistic EC grain policy than with a liberalized EC grain policy cannot be rejected. However, the effect would be negligible. If, for example, the share of EC wheat production in world production should go down from 13 percent to 10 percent, the coefficient of variation for world production would increase from 4.97 to 5.05.

A comparison of instability indexes for the EC and the rest of the world (Table 28) shows that not only production but yields and area harvested fluctuate more in the EC.

Table 27—Ratio of coefficients of variation and ratio of share in production of the European Community and the rest of the world, 1961-79

Grain	Ratio of Corrected Coefficients of Variation (CV_R^2/CV_E^2)	Ratio of Production Shares for 1980 (s_E/s_R)
Wheat	0.46	0.14
Barley	0.81	0.33
Maize	0.08	0.05
Oats	1.01	0.17

Source: Calculations based on data from the Food and Agriculture Organization of the United Nations, *Production Yearbook*, various issues (Rome: FAO, various years).

Notes: CV_R is the coefficient of variation of the rest of the world; CV_E is the coefficient of variation of the European Community. s_E is the share of the European Community in world production; s_R is the share of the rest of the world in world production.

Table 28—Instability indexes of grain production in the European Community and the rest of the world, 1961-79

Crop/Variable	European Community			Rest of the World		
	Index	Instability Measure	$\bar{R}^2$	Index	Instability Measure	$\bar{R}^2$
Wheat						
Yield	6.24	v_L^x	0.85	5.22	v_L^x	0.88
Area harvested	4.02	v	n.s.	2.64	v_L^x	0.76
Production	8.19	v_L^x	0.70	5.54	v_{LL}^x	0.92
Barley						
Yield	6.38	v_L^x	0.58	7.33	v_{LL}^x	0.64
Area harvested	4.77	v_L^x	0.86	3.80	v_{LL}^x	0.91
Production	7.55	v_L^x	0.87	6.79	v_{LL}^x	0.91
Maize						
Yield	9.0	v_L^x	0.82	3.82	v_{LL}^x	0.91
Area harvested	9.3	v_{LL}^x	0.69	1.49	v_{LL}^x	0.94
Production	13.63	v_L^x	0.85	3.92	v_{LL}^x	0.96
Oats						
Yield	8.44	v_{LL}^x	0.64	7.14	v_{LL}^x	0.42
Area harvested	3.19	v_{LL}^x	0.98	5.79	v_{LL}^x	0.33
Production	8.19	v_L^x	0.61	8.22	v	n.s.

Source: Calculations based on data from the Food and Agriculture Organization of the United Nations, *Production Yearbook*, various issues (Rome: FAO, various years).

Notes: v is the coefficient of variation; v_L^x is the corrected coefficient of variation (linear trend), and v_{LL}^x is the corrected coefficient of variation (log linear trend). Where n.s. appears, the statistic was not significant at the 1 percent level.

The high instability of the area harvested is surprising as the stability in grain prices for producers resulting from the EC grain market organization might be expected to contribute to the stability of harvested area. However, harvested area fluctuates more for wheat, barley, and maize than in the rest of the world. Only the harvested area of oats is more stable in the EC. A hypothesis to explain this phenomenon follows.

There is a strong argument that EC price stabilization leads to an increase in the variability of EC production for certain types of grain. Price stabilization is likely to decrease the variability of area planted with wheat and barley but increase the variability of area harvested. This could result if yields expected in spring are much lower than those that were anticipated at planting time in the preceding fall. If this were so, EC farmers might decide to grow spring cereals (barley and oats) on the area originally planted with winter crops. The decision to replant would be affected by different considerations when price stabilization is in effect than in a free market. In the latter case low yields for winter crops would lead to higher market prices whereas shifting from winter crops to spring crops would depress market prices for spring crops. Consequently, farmers would have less incentive to replant. Thus the effect of adverse weather conditions on area harvested and on production of certain types of grain is stronger in the EC than under free market conditions.

This instability could be mitigated if the EC were to allow some flexibility of producer prices in accordance with variations expected in yields. At present, domestic producer prices are allowed to vary between the target and intervention prices. Because of the surplus of wheat and barley, however, market prices are determined by intervention prices and are independent of weather con-

ditions. The EC could allow for more variability in producer prices by modifying export policy. At present, when market prices tend to fall below intervention prices, as often happens, intervention stores have to buy the quantities in excess of private demand. These are eventually sold on the world market. There is no economic reason why the public should buy on the domestic market, store the commodities, and then sell on the world market. It would be more reasonable to increase private demand on the domestic markets by paying an adequate export restitution. Thus, domestic prices would stay above intervention prices and could vary with the outcome of the domestic harvest. Average producer prices would be completely unaffected. This policy would not only help to stabilize domestic production of certain types of grain, but could stabilize producers' revenues as well by offsetting adverse weather and crop conditions with higher prices.

Carryover Stocks and Trade

The effect of a given set of EC policy instruments on world market prices also depends on storage activities. Their importance has been emphasized by Josling.[28] In the following, carryover stocks are defined as that part of interseasonal stocks not needed as working stocks. Unfortunately, there is no precise information available about national carryover stocks. Official statistics only report the stocks held at the end of the crop year, which include carryover stocks and the working stocks needed for domestic consumption from the end of the crop year until grain becomes available from the new harvest. The amount of working stocks needed at t_0 should equal the amount consumed between t_0 and t_1 if storage costs are smaller or equal to the difference between import prices at the end of crop year t_0 and at a time before the arrival of the new harvest (t_1). If EC storage costs are higher than this price differential, the only purpose working stocks serve is to allow a continuous flow of consumption domestically if there is some delay in imports. The amount of stocks needed to meet domestic consumption needs if imports are delayed also depends on the size of the region. The larger the region the lower the probability that the region as a whole will suffer from delays in delivery. From this it follows that the EC-10 needs relatively smaller working stocks of imported grains than the EC-6. Furthermore, there is a wide range of substitution possibilities among grains and other feedstuffs such as cassava and soya. Hence, working stocks of grains that the EC imports could be quite low. As the statistical crop year ends July 31, and the harvest starts in July or August, there is little need for working stocks, especially if EC storage costs are higher than the price differential for imports before grain from the new harvest arrives.

Working stocks at t_0 may be much higher for exported grain. Exports could be concentrated in the period t_0 to t_1 if this is profitable. Hence, the determination of the optimal level of working stocks depends on the seasonal price pattern on the world market and EC storage costs. It is obvious from Figure 11 that EC exports of wheat should be spread through the fall but should be minimal after December. And so there should be no working stocks for exports at the end of the year, before the new harvest arrives.

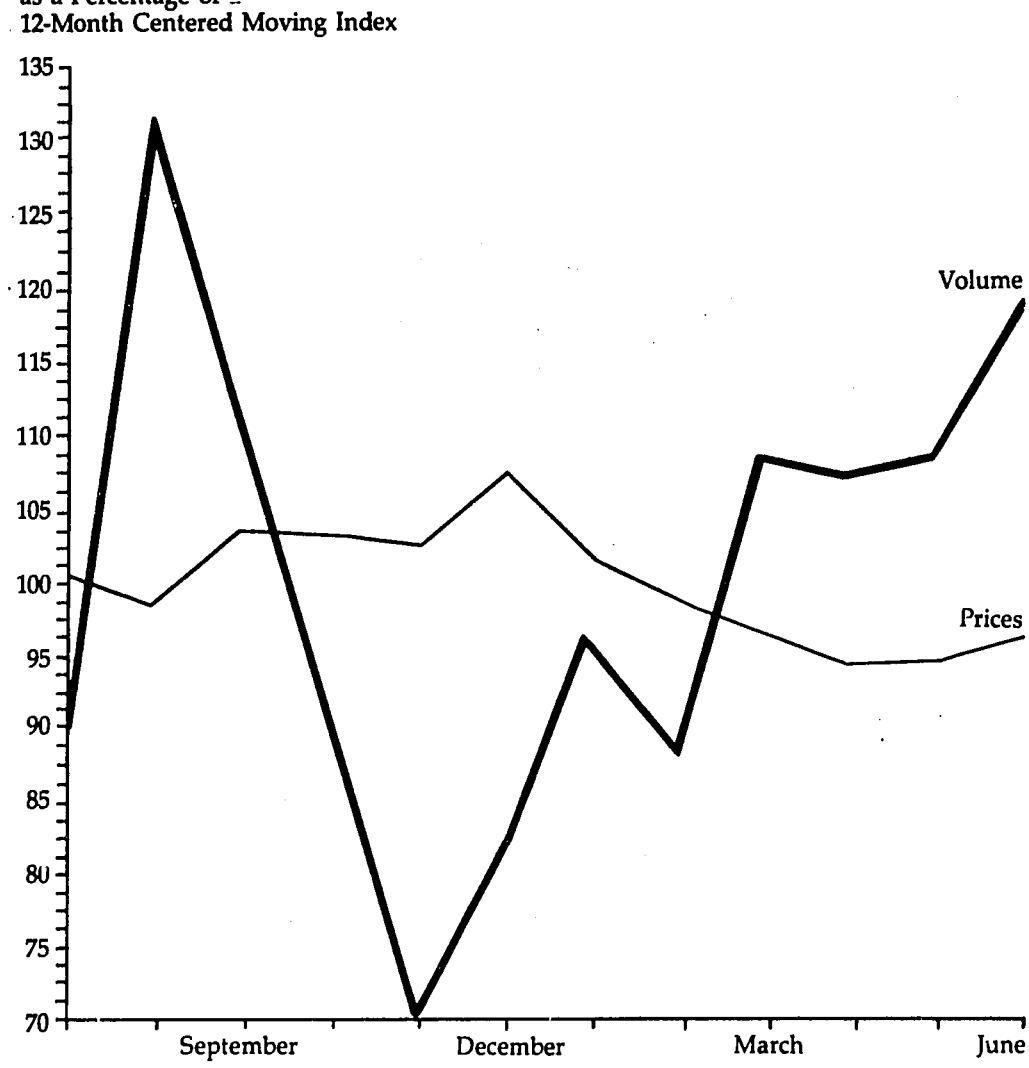
Unfortunately, it is not possible to give an exact quantification of working stocks. Morrow assumed that they are equivalent to the lowest ending stocks over a given period of years.[29] Some purposes require only knowledge of changes in carryover stocks. Hence, it is assumed that changes in ending and carryover stocks are equal. This implies that working stocks are constant over time, an assumption implicit in Morrow's procedure as well. Where the absolute size of carryover stocks is needed, it is assumed that working stocks are 1.5 times average monthly consumption.

The determinants of privately owned stocks differ from those of stocks held by

[28] Josling, "Price, Stock, and Trade Policies."

[29] Daniel T. Morrow, *The Economics of the International Stockholding of Wheat*, Research Report 18 (Washington, D.C.: International Food Policy Research Institute, 1980).

Figure 11—Seasonal indexes of wheat export volume and prices



Source: International Wheat Council, *World Wheat Statistics*, various issues (London: World Wheat Council, various years).

the public. A major difference is the role of price expectations for private stockpiling. These expectations in turn are influenced by the EC grain market policy.

EC grain prices are totally disconnected from the world market by variable levies or import restrictions, which make up the differences between EC prices and world market prices. Consequently, expectations about market prices for grain are irrelevant for private EC stockholders. The incentives to hold private carryover stocks are also distorted by the changes in the effective rate of protection of grain storage in the EC, which are cyclical and negative. They are more negative for negative changes in world market prices and less negative for positive changes in world market prices. This can be shown, beginning with the formula for the effective rate of protection:

$$T_r = (V^E - V^W)/V^W, \qquad (24)$$

where T_r is the rate of effective protection of grain storage in the EC, V^E is the value added of grain storage in the EC prices, and V^W is the value added of grain storage in the EC at world market prices. The value added for grain storage is:

$$V = p_t\, q - p_0 q, \qquad (25)$$

where p_t are the prices for grain in period t, p_0 are the prices for grain in period 0, and q is the quantity stored. Hence,

$$\begin{aligned} T_r &= [p_t^E q^E - p_0^E q^E - (p_t^W q^E - p_0^W q^E)]/ \\ &\quad (p_t^W q^E - p_0^W q^E) \\ &= [(p_t^E q^E - p_0^E q^E)/ \\ &\quad (p_t^W q^E - p_0^W q^E)] - 1, \qquad (26) \end{aligned}$$

where E indicates variables in the EC and w indicates variables on the world market.

The difference between year to year prices in the EC is the result of policy decisions. For example, German wheat intervention prices increased almost steadily by 0.5 percent annually from 1973/74 to 1980/81 and wheat market prices increased 1.8 percent. Hence, value added for holding private carryover stocks was 1.8 percent of the monthly value of stored wheat in Germany. However, with world market prices for grain, whether the value added of storage was positive or negative depended on the changes in world market prices from year to year. This indicates that where expected and actual increases in world market prices were far greater than those in the EC, the effective rate of protection for EC storage was negative and slightly less than 100 percent. For expected and actual decreases in world market prices, the effective rate of protection is negative as well, but greater than 100 percent. Thus the EC grain market regulation is prohibitive for the private holding of carryover stocks.

Even if changes in EC prices from year to year were the same as changes in world market prices, the rate of protection would be negative. This is because EC grain prices are higher than world market prices. So storage implies a higher capital investment in the EC than outside.

This analysis clearly shows that it is unlikely that changes in private stocks for grain in the EC will correspond to changes in world market prices. Carryover stocks in the EC will be public, not private.

There are other ways of evaluating the performance of EC carryover stocks. Past EC carryover stocks could be compared to the optimum level of stocks.[30] This would require determination of the optimum level of storage as the first step. However, it is questionable whether this alternative should be chosen. An optimal storage rule can only be derived from a well-defined objective function. It may well be, for example, that EC carryover stocks would be optimal for the EC but not for the world as a whole. First, this would certainly be so if the EC faced a price-demand function that is not completely elastic. This would allow the EC to exert at least some market power. It is obvious that optimum storage is different for a monopolistic storage holder than for a price taker. Second, if there were a high negative correlation between changes in carryover stocks in the EC and changes in those elsewhere, a storage rule that is optimal for the EC would differ greatly from an optimal one for the world. As it is not known how other stockholders would react to changes in EC stocks, it is not possible to derive an optimal storage rule for the EC.

Having no optimal storage rule at hand, alternative procedures are followed. First, the size of EC stocks of wheat is evaluated. Second, past changes in stocks are compared with postulated norms. The size of the stocks indicates the potential for stabilizing the world market but does not indicate the stabilizing effects of the storage policy. Such an effect can arise only if changes in stocks are related negatively to changes in production. A given storage policy can have an adequate stabilizing effect only if the size of stocks is adequate.

As an optimal size of stocks for the EC cannot be derived, EC carryover stocks are compared with those of the world as a whole and the world excluding the EC. Table 29 shows that the relation of EC wheat production

[30] See Bruce L. Gardner, *Optimal Stockpiling of Grain* (Lexington, Mass.: Lexington Books, 1979).

Table 29—Production and stockpiling of wheat, 1968/69-1980/81

Year	Wheat Production: World	Wheat Production: European Community	Wheat Production: Rest of the World	Ratios of Production: European Community to World	Ratios of Production: Rest of the World to World	Carry-Over Stocks: European Community	Carry-Over Stocks: Rest of the World	Ratios of Carry-Over Stocks: European Community to Rest of the World	Ratios of Carry-Over Stocks: Rest of the World to World
	(million metric tons)					(million metric tons)			
1968/69	328.3	36.8	291.5	0.112	0.126	3.8	81.6	0.052	0.050
1969/70	309.6	35.7	273.9	0.115	0.130	0.0	56.8	0.000	0.000
1970/71	315.5	34.8	280.7	0.110	0.124	0.4	31.4	0.013	0.013
1971/72	349.3	40.1	309.2	0.115	0.130	1.9	36.4	0.052	0.050
1972/73	343.4	41.5	301.9	0.121	0.137	0.5	16.9	0.003	0.029
1973/74	372.6	41.4	331.2	0.111	0.125	2.3	22.5	0.102	0.093
1974/75	357.3	45.4	311.9	0.127	0.146	4.6	13.8	0.333	0.250
1975/76	350.6	38.1	312.5	0.109	0.122	2.8	16.1	0.174	0.149
1976/77	421.2	39.1	382.1	0.093	0.102	2.2	48.6	0.045	0.043
1977/78	384.4	38.4	346.0	0.100	0.111	1.2	30.1	0.040	0.038
1978/79	446.6	47.6	399.0	0.107	0.119	3.9	43.3	0.090	0.083
1979/80	422.3	46.4	375.9	0.110	0.123	2.6	21.2	0.123	0.109
1980/81	438.7[a]	51.9	386.8	0.118	0.134	3.2	15.9	0.201	0.168

Sources: The world wheat production figures are from U.S. Department of Agriculture, Foreign Agricultural Service, *Foreign Agriculture Circular—Grains*, FG-46-81 (Washington, D.C.: USDA, December 1981); the European Community wheat production figures are from USDA, Foreign Agricultural Service, *Foreign Agriculture Circular—Grains*, FG-42-81 (Washington, D.C.: USDA, December 11, 1981), except for the 1980/81 figure, which is from Food and Agriculture Organization of the United Nations, *Production Yearbook* (Rome: FAO, 1980).

[a] This is a preliminary estimate.

to world production in most years is higher than the ratio of the EC's carryover stocks to either the world's carryover stocks or to the rest of the world's stocks. If EC stocks are considered adequate when the ratio between EC stocks and world stocks is at least equal to the ratio between EC production and world production, then EC stocks were adequate in only two years from 1968/69 to 1980/81. It may be argued that EC stocks should be even higher. If stocks were optimally distributed worldwide, exporters would have higher stocks than importers because prices in the export regions and, therefore, storage costs could be lower.[31] In addition, wastage and interest rates, the most important determinants of storage costs, are supposed to be lower than in developing countries. This supports the argument that EC stocks should be even higher than indicated above. It also strongly supports the argument that EC wheat stocks were inadequate during the period 1968/69-1980/81.

Aside from its effect on the world wheat market, EC storage policy could be effective if changes in stocks were in line with stabilizing needs. This is investigated as follows:

First, the effects of domestic supply fluctuations on world markets are determined. It is shown above that EC wheat production fluctuates independently of the rest of the world. Hence, the total variance of world wheat production is given by

$$\sigma^2_{Wp} = \sigma^2_{Ep} + \sigma^2_{Rp}, \qquad (27)$$

where σ^2_{Wp} is the variance of world production, σ^2_{Ep} is the variance of EC production, and σ^2_{Rp} is the variance of production of the rest of the world. Without any storage activities the

[31] See United Nations, Department of International Economics and Social Affairs, Statistical Office of the United Nations, *Storage Costs and Warehouse Facilities* (Geneva: FAO/ECE, 1978).

variance of world supply (σ^2_{Ws}) would equal that of world production. With storage activities the variation in world supply is given by:

$$\sigma^2_{Ws} = \sigma^2_{Wp} + \sigma^2_{Wst} + 2r\sigma_{Wp}\,\sigma_{Wst}, \quad (28)$$

where σ^2_{Wst} is the variance of supply due to changes in storage, σ_{Wst} is the standard deviation of supply due to changes in storage, and r is the coefficient of correlation between the fluctuations in production and the fluctuations in supply due to changes in storage.

To derive an empirical answer about whether EC supply fluctuations increased instability in world market prices, a regression was run between deviations from the trend of EC production and changes in stocks for the 1970-81 period. The result is

$$\Delta St^E = -0.0597 + \underset{(1.96)}{0.3}\,\Delta Q^E; \quad (29)$$

$$\bar{R}^2 = 0.21,$$

where ΔSt^E are deviations from the trend of EC production (t values, here and below, are in parentheses).

The finding says that EC storage only partly compensates for fluctuations in EC production. Hence, fluctuations in EC production affected the rest of the world as well.

Second, an investigation is made into whether changes in EC stocks of wheat corresponded to fluctuations in world wheat production (ΔQ^W) for the same period. This result is

$$\Delta St^E = 0.0023 + \underset{(1.79)}{0.051}\,\Delta Q^W; \quad (30)$$

$$\bar{R}^2 = 0.17.$$

It shows that only 17 percent of the variance in EC wheat stocks can be explained by the variance in world wheat production. Again, this says that EC storage activities were of little help in stabilizing the world wheat market.

Next, a test is made of whether changes in EC stocks were in line with changes in world stocks (ΔSt^W). The following regression is run,

$$\Delta St^E = 0.240 + \underset{(1.86)}{0.0524}\,\Delta St^W;$$

$$\bar{R}^2 = 0.184. \quad (31)$$

The results show no significant correlation between changes in EC and world stocks. Obviously, the EC storage activities are not well integrated in worldwide storage activities.

One more test is tried. As mentioned above, private carryover stocks in the EC are minimal. If carryover stocks in the EC did not change in accordance with needs for stabilizing world market prices, it may be because the expectations of public storage authorities about future prices proved to be incorrect. To test this hypothesis, the question whether the use of grain price quotations on the futures markets would have led to better results is examined. Changes in EC carryover stocks of year t are correlated with the difference in prices between October future prices in year t and September spot prices in the previous year (t−1). This calculation implies that EC grain from a new harvest is available for shipping in September. Hence, the EC storage authority could decide then how large the carryover stocks should be. Storage would be nearly riskless if the quantity stored were sold on the futures markets. Futures contracts for wheat are traded up to 13 months in advance. So the September price of year t is compared with the October price of the next year (t+1).

A significant positive correlation could indicate some rationale behind EC storage policy. A significant negative correlation or an insignificant correlation would mean an uneconomic EC storage policy. The comparisons are shown in Table 30. A positive sign for yearly data in the columns for EC ending stocks and futures prices indicates that EC stocks increased in expectation of price increases a year ahead. A negative sign for the figures in these columns indicates the opposite. The sign is correct in only four out of nine years. EC stocks even increased in 1973 and 1974 when world market prices were extremely high and expectations were for lower prices.

The regression analysis between changes in stocks and the price differential yielded no significant result ($\bar{R}^2 = 0.05$). Hence, the hypothesis that EC storage policy is economically rational cannot be supported.

Table 30—Stocks and cash and futures prices for wheat, 1969-78

Year	European Community Ending Stocks	Increment to Stocks[a]	Cash Prices	Futures Prices	Difference Between Futures Prices and Cash Prices of Previous Year
	(1,000 metric tons)			(U.S. $/bushel)	
1969	5,106	...	1.36	...	...
1970	5,498	383	1.74	1.3925	0.0325
1971	7,001	1,512	1.53	1.615	-0.125
1972	5,818	-1,183	2.11	1.411	-0.119
1973	7,286	1,468	4.75	1.945	-0.165
1974	9.731	2,445	5.03	3.84	-0.91
1975	7,534	-2,197	3.84	4.88	-0.15
1976	7,043	-491	2.72	4.26	0.42
1977	6,097	-946	2.27	3.18	0.46
1978	8,989	2,892	...	2.75	0.483

Sources: The figures for the European Community ending stocks are from U.S. Department of Agriculture, Economic Research Service, *Foreign Agricultural Situation*, various issues (Washington, D.C.: USDA, various years); and the cash and futures prices are from Chicago Board of Trade, *Statistical Annual*, various issues.

Notes: The cash prices are the Chicago contract cash prices in October. The wheat futures prices are those of October 15 of one year for futures in the following September.

Inadequate changes in carryover stocks imply that the EC's fluctuations in export supply or import demand are not in line with the objective of stabilizing the world grain market.

EC Export Policy for Grain

Grain exports of the EC depend solely on the administrative disposal of surpluses (annual domestic production minus annual domestic consumption). There are three administrative channels for marketing EC exports.

First, an administrative committee of the EC announces weekly export restitutions, which are paid to those who ask for an export license. The export restitutions are supposed to bridge the gap between EC prices and world market prices. Regionalization of restitutions with respect to receiver countries can be applied. Exporters who ask for a license have to export within three months.

Second, exports are made out of intervention stores according to the principles described for the first channel. Intervention stores announce the quantities they want to export and the restitution they are willing to pay. Individual bidders have to be located within the EC.

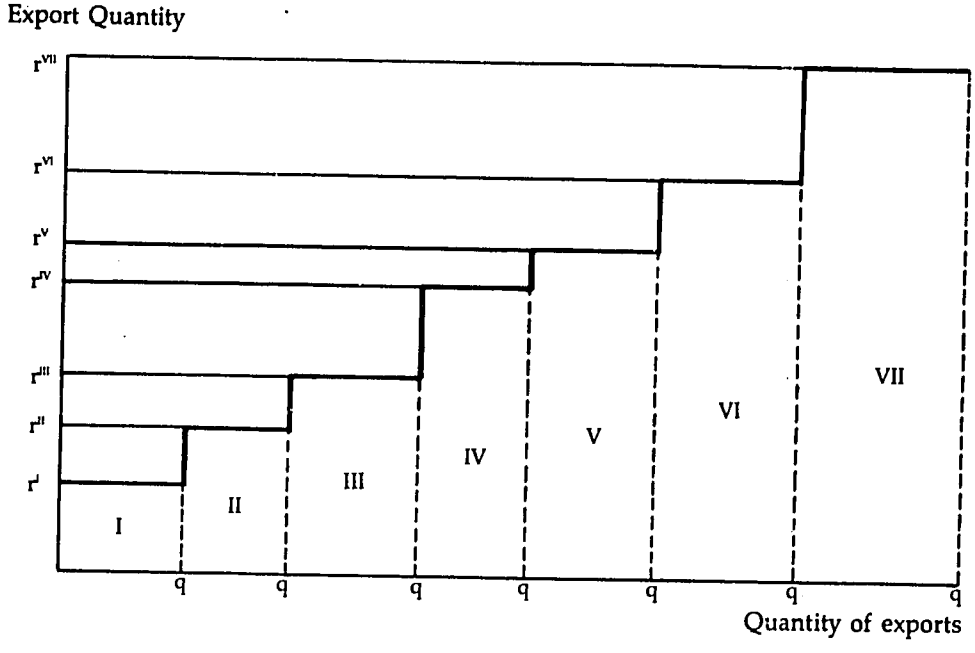
Third, exports are made under the permanent bidding system. This has increased in importance. The EC Commission announces the quantity available for export in a given period, usually of several months. Bidders are allowed to make offers each week, stating how much they are willing to export and the export restitution they will require. If these offers are accepted they receive a license to export during that and the following four months. Export restitution also may be set by region of destination.

All three export channels imply that private exporters' expectations of future world market prices are not relevant. This is true for the period in which the licenses are valid. If the differential between EC prices and world market prices at the time of exportation is different from that at the time the licenses were granted, export restitutions will be changed.

The present tender system, which provides for regionalization of export restitution, is not reasonable. The EC Commission divides the world grain market into seven subregions and is willing to pay higher export restitutions for exports to distant areas. This leads to variance of EC f.o.b. prices for grain and may allow the EC Commission to absorb the potential rent of exporters. Figure 12 helps to explain the general philosophy behind the present system.

It is assumed that European grain traders

Figure 12—Export restitutions per unit of exports in different export regions



are willing to export specified quantities to individual regions if they get the export restitution they ask for. Region I is close, so transport costs are low and it is assumed that EC exporters may be competitive at high prices. So exporters may ask for a small export restitution, which implies fairly high EC f.o.b. export prices. It is assumed that EC exporters are only competitive in distant regions if they receive a higher export restitution than exporters to region I. If, for example, the total export quantity is q^V, only those exporters who made offers for exports in regions I to V get access to the quantities asked for. However, exporters to region I get restitution r^I and exporters to region V get restitution r^V. This precludes exporters to regions I to IV from receiving a rent if they get restitution r^V. This system raises several problems, outlined below.

The idea that exporters to distant regions need higher subsidies than exporters to nearby regions is not reasonable. Competitiveness of EC exporters in foreign countries depends on prices in these countries and EC f.o.b. prices as well as transport costs. In a free, competitive world grain economy, national grain prices would reflect differing transport costs. Hence, an EC exporter to region I would receive the same profit as an EC exporter to region V, even with the same EC f.o.b. prices. Under present conditions, however, differences in national prices may be due more to national border regulations than to transport costs. If so, it is not reasonable to classify importing regions by their distance from the EC.

As pointed out above, exporters to nearby regions would not receive a rent if they had to pay the same f.o.b. export price as exporters to distant regions. Rents for EC grain exporters could vanish even in a trade-restricted world grain economy if the tender system were modified. If, for example, some exporters are willing to export the quantity q^I to import region I they may ask for restitution r^I. But they might be able to export as much as quantity q^V to region I if the export restitution were higher than r^I but lower than r^V. This could be true if the import demand of region I were not completely price inelastic. Hence, rents for EC exporters and the rationale of the EC restitution system imply that import demand is

completely price inelastic with respect to EC supplies to any importing region. This is definitely unrealistic. However, it cannot be denied that the import demand of some countries where trade is controlled by the state may be completely price inelastic and private and EC exporters might receive a rent by exporting to these countries instead of others. The potential rent could be captured easily by the EC if there were a separated bidding system for any region with price inelastic demand. Actually, no export restitution should be paid for these exports.

The functioning of a tender system depends to a large extent on the market structure. If there are only a few bidders, there are the dangers of collusion and strategy bidding. However, under the EC grain tender system, only EC exporters are allowed to bid. It is unlikely that the present tender system will function optimally, given the oligopolistic structure of the EC grain export market.

The license period for EC exports does not guarantee that exports will be made in either the month or the year of highest prices. For example, if an exporter receives a license in January he must export by the end of May, a period of low prices (Figure 11). It may be that he could get a higher price later in the year or could hedge on the futures market. The present system does not favor those who expect more profitable export alternatives in later periods. If high prices are expected, private traders would take this into consideration in bidding for export licenses and asking for export restitution. For instance, they might like to receive the license now and store the grain for future sale. This is not possible under present export regulations.

A reorientation of the EC export policy should include six elements:

First, the number of bidders should be as high as possible. All grain traders should get access to EC grain that has been designated for export, regardless of location and nationality.

Second, licenses should be valid for at least two years.

Third, the EC commission should determine the annual exportable surplus (production minus consumption minus planned changes in state-owned grain reserves) shortly after the size of the harvest is known. It should be sold through a tender system in a short period of time, say one month. This would guarantee that the quantity offered is large enough to attract a large number of bidders.

Fourth, the EC Commission should ask individual bidders to make offers with alternative export restitutions and export quantities.

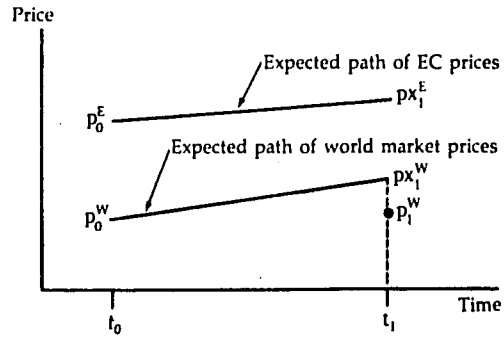
Fifth, the export restitution should be the same for all exporters.

Lastly, the EC Commission should set the export restitution as low as possible, compatible with selling the exportable surplus. This would guarantee that bidders for licenses will take into account the risk that the difference between expected world market prices and actual world market prices will change. The basic idea is clarified in Figure 13.

Assume that a potential exporter bids for a license at t_0 with actual EC price p_0^E and actual world market price p_0^W. Given the present system he would be willing to export only if an export restitution of $p_0^E - p_0^W$ is paid. For exports at a later time he would receive a smaller restitution. Under the present system the export restitution equals the difference between actual and domestic prices in all periods. Hence, there is no incentive to export when the gap between domestic and world market prices is smallest.

Under the proposed regulation, a bidder for a license asking for an export restitution at point t_0 would take into account the actual price at t_0, the expected trend of EC prices to the end of his license period, and the expected trend of world market prices.

Figure 13—Optimal relationship between the expected price pattern in the European Community and on the world market



The risk involved in expectations about EC prices is not high because of the intervention system. Moreover, the potential exporter may calculate the expected price as actual EC prices at t_0 plus storage costs, which are fairly well known. The risk of changes in world market prices from those expected can be largely offset by transactions on the futures markets. For the sake of simplicity, it is assumed in Figure 13 that the exporter's expected prices are equal to price quotations on the futures market. Given this situation, the potential exporter will ask for an export restitution equal to the difference between expected EC prices at time t (px_t^E) and expected world market prices at time t_1 (px_1^E). Hence, he would export at time t_1. Thus, the system would guarantee that exporters export when the gap between domestic and world market prices is smallest. This will help to minimize the export restitutions the EC has to pay.

One problem could arise if a potential exporter did not hedge on the futures market but speculated on the basis of his own price expectations instead. It could be that the price gap between EC and world market prices might be much larger than the exporter expected at time t_1. Let us assume that world market prices at t_1 are actually equal to p_1^W. Receiving an export restitution equal to $px_1^E - px_1^W$ and exporting it at t_1 would result in a loss equal to $px_1^W - p_1^W$. In this case, the exporter might prefer not to export. If he were allowed to do that without paying a penalty fee, the EC market price might drop to equal the intervention price and the intervention authorities would have to buy and store or export the quantities. Bidding for export licenses and asking for low export restitutions would entail no risk from the potential exporter's point of view. Moreover, it would not guarantee that the EC intervention authorities would not directly intervene in the market. This can be avoided if, when the potential exporter acquires a license, he pays a charge equal to the public storage costs during the time his license is valid. This charge would be repaid if he exports while the license is valid. This would prevent the intervention authority from being penalized by the bidder's miscalculation.

The proposed bidding system would not only foster better timing of exports, but would bring more foreign grain dealers into EC trade. Importing countries would be encouraged to buy on the EC market when they think the gap between EC prices and world market prices is smallest.

Such a system would also favor the EC grain traders because they would be able to reduce risks by hedging on futures markets.

To maximize domestic welfare and minimize export restitution payments, the EC should export when world market prices are highest. This would also help to stabilize seasonal fluctuations on the world market. During 1973-80, however, EC monthly exports were above average in August and September, immediately after the harvest, and in March-June, the end of the crop year (Figure 11). Because this timing does not correspond inversely to the seasonal index of export prices, better timing of exports would be advisable. This argument is supported by Table 31, which shows that the EC did not export when world market prices were favorable and export restitutions would have been lowest. Optimal timing of exports could have led to gains of 23.4 million European Currency Units (ECU) for 1978/79 and 65.4 million ECU in 1979/80.

This uneconomic performance is built into the present system. As exporters are paid the difference between domestic and world market prices, they are well advised to export at the end of the crop year when domestic prices reflect storage costs.

By introducing the modified bidding system proposed above, the timing of exports over a season could be improved. In bidding for a license, exporters would take into account the expected seasonal price pattern on the world market, and they would have an incentive to export when world market prices are highest.

Table 31—Loss from unprofitable timing of wheat exports, 1978/79 and 1979/80

Month	Maximum Subsidy	Export Quantity	Subsidy
	(ECU/ton)	(1,000 metric tons)	(million ECU)
September 1978	66.00	171	11.286
October 1978	70.95	388	27.529
November 1978	68.65	285	19.428
December 1978	69.27	230	15.932
January 1979	75.21	534	40.162
February 1979	76.75	431	33.079
March 1979	74.44	464	34.540
April 1979	71.50	361	25.822
May 1979	76.47	445	34.029
Total 1978/79	...	3,307	241.807
September 1979	50.47	126	6.359
October 1979	49.39	236	11.656
November 1979	52.22	228	11.906
December 1979	58.00	317	18.386
January 1980	60.34	610	36.807
February 1980	59.25	796	47.163
March 1980	56.74	975	55.322
April 1980	62.97	815	51.327
May 1980	69.50	689	47.886
June 1980	72.66	658	47.810
Total 1979/80	...	5,450	334.616

Sources: U.S. Department of Agriculture, Foreign Agricultural Service, *Foreign Agriculture Circular—Grains*, FG-42-81 (Washington, D.C.: USDA, December 11, 1981); and International Wheat Council, *World Wheat Statistics* (London: International Wheat Council, various years).

Notes: ECU stands for European Currency Units. The hypothetical subsidy, based on total exports in the month with the lowest subsidy, was 218.262 million ECU in 1978/79 and 269.176 million ECU in 1979/80. The gains, that is the difference between the true subsidy and the hypothetical subsidy, were 23.545 million ECU in 1978/79 and 65.44 million ECU in 1979/80.

APPENDIX 1:

THE AGRIMONETARY SYSTEM OF THE EUROPEAN COMMUNITY AND TRADE FLOWS IN GRAIN

In the main text of this report, it was assumed that the grain market regulations of the EC were the same in all member countries. This was done to present the basic features of the EC grain policy and their implications for developing countries. This appendix explores the significance of national differences. Agricultural trade flows among EC members and between the EC and the rest of the world are affected by the institutionalized linkages between agricultural product prices, exchange rate variations, and the monetary compensatory amounts (MCAs) resulting from exchange rate variations. These interrelationships form the agrimonetary system.

Some linkages between the monetary system and agricultural trade are normal in a market economy, but those in the EC have a special character.[32] The following analysis shows that institutional arrangements affect the national and EC-wide degrees of nominal and effective protection and so have implications for developing countries. It examines these institutional arrangements with respect to the linkages between currency policy and the agricultural price policies that are needed to integrate national markets. This case study may be useful for other regions, and especially for developing countries considering more intensive regional integration. The analysis focuses on how changes in trade flows may be caused by the agrimonetary system. It includes an examination of the effect of exchange rate variations on the degree of protection, and the trade effects of MCAs.[33]

Spot and Futures Exchange Rates

Common market order prices are set in a fictional currency—the European Currency Unit (ECU)—which is converted into national prices. The conversion factor takes exchange rates among the individual European countries into consideration. For the French franc and the German mark, for example, the following set of equations must hold true in equilibrium.

$$p_I^{ECU} \cdot u_{ECU}^{DM} = p_I^{DM} \quad (32)$$

$$p_I^{ECU} \cdot u_{ECU}^{FF} = p_I^{FF} \quad (33)$$

$$p_I^{FF} \cdot r_{FF}^{DM} = p_I^{DM} \quad (34)$$

From this, it follows that

$$(u_{ECU}^{DM}/u_{ECU}^{FF}) = r_{FF}^{DM}, \quad (35)$$

where

p_I^{ECU} = intervention price in ECU,
p_I^{DM} = intervention price in DM,
p_I^{FF} = intervention price in FF,
u_{ECU}^{DM} = conversion factor between DM and ECU,
u_{ECU}^{FF} = conversion factor between FF and ECU, and
r_{FF}^{DM} = exchange rate between DM and FF.

If equations (32) and (34) hold, the intervention price in Germany is equal to the intervention price in France from the exporters' and importers' points of view. Such an equilibrium can exist only if there is a unique exchange rate. However, with rates of interest and inflation differing from country to country, there will be not only a spot market for foreign exchange but also a futures market if the expected future spot market rate differs from the current one. This is quite likely under a system of floating exchange rates—like those between the EC currencies (except for the United Kingdom and Greece) and

[32] The general interrelationship in an open economy has been analyzed by Robert G. Chambers and Richard E. Just, "Effects of Exchange Rate Changes on U.S. Agriculture: A Dynamic Analysis," *American Journal of Agricultural Economics* 63 (February 1981): 32-46; and G. Edward Schuh, "The Exchange Rate and U.S. Agriculture," *American Journal of Agricultural Economics* 56 (January 1974): 1-13.

[33] A review of the last is given by Christopher Ritson and Stefan Tangermann in "The Economics and Politics of Monetary Compensatory Amounts," *European Review of Agricultural Economics* 6 (No. 2, 1979): 119-164.

other countries—as well as for the European currencies that are supposed to have fixed spot market rates. Due to different rates of inflation, a realignment of currencies in the European Monetary System (EMS) is necessary from time to time. Because of the lack of security for future spot market exchange rates, there is a market for future currencies—even EMS currencies. Additionally, the futures rates for individual EMS currencies are related to the futures rates for the dollar. The difference between the futures and spot rates for the German mark and the dollar, or the French franc and the dollar, is mainly determined by the differences in interest rates between Germany or France and the United States.

Futures markets for foreign exchange may affect the functioning of the common price system. Intervention prices are not equal for exporters or importers if the differences between spot and futures rates do not equal the differences in interest rates. As the futures rate anticipates a revaluation or devaluation of a currency, the intervention price will be higher—from the traders' point of view—in the country expecting to revalue. Consequently, there will be a trade flow from the weak-currency country to the strong-currency country.

This conclusion is supported by empirical evidence for France and Germany. It would be expected that market prices would be nearer the intervention price in exporting rather than in importing EC countries. For example, up to 1978/79 market prices for wheat were far higher than intervention prices in France, a surplus producer, but near intervention prices in Germany, a net importer (Table 32). Consequently, intervention authorities did not have to buy in France, but did in Germany. More than 90 percent of the intervention quantities were bought in Germany in 1975/76 to 1978/79 (Table 33). The situation was reversed in 1979/80 and 1980/81 when market prices were higher than intervention prices in Germany than in France. This was in line with the reversal in the difference between spot and futures rates. In 1979/80 and 1980/81, the franc was strong against the mark, leading to an expectation of a revaluation of the franc and a devaluation of the mark.

Table 34 indicates that the effective difference in intervention prices is as much as 11 percent in some months.

Exchange Rate Variations

Due to the agrimonetary system of the EC, the trade effects of exchange rate variations on agricultural markets are not normal. As agricultural markets are protected, variation in an exchange rate may change the degree of protection and thus affect production, consumption, and trade.

For example, assume that prices in the EC grain market are nearly equal to intervention prices in most regions. A 1 percent change in intervention prices would be equal to a 1 percent change in market prices.

The domestic consumption pattern would not be distorted if domestic price ratios were equal to world market price ratios. But since protection for agricultural products is much higher than for nonagricultural products, the consumption pattern is distorted. The effect of exchange rate variations on consumption patterns and the nominal rate of protection were analyzed. The way domestic and world market prices for grain in domestic currencies are affected by an exchange rate variation was also investigated. The effect on domestic prices is explained first.

Domestic intervention prices in national currencies are tied to ECU prices by the conversion factor u_{ECU}. Hence, domestic intervention prices will be affected by an exchange rate variation if the conversion factor is affected by one. To clarify the relationship, equations (36) and (37) are written in rates of change:[34]

$$(du^{DM}_{ECU}/u^{DM}_{ECU}) - (du^{FF}_{ECU}/u^{FF}_{ECU}) = (dr^{DM}_{FF}/r^{DM}_{FF}), \quad (36)$$

[34] In carrying out empirical calculations, the following formula cannot be applied, because it holds only for marginal changes. Otherwise the joint effect must be included or equation (30) must be rewritten as,

$$(1 + du^{DM}_{ECU}/u^{DM}_{ECU})/(1 + du^{FF}_{ECU}/u^{FF}_{ECU}) = 1 + dr^{DM}_{FF}/r^{DM}_{FF},$$

which takes care of the joint effects.

Table 32—Market price of common wheat as a percentage of the intervention price in the Federal Republic of Germany and France, 1974-81

Month	1974		1975		1976		1977	
	Federal Republic of Germany	France	Federal Republic of Germany	France	Federal Republic of Germany	France	Federal Republic of Germany	France
January			99.97	107.62	101.30	104.00	104.83	109.84
February			99.40	104.78	101.17	104.19	104.84	110.34
March			99.12	102.95	101.38	104.91	104.48	109.20
April			99.38	102.94	101.20	107.63	104.87	110.69
May			99.58	101.57	102.18	110.46	106.02	110.74
June			100.11	101.63	103.40	111.37	106.96	109.22
July			98.65	104.35	99.64	108.26	106.91	...
August	100.15	113.32	100.83	107.27	107.62	109.36	109.53	115.97
September	101.03	114.01	102.54	106.40	107.22	110.60	105.97	118.17
October	101.94	113.29	102.20	105.66	106.88	109.93	109.01	118.20
November	101.78	114.57	101.77	101.36	106.05	109.51	108.15	119.39
December	100.74	111.97	101.25	104.38	105.22	108.71	107.65	119.75

Month	1978		1979		1980		1981	
	Federal Republic of Germany	France	Federal Republic of Germany	France	Federal Republic of Germany	France	Federal Republic of Germany	France
January	109.05	120.09	112.97	116.87	113.98	11[illegible].39	112.32	110.04
February	109.09	121.01	112.67	115.94	113.51	1[illegible]2.94	112.18	110.81
March	110.63	119.02	112.06	115.65	113.27	110.85	112.11	109.67
April	111.17	116.49	112.04	114.05	112.67	109.47	111.99	108.91
May	111.46	115.26	111.91	113.98	108.54	107.79	112.03	110.25
June	113.27	113.54	113.26	111.73	112.92	109.94	113.76	110.03
July	112.75	112.81	112.84	110.49	113.58	111.10	113.42	106.92
August	113.42	115.88	113.92	113.63	114.24	108.27		
September	112.09	115.18	113.02	112.78	112.30	110.22		
October	112.24	117.57	113.59	113.21	112.77	109.64		
November	112.63	117.80	113.93	115.36	112.51	112.08		
December	112.74	117.24	114.09	114.08	112.79	110.81		

Source: Commission of the European Community, *The Agricultural Situation in the Community*, various reports (Luxembourg: Commission of the European Community, various years).

and

$$dp_I^{ECU}/p_I^{ECU} + du_{ECU}^{DM}/u_{ECU} = dp_I^{DM}/p_I^{DM}. \quad (37)$$

Substituting $du_{ECU}^{DM}/u_{ECU}^{DM}$ from equation (30) into equation (31),

$$dp_I^{DM}/p_I^{DM} = dp_I^{ECU}/p_I^{ECU} + dr_{FF}^{DM}/r_{FF}^{DM} + du_{ECU}^{FF}/u_{ECU}^{FF}. \quad (38)$$

Exchange rate variations do not directly affect prices in ECU. Hence,

$$dp_I^{ECU}/p_I^{ECU} = 0. \quad (39)$$

Before the EMS came into being in 1979,

$$du_{ECU}^{FF}/u_{ECU}^{FF} = 0. \quad (40)$$

Consequently, it always held that

$$dp_I^{DM}/p_I^{DM} = dr_{FF}^{DM}/r_{FF}^{DM}. \quad (41)$$

Table 33—Wheat bought by intervention authorities, 1973/74-1980/81

Country	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81
				(1,000 metric tons)				
Germany, Federal Republic of	760	1,102	729	91	177	512	676	799
France	0	399	27	...	...	...	788	2,139
Italy	200	238	...	4	...	...	...	...
Netherlands	63	93	...	...	1	...	14	31
Belgium	237	210	3	...	...	2	49	36
Luxembourg	8	6	...	...	...	3	...	...
European Community 6	1,268	2,048	759	95	178	517	1,527	3,005
Denmark	...	9	17	6	12	25	63	37
United Kingdom	...	...	...	...	...	...	2	87
Ireland	...	...	...	...	...	...	...	...
European Community 9	1,268	2,057	776	101	190	542	1,592	3,129

Source: Commission of the European Community, *The Agricultural Situation in the Community*, various reports (Luxembourg: Commission of the European Community, various years).

According to equation (41), a reduction in the exchange rate by 1 percent (that is, a revaluation of the mark) leads to a 1 percent decrease in intervention prices if the mechanism of the agrimonetary system is allowed to work. The effect of a devaluation is the reverse.

With the EMS, the relationship is a bit different. Now, it holds that

$$du_{ECU}^{DM}/u_{ECU}^{DM} = (1 - \alpha) \cdot (dr_{FF}^{DM}/r_{FF}^{DM}) \quad (42)$$

and, hence, according to equations (37) and (39),

$$dp_i^{DM}/p_i^{DM} = (1 - \alpha)(dr_{FF}^{DM}/r_{FF}^{DM}) \quad (43)$$

where α is the share of the German mark in the value of the European currency basket. At the time being, α is about 0.3. Hence, a reduction in the exchange rate (revaluation) of 1 percent leads to a decrease in German product prices of 0.7 percent.

Table 34—Rate of swap between the French franc and the German mark, August 1976-January 1982

Month	1976	1977	1978	1979	1980	1981	1982
				(percent)			
January		-7.11	-10.04	-4.04	-4.31	-1.66	-5.09
February		-6.66	-9.84	-4.06	-5.06	+0.85	
March		-5.82	-5.71	-3.04	-4.38	-0.28	
April		-5.30	-6.24	-3.31	-3.50	-1.23	
May		-6.55	-6.19	-5.56	-3.17	-7.53	
June		-5.55	-6.60	-4.59	-3.07	-11.64	
July		-8.20	-5.61	-5.86	-3.70	-9.30	
August	-5.95	-6.38	-5.48	-5.13	-3.81	-15.71	
September	-7.57	-5.10	-7.20	-5.93	-3.71	-15.83	
October	-8.05	-6.43	-5.54	-5.01	-2.30	-5.93	
November	-7.31	-9.29	-5.41	-4.80	-1.58	-6.06	
December	-7.65	-11.49	-5.78	-5.59	-2.50	-6.49	

Source: Deutsche Bundesbank, "Statistische Beihefte zu den Monatsberichten der Deutschen Bundesbank," in *Reihe 5: Die Währungen der Welt*, various issues (Frankfurt: Deutsche Bundesbank, various years).

Note: The rate of swap is the difference between the futures and the spot exchange rates.

Due to the EMS and the present linkage between national agricultural intervention prices and prices in ECU, exchange rate variations affect not only the intervention prices of countries that revalue or devalue their currency, but also directly affect intervention prices in any EC country that belongs to the EMS. Hence, to investigate the effects of exchange rate variations on trade flows and the degree of nominal protection, it is necessary to analyze the effect not only on the prices of the devaluing or revaluing country but also on the average prices in the EC.

Again, an exchange rate variation is assumed for the German mark. The total effect of an exchange rate variation on the other EC countries is given by:

$$dp_I^{NG}/p_I^{NG} = -\alpha \cdot dr_{FF}^{DM}/r_{FF}^{DM}, \qquad (44)$$

where p_I^{NG} is the average intervention price of all EC countries except Germany. The rate of change of the average intervention price in the EC is given by:

$$dp_I^{EC}/p_I^{EC} = \beta^{DM}(dp_I^{DM}/p_I^{DM}) + \gamma^{NG}(dp_I^{NG}/p_I^{NG}), \qquad (45)$$

where p_I^{EC} is the average EC intervention price, β^{DM} is the share of the German production value of intervention products in total EC value of intervention products, and γ^{NG} is the share of value of intervention products of the EC (excluding Germany) in the total EC value of intervention products. Substituting equations (43) and (44) into equation (45),

$$dp_I^{EC}/p_I^{EC} = \beta^{DM}(1 - \alpha)(dr_{FF}^{DM}/r_{FF}^{DM}) + \gamma^{NG}[-\alpha(dr_{FF}^{DM}/r_{FF}^{DM})], \qquad (46)$$

and

$$dp_I^{EC}/p_I^{EC} = dr_{FF}^{DM}/r_{FF}^{DM} \cdot [\beta^{DM}(1 - \alpha) - \alpha\gamma^{NG}]. \qquad (47)$$

For a devaluation of the German mark it holds that

$$dr_{FF}^{DM}/r_{FF}^{DM} > 0, \qquad (48)$$

and for revaluation,

$$dr_{FF}^{DM}/r_{FF}^{DM} < 0. \qquad (49)$$

A devaluation will increase and a revaluation will decrease the average intervention prices in the EC if

$$\beta^{DM}(1 - \alpha) - \alpha\gamma^{NG} > 0. \qquad (50)$$

Taking into account that $\beta^{DM} + \gamma^{NG} = 1$, it follows from equation (50) that

$$\beta^{DM} > \alpha. \qquad (51)$$

Equation (51) is a necessary condition for both a devaluation of the German mark to lead to an increase in the average intervention price in the EC and for a revaluation to lower the average intervention price. Of course, equation (51) holds as well for the effects of an exchange rate variation of any EC currency.

The coefficients β and α differ by country. α represents the weight of a national currency in the composition of the ECU basket, which was fixed in March 1979 when the EMS began to function on the basis of national GNP shares in EC GNP adjusted for the importance of trade (see Table 35).[35] A revision of the weights can be expected if the base data change. Germany's share in Community production of soft wheat was 17 percent, of barley, 21.3 percent, and of maize, 4.2 percent.[36] Only for Germany would the average EC price of wheat and barley increase due to a revaluation of the German mark and decrease due to a devaluation. The same relationship holds true for maize and an exchange rate variation of the French franc. For the exchange rates of the other EC currencies, $\beta > \alpha$ states that EC prices will increase with a devaluation and decrease with a revaluation of the national currency.

The impact of an exchange rate variation on world market prices expressed in national currencies was different before 1971 when worldwide exchange rates were fixed. At that time, a change in the exchange rate of a given currency implied a change in the rates of all other currencies that belonged to the Bretton Woods System. Assuming that a

[35] Deutsche Bundesbank, "Statistische Beihefte zu den Monatsberichten der Deutschen Bundesbank," in *Reihe 5: Die Währungen der Welt*, various issues (Frankfurt: Deutsche Bundesbank, various years).

[36] European Community, *Crop Production*, 4-1981 (Luxembourg: Statistical Office of the European Community, 1981).

Table 35—Composition of the European currency unit

Currency	Amount in 1 ECU	Percent of the Value of 1 ECU		
		March 13, 1979	November 30, 1979	September 1, 1981
DM	0.828	33.0	33.36	32.53
UK £	0.0885	13.3	13.64	16.33
FF	1.15	19.8	19.64	19.18
LIT	109.00	9.5	9.41	8.63
HFL	0.286	10.5	10.42	10.17
BFR	3.66	9.6[a]	9.20	9.31[a]
LFR	0.14	...[a]	0.35	...[a]
DKR	0.217	3.1	2.81	2.74
IR £	0.00759	1.2	1.14	1.11

Source: Toepfer International, *The E.E.C. Grain Market Regulations* (Hamburg: Toepfer International, various years).

Note: ECU stands for European Currency Unit.

[a] This is the total share of the Belgian franc and the Luxembourgian franc.

change in the exchange rate of the mark does not affect dollar prices for grain on the world market, the change of world market prices due to a change in the German exchange rate is

$$dp_W^{DM}/p_W^{DM} = dr_{FF}^{DM}/r_{FF}^{DM}, \qquad (52)$$

where p_W^{DM} equals the world market price in marks.

Equations (41) and (52) indicate that until 1971, variations in the exchange rates did not affect the nominal rate of protection.

Nowadays, the situation is different. As the dollar floats against the EC currencies, an official exchange rate variation of any EC currency will only slightly affect the German exchange rate against the dollar. Hence it may be that

$$dp_W^{DM}/p_W^{DM} = 0. \qquad (53)$$

From equations (43) and (53), it can be concluded that a devaluation of the German mark increases the rate of nominal protection of German grain production whereas a revaluation has the opposite effect. Hence, a revaluation decreases the distortion in the consumption pattern, and a devaluation increases it. This implies that a devaluation increases the average rate of nominal protection of the EC and gives rise to additional trade flows from the EC to third countries and within the EC from the country that devalues to the other EC countries.

The total trade effects due to an exchange rate variation depend not only on the change in the nominal rate of protection, but also on the effect on the effective rate of protection. This relationship is investigated below.

The effective rate of protection (T_E) is defined as

$$T_E = (V^D - V^W)/V^W, \qquad (54)$$

where V^D is the value added with domestic prices, and V^W is the value added with world market prices.

Exchange rate variations will affect the effective rate of protection if the change in sectoral output prices is different from that in sectoral input prices. The effect on output prices was analyzed above. The situation with respect to sectoral input prices has gradually changed since 1971. Up to that time, a devaluation of an EC currency led automatically to an increase of all import prices. However, as agriculture uses domestic and foreign inputs, average input prices increase less than average output prices. Hence, the rate of effective protection normally went up with devaluation and down with revaluation. This still holds true. However, nowadays the rate of effective protection increases differently. Output prices rise less with a devaluation than before the EMS. The same holds true for input prices as only those inputs that are imported from EMS countries are affected. For a small country that has only a small share of its currency in the currency basket

and imports mainly from outside the EC, the effective rate of protection may increase more than before. For a large country with a large share of its currency in the currency basket, the effective rate of protection will increase, but possibly less than before the EMS and before 1971.

However, devaluation by any EC country will not only increase its rate of effective protection but also affect that of the EC. The same reasoning holds when investigating the nominal rate of protection. For $\beta > \alpha$, the average rate of effective protection will go up with devaluation and down with revaluation. For $\beta < \alpha$, it is reversed.

To sum up, a variation in an exchange rate by an EMS country affects the nominal and effective rates of protection of that and other EMS countries. This gives rise to changes in trade for grain within the EC and between the EC and other countries. The size of the effect depends on the country that varies the exchange rate, its share in total EC production, and its share in the currency basket.

Monetary Compensatory Amounts

MCAs were first used in 1969 when the French devalued the franc and the Germans revalued the mark. In general, the MCAs result from exchange rate variations of EC currencies. Any further variation in exchange rates may lead to further changes in the MCAs. The logic of MCAs may be seen from equations (41) or (43), which indicate that changes in intervention prices are tied to exchange rate variations. Of course, they do not imply that these relationships are the best ways to maximize a national objective. Indeed, governments of the EC countries have not been willing to link variations of the exchange rate to intervention prices. In nearly all cases, they have tried to eliminate the direct effect of exchange rate variations. For such a case, the size of an MCA in the pre-EMS phase is given by:

$$MCA = dr_{FF}^{DM}/r_{FF}^{DM} \cdot p_I^{DM}. \qquad (55)$$

As with the EMS, the pure functioning of the agrimonetary system is expressed with equation (43) and the size of MCAs needed to keep intervention prices constant is given by:

$$MCA = (1 - \alpha) \cdot dr_{FF}^{DM}/r_{FF}^{DM} \cdot p_I^{DM}. \qquad (56)$$

Equations (55) and (56) indicate that the basis for calculating the MCA is always the intervention price. Hence, a positive MCA of 10 percent states that domestic intervention prices should be 10 percent lower for a pure functioning of the agrimonetary system. The opposite is the case for a negative MCA. A comparison of equations (55) and (56) shows that the MCAs have been lower since the EMS than they were before. This is because exchange rate variations affect the value of the ECU and, thus, directly affect the conversion factor of all other EMS currencies, as described above.

The MCAs affect trade with third countries through their effect on the degree of protection. However, it cannot be determined in advance whether a given MCA pattern will lead to a higher rate of protection.[37] First, the relationship between MCAs and common decisions about prices in ECUs has to be investigated. A reduction of negative MCAs leads to an increase in national intervention prices and vice versa. It is possible that the Council of Agricultural Ministers, which decides annually on prices in ECUs, will consider the effects of changes in MCAs on national prices. For example, if a reduction of a positive MCA is wanted, which would mean a negative change in national intervention prices, the Council may adopt a positive change in ECU prices to compensate for the reduction in MCAs. Because European governments have disliked reducing the nominal guaranteed producer prices in the past, it is likely that without positive MCAs, the price in ECUs would be higher. This might not affect the national prices of those countries that have positive MCAs, but would

[37] See Ritson and Tangermann, "The Economics and Politics of Monetary Compensatory Amounts," p. 130. The authors found that the EC's degree of self-sufficiency for the aggregate of grain, sugar, beef and veal, pig meat, poultry, eggs, and milk would have gone up from 97.2 percent to 100.4 to 103.6 percent in 1976 if MCAs had been abolished. See also Peter M. Schmitz, "EC Price Harmonization: A Macroeconomic Approach," *European Review of Agricultural Economics* 6 (No. 2, 1979): 177. Schmitz found, in complete accord with Ritson and Tangermann, that a reduction of existing MCAs in 1976 would have led to an increase in the degree of agricultural protection for the EC as a whole.

more than likely affect the national prices of other EC countries. Hence, the average degree of protection would more than likely be higher. Even negative MCAs may contribute to a smaller increase of the price in ECUs. As countries with negative MCAs may raise their farm prices without a decision about the common price, they may seek a smaller increase of the common price. Hence, it is not obvious what effect MCAs have on the degree of protection. The average EC price would definitely be higher if no MCAs were allowed, but the EC norm price had to be changed in order to avoid reductions in national prices as a consequence of exchange rate variations.

Second, even if there were no linkage between a reduction in MCAs and the common price in ECUs, the effect of an elimination of MCAs on the rate of protection would not be obvious. The MCAs are positive for some countries and negative for others. The effect of a total reduction of MCAs by a country on the degree of protection depends on the size of its MCAs and on its share of EC production. Such an action might increase the rate of protection for one product and decrease it for another.

The ambiguous nature of the MCA system may be the reason why it has been less criticized by those outside the EC than was expected. The MCAs are analogous to tariffs, and the MCAs were much larger than the amounts allowed under GATT rules. Nevertheless, the system might have helped third countries by keeping down the effective and nominal rates of protection.

The effects of MCAs on trade within the EC can be analyzed in more detail. Such trade in grain and its processed products may be distorted by MCAs if their sizes are not correctly fixed for homogenous products, or if there is no MCA on close substitutes.

If market and intervention prices for grain were equal in all EC countries, exchange rate variations and the introduction of compensatory MCAs would have no immediate effects on trade. However, trade in the short run will be affected if market prices are above intervention prices as they generally are in importing countries. Further, even the long run variations in exchange rates and MCAs will affect nominal and effective rates of protection and thus trade.

As indicated above, MCAs are linked to the rate of change of the conversion factor and to intervention prices. The normal effect of an exchange rate variation is eliminated only as far as intervention prices are concerned. If market prices are higher than intervention prices, the price differential is affected by an exchange rate variation; prices will go up in countries that devalue and go down in countries that revalue. The direction of price changes is the same as in a free market but the changes are smaller. Consequently, MCAs distort trade. Countries with a positive MCA produce more and consume less. The opposite is true with a negative MCA.

If MCAs are fixed for processed grain products, the grain content of the processed product should be known. This is, of course, no problem if there is a linear relationship between the two. However, this is not always so. For example, up to January 1978, there was no MCA on EC trade in durum wheat and processed durum products, and durum wheat prices only differed because of transport costs. On the other hand, there were MCAs on common wheat and its processed products, the prices of which were much lower in Italy, which had a negative MCA, than in Germany, which had a positive MCA. The Italian noodle producers used common wheat and eggs because they were cheaper. Because it is not possible to determine the ingredients by inspection, officials assumed that Italian exporters had continued to use durum wheat and did not require them to pay MCAs. Their exports of noodle products rose more than 50 percent from 1976 to 1977. After MCAs were applied to durum wheat in January 1978, Italian exports in that year fell 25 percent from 1977.

This example highlights the trade distortion that may occur if the MCAs differ for products that can be partly substituted for one another in production, processing, or consumption. Some distortion is always likely since at least some substitution is possible among agricultural products and since the MCAs range from zero to a full compensation for exchange variation.

APPENDIX 2: TRADE PREFERENCES FOR GRAIN IMPORTS

So far the EC has been reluctant to open the domestic grain market to foreign supply either by reducing protection or by allowing special trade preferences for selected countries. Only some North African countries, Turkey, and the countries of Africa, the Caribbean and the Pacific that signed the Lomé Convention, received some preferences, which were generally of minor importance (Table 36). A reduction of the variable levy by only 0.5 units of account per ton or about U.S. $0.50 is not enough to make supplies from the preferred countries competitive with those from North America.

Table 36—Trade preferences for grain, 1981/82, and grain exports of preferred countries, 1977-80

Country/Grain	Exports 1977	1978	1979	1980	Reduction of Levies
	(metric tons)				
Morocco					
Hard wheat	...	...	...	...	Reduced by 0.5 units of account
Turkey					
Rye	...	...	...	...	Reduced up to 5.0 ECUs per ton
Hard wheat	...	28,148	3,001	...	Reduced by 0.5 ECU per ton
Canary seed	...	...	1,576	2,048	Reduced by 0.5 ECU per ton
Malt	4,985	...	...	...	Fixed proportion reduced by 50 percent
ACP Countries[a]					
Maize	...	...	...	...	Reduced by 1.81 ECUs per ton
Millet, Tanzania	...	...	39,643	11,601	Reduced by 50 percent
Sorghum, Sudan	19,127	17,971	14,946	13,699	
Tanzania	...	...	59,257	4,766	
Rice, raw	...	...	...	...	Reduced by 50 percent and fixed amount of 0.36 ECU per 100 kilograms
Rice, peeled, Surinam	27,274	46,254	76,745	63,194	
Rice, partly polished	...	...	...	...	Reduced by 50 percent and fixed amount of 0.54 ECU per 100 kilograms
Rice, totally polished					
Madagascar	2,395	1,133	...	248	
Surinam	3,310	1,708	...	720	
Guyana	...	10,451	...	...	
Rice, broken					Reduced by 50 percent and fixed amount of 0.30 ECU per 100 kilograms
Malawi	1,570	1,121	...	...	
Surinam	3,585	7,992	909	5,750	
Guyana	...	4,577	...	...	
Solomon Islands	...	...	...	557	
Madagascar	...	...	1,021	...	
Flour of barley, oats, and maize	...	...	...	...	Reduced by fixed proportion
Roots					Reduced by fixed proportion and 0.181 ECU per 100 kilograms (excludes Maranta)
Ghana	519	521	...	415	
Tanzania	...	39,508	34,967	8,074	
Malawi	1,026	2,059	3,400	2,087	
Jamaica	1,535	2,134	2,689	2,037	
St. Vincent	...	...	...	224	
Barbados	458	449	600	323	
Surinam	...	131	181	...	

Table 36—Continued

Tunisia					
Bran	975	...	5,749	5,232	Variable proportion of levies reduced by 60 percent
Algeria					
Bran	34,863	...	...	...	

Sources: European Community, *Analytical Tables of Foreign Trade* (Luxembourg: Statistical Office of the European Community, 1977-80); and P. Wilhelmi, ed., *Agrarmarktgesetze und Verordnungen der EG, Teil I: Getreide* (Hannover: Strothe, 1981).

Notes: ECU stands for European Currency Unit. The regulation giving preference to Moroccan hard wheat was number 1520 in 1976; the one giving preference to Turkish grain was number 1180 in 1977. The ACP countries were given preferences in regulation 706 of 1976 and regulation 435 of 1980. Finally, the preferences for grain from Tunisia and Algeria were established by regulations 1513, 1519, and 1526 of 1976 and 1251 of 1977.

[a] The ACPs are the countries of Africa, the Caribbean, and the Pacific that signed the Lomé Convention.

APPENDIX 3: SUPPLEMENTARY TABLES

Table 37—Wheat production in 1980 and projected to 1985 and 1990

Country	Yield			Area			Production		
	1980	1985	1990	1980	1985	1990	1980	1985	1990
	(quintals/hectare)			(hectares)			(metric tons)		
Belgium and Luxembourg	49.54	54.00[a]	58.09[a]	194,000	181,994[a]	172,310[b]	961,076	982,768	1,000,949
Denmark	46.98	54.73[a]	57.68[a]	139,000	117,484[a]	117,532[a]	653,022	642,990	677,925
France									
Soft wheat	52.10	56.34[a]	62.52[a]	4,465,700	3,910,000[b]	3,883,000[b]	23,266,297	22,028,940	24,276,516
Durum wheat	36.90	39.02[a]	43.45[a]	115,700	281,200[b]	405,100[b]	426,933	1,097,242	1,760,160
Germany, Federal Republic of	48.90	54.70[a]	59.45[a]	1,668,000	1,782,154[b]	1,885,732[b]	8,156,520	9,748,382	11,210,677
Ireland	51.16	55.65[a]	60.70[a]	43,000	33,673	26,214[b]	219,988	187,390	159,119
Italy									
Soft wheat	32.40	35.36[a]	38.00[a]	1,695,300	1,369,000	1,135,000[b]	5,492,772	4,840,784	4,313,000
Durum wheat	21.40	23.54[a]	25.82[a]	1,709,500	1,758,000	1,866,000[b]	3,658,330	4,138,332	4,818,012
Netherlands	62.11	64.42[a]	69.64[a]	142,000	129,999[a]	126,928[a]	881,962	837,454	883,927
United Kingdom	56.90	54.12[a]	57.77[a]	1,441,000	1,534,448[b]	1,757,407[b]	8,199,290	8,304,433	10,152,540
European Community - 9									
Soft wheat	48.87	52.52	57.86	9,788,000	9,058,752	9,104,123	47,830,927	47,573,141	52,674,653
Durum wheat	22.38	25.67	28.96	1,825,200	2,039,200	2,271,100	4,085,263	5,235,574	6,578,172
Greece	30.65	30.40[a]	34.09	955,000	817,805	756,663	2,927,075	2,486,127	2,579,464
European Community - 10	43.64	46.40	50.97	12,568,200	11,915,757	12,131,886	54,843,265	55,294,842	61,832,289

Sources: Data for 1961-77 were taken from Food and Agriculture Organization of the United Nations, *Production Yearbook* (Rome: FAO, various years). Data for 1978-80 were taken from U.S. Department of Agriculture, Foreign Agricultural Service, *Foreign Agriculture Circular—Grains*, FG-4-81 (Washington, D.C.: USDA, January 28, 1981). The data for France and Italy are from European Community, *Crop Production* (Luxembourg: Statistical Office of the European Community, February 1981).

Notes: The 1980 projections are based on data from 1961-80.

[a] This projection uses the log-functional form.

[b] This projection uses the linear-functional form.

Table 38—Maize production in 1980 and projected to 1985 and 1990

Country	Yield			Area			Production		
	1980	1985	1990	1980	1985	1990	1980	1985	1990
	(quintals/hectare)			(hectares)			(metric tons)		
Belgium and Luxembourg	55.00	60.72[a]	63.34[a]	6,000	23,827[b]	58,024[a]	33,000	144,677	367,524
France	53.37	61.44[a]	67.72[a]	1,783,000	2,681,329[b]	3,403,706[a]	9,515,871	16,527,712	23,049,897
Germany, Federal Republic of	56.47	67.27[a]	74.20[a]	119,000	169,456[a]	202,235[b]	671,993	1,139,930	1,500,584
Italy	66.60	80.47[a]	91.46[a]	961,000	815,555[a]	756,554[b]	6,400,260	6,562,771	6,919,443
Netherlands	54.23[a]	59.19[a]	64.16[a]	3,038[a]	8,924[b]	26,215[a]	16,475	52,821	168,195
European Community - 9	57.93	66.04	71.97	2,872,038	3,699,091	4,446,734	16,637,599	24,427,911	32,005,643
Greece	74.63	67.41[a]	79.78[a]	164,000	119,904	109,679	1,223,932	808,273	875,019
European Community - 10	58.83	66.08	72.16	3,036,038	3,819,095	4,556,513	17,861,531	25,236,184	32,880,662

Source: The figures for 1980 are from U.S. Department of Agriculture, Foreign Agricultural Service, *Foreign Agriculture Circular—Grains*, FG-4-81 (Washington, D.C.: USDA, January 28, 1981). The 1985 and 1990 projections are based on data for 1961-79 from Food and Agriculture Organization of the United Nations, *Production Yearbook*, various issues (Rome: FAO, various years) and on the 1980 figures in the table.

Note: Only negligible amounts of maize were grown in Denmark, Ireland, and the United Kingdom.

[a] This projection uses the linear-projection form.

[b] This projection uses the log-functional form.

Table 39—Barley production in 1980 and projected to 1985 and 1990

Country	Yield			Area			Production		
	1980	1985	1990	1980	1985	1990	1980	1985	1990
	(quintals/hectare)			(hectares)			(metric tons)		
Belgium and Luxembourg	50.64	50.61[a]	54.53[a]	171,000	182,224[b]	189,825[b]	865,944	922,236	1,035,116
Denmark	38.35	39.08[a]	39.29[a]	1,576,000	1,393,882[a]	2,105,091[a]	6,043,960	7,401,291	8,270,902
France	44.40	44.09[a]	47.74[a]	2,648,000	3,030,780[a]	3,155,136[a]	11,757,120	13,362,709	15,062,619
Germany, Federal Republic of	44.11	48.17[a]	52.18[a]	2,001,000	2,402,673[b]	2,839,512[b]	8,826,411	11,573,676	14,816,574
Ireland	39.04	46.91[a]	49.75[a]	332,000	390,103[b]	474,057[b]	1,296,128	1,829,973	2,358,434
Italy	28.70	33.32[a]	37.97[a]	330,000	315,448[b]	358,685[b]	947,100	1,051,073	1,361,927
Netherlands	48.68	47.46[a]	49.70[a]	53,000	54,720[b]	46,726[b]	258,004	259,701	232,228
United Kingdom	44.27	43.71[a]	45.75[a]	2,330,000	2,665,497[b]	2,848,586[b]	10,314,910	11,650,887	13,032,281
European Community - 9	42.70	43.94	46.74	9,441,000	10,935,327	12,017,618	40,309,577	48,051,546	56,170,081
Greece	25.77[a]	29.13[a]	32.49[a]	334,000	556,156[b]	686,213[b]	860,718	1,620,082	2,229,506
European Community - 10	42.12	43.27	45.97	9,775,000	11,491,483	12,703,831	41,170,295	49,671,628	58,399,587

Sources: The 1980 figures are from European Community, *Crop Production*, 2-1981 (Luxembourg: Statistical Office of the European Community, 1981). The 1985 and 1990 projections are based on data for 1961-79 from Food and Agriculture Organization of the United Nations, *Production Yearbook*, various issues (Rome: FAO, various years).

[a] This projection uses the linear-functional form.

[b] This projection uses the log-functional form.

Table 40—Oat production in 1980 and projected to 1985 and 1990

Country	Yield			Area			Production		
	1980	1985	1990	1980	1985	1990	1980	1985	1990
	(quintals/hectare)			(hectares)			(metric tons)		
Belgium and Luxembourg	36.49	39.76[a]	40.61[a]	37,000	29,360[b]	20,658[b]	135,013	116,735	83,892
Denmark	39.75	35.54[a]	35.20[a]	40,000	42,239[b]	28,238[b]	159,000	150,117	99,398
France	36.09	38.31[a]	42.09[a]	534,000	402,922[b]	312,736[b]	1,927,206	1,543,594	1,316,306
Germany, Federal Republic of	38.47	43.01[a]	46.11[a]	691,000	807,515[a]	811,179[a]	2,658,277	3,473,122	3,740,347
Ireland	34.62	41.19[a]	44.27[a]	26,000	16,463[b]	10,262[b]	90,012	67,811	45,430
Italy	19.82	22.29[a]	24.31[a]	227,000	167,040[b]	137,590[b]	449,914	372,332	334,481
Netherlands	52.22	54.96[a]	59.11[a]	18,000	10,064[b]	5,761[b]	93,996	55,311	34,053
United Kingdom	41.62	44.28[a]	47.72[a]	148,000	109,109[b]	75,406[b]	615,976	483,134	359,837
European Community - 9	35.61	39.52	42.90	1,721,000	1,584,712	1,401,830	6,129,394	6,262,156	6,013,744
Greece	16.58	18.16[a]	19.74[a]	53,000	38,222[b]	28,952[b]	87,874	69,411	57,151
European Community - 10	39.50	39.06	42.43	1,774,000	1,622,934	1,430,782	7,008,134	6,338,600	6,070,895

Sources: The 1980 figures are from European Community, *Crop Production*, 2-1981 (Luxembourg: Statistical Office of the European Community, 1981). The 1985 and 1990 projections are based on data for 1961-79 from Food and Agriculture Organization of the United Nations, *Production Yearbook*, various issues (Rome: FAO, various years).

[a] This projection uses the linear-functional form.

[b] This projection uses the log-functional form.

Table 41—Wheat consumption in 1980 and projected to 1985 and 1990

Country	Per Capita Consumption			Population			Total Consumption		
	1980	1985	1990	1980	1985	1990	1980	1985	1990
	(kilograms/year)			(thousands)			(metric tons)		
Belgium and Luxembourg	143.30	155.80	168.30	10,235	10,348	10,462	1,466,675	1,612,218	1,760,755
Denmark	85.71	83.98	82.24	5,125	5,226	5,328	439,264	438,879	438,175
France	177.70	173.20	168.60	53,713	55,234	56,798	9,544,800	9,566,529	9,576,143
Germany, Federal Republic of	129.40	135.20	140.90	61,561	61,931	62,304	7,965,993	8,373,071	8,778,634
Ireland	120.40	103.50	89.03	3,428	3,693	3,978	412,731	382,225	354,161
Italy	184.90	182.10	179.20	57,042	58,803	60,619	10,547,066	10,708,026	10,862,925
Netherlands	85.81	84.04	82.26	14,144	14,733	15,347	1,213,697	1,238,161	1,262,444
United Kingdom	159.00	164.10	169.10	56,000	56,224	56,450	8,904,000	9,226,358	9,545,695
European Community - 9	155.00	156.07	156.95	261,248	266,192	271,286	40,494,226	41,545,467	42,578,932
Greece	194.00	190.60	187.20	9,520	9,877	10,248	1,846,880	1,882,556	1,918,426
European Community - 10	156.37	157.31	158.05	270,768	276,069	281,534	42,341,106	43,428,023	44,497,358

Sources: The projections of total wheat consumption are based on data for 1961-77 from Food and Agriculture Organization of the United Nations, *Food Balance Sheets, 1975-77 Average and Per Caput Food Supplies, 1961-65 Average, 1967 to 1977* (Rome: FAO, 1980) and for 1978-80 from U.S. Department of Agriculture, Foreign Agricultural Service, *Foreign Agriculture Circular—Grains*, FG-4-81 (Washington, D.C.: USDA, January 28, 1981). The linear-functional form of projection was used for all countries except Ireland. The 1980 total consumption data are from USDA, *Foreign Agriculture Circular—Grains*, FG-4-81. The projections for population are based on data for 1961-73 from U.S. Department of Commerce, Bureau of the Census, *World Population 1977* (Washington, D.C.: Bureau of the Census, 1978) and for 1974-80 from Organization for Economic Cooperation and Development, *Main Economic Indicators*, July 1981 (Paris, OECD, 1981). They are based on compound growth rates, for 1970-80 for most countries, but for 1969-79 for Greece and 1977-80 for the Federal Republic of Germany. The 1980 population data for all countries except the United Kingdom are from OECD, *Main Economic Indicators*, July 1981.

Table 42—Maize consumption in 1980 and projected to 1985 and 1990

Country	Per Capita Consumption			Population			Total Consumption		
	1980	1985	1990	1980	1985	1990	1980	1985	1990
	(kilograms/year)			(thousands)			(metric tons)		
Belgium and Luxembourg	156.80	186.40	215.90	10,235	10,348	10,462	1,604,848	1,928,867	2,258,746
Denmark	64.80	60.94	57.09	5,125	5,226	5,328	322,100	318,472	304,175
France	144.80	174.60	204.50	53,713	55,234	56,798	7,777,642	9,643,856	11,615,191
Germany, Federal Republic of	56.12	62.36	68.59	61,561	61,931	62,304	3,454,803	3,862,017	4,273,431
Ireland	84.87	99.07	113.30	3,428	3,693	3,978	290,934	365,865	450,707
Italy	175.10	178.00	180.90	57,042	58,803	60,619	9,988,054	10,466,934	10,965,977
Netherlands	188.20	199.80	211.30	14,144	14,733	15,347	2,661,901	2,943,653	3,242,821
United Kingdom	60.70	60.49	60.27	56,000	56,224	56,450	3,399,200	3,400,990	3,402,241
European Community - 9	112.95	123.71	134.59	261,248	266,192	271,286	29,509,482	32,930,654	36,513,289
Greece	194.30	298.20	457.70	9,520	9,877	10,248	1,849,736	2,945,532	4,690,510
European Community - 10	115.81	129.95	146.35	270,768	276,069	281,534	31,359,218	35,876,186	41,203,799

Sources: The population data for 1980, except for the United Kingdom, are from Organization for Economic Cooperation and Development, *Main Economic Indicators*, July 1981 (Paris: OECD, 1981). The projections are based on data for 1961-73 from U.S. Department of Commerce, Bureau of the Census, *World Population 1977* (Washington, D.C.: Bureau of the Census, 1978) and for 1974-80 from OECD, *Main Economic Indicators*, July 1981. Projections are based on compound growth rates, for 1970-80 for most countries, but for 1969-79 for Belgium, Luxembourg, and Greece, and for 1977-80 for the Federal Republic of Germany. The 1980 data for total consumption is from U.S. Department of Agriculture, Foreign Agricultural Service, *Foreign Economic Circular—Grains*, FG-4-81 (Washington, D.C.: USDA, January 28, 1981). The projections are based on data for 1961-77 from Food and Agriculture Organization of the United Nations, *Food Balance Sheets, 1975-77 Average and Per Caput Food Supplies, 1961-65 Average 1967 to 1977* (Rome: FAO, 1980) and 1974-80 from USDA, *Foreign Agriculture Circular—Grains*, FG-4-81. The linear-functional form of projection was used for all except Greece, for which a log-functional form was used.

Table 43—Barley consumption in 1980 and projected to 1985 and 1990

Country	Per Capita Consumption			Population			Total Consumption		
	1980	1985	1990	1980	1985	1990	1980	1985	1990
	(kilograms/year)			(thousands)			(metric tons)		
Belgium and Luxembourg	116.30	124.40	132.40	10,235	10,348	10,462	1,190,330	1,287,291	1,385,169
Denmark	1,049.00	1,077.00	1,104.00	5,125	5,226	5,328	5,376,125	5,628,402	5,882,112
France	114.60	113.60	112.50	53,713	55,234	56,798	6,155,510	6,274,582	6,389,775
Germany, Federal Republic of	151.00	172.10	193.30	61,561	61,931	62,304	9,295,711	10,658,325	12,043,363
Ireland	353.80	394.80	435.80	3,428	3,693	3,978	1,212,826	1,457,996	1,733,612
Italy	38.03	43.20	48.36	57,042	58,803	60,619	2,169,307	2,540,290	2,931,153
Netherlands	32.92	31.77	30.62	14,144	14,733	15,347	465,620	468,067	469,925
United Kingdom	172.60	175.60	178.50	56,000	56,224	56,450	9,665,600	9,872,934	10,076,325
European Community - 9	136.00	143.46	150.80	261,248	266,192	271,286	35,531,029	38,187,887	40,911,434
Greece	126.60	150.60	174.60	9,520	9,877	10,248	1,205,232	1,487,476	1,789,301
European Community - 10	135.67	143.71	151.67	270,768	276,069	281,534	36,736,261	39,675,363	42,700,735

Sources: The population data for 1980, except for the United Kingdom, are from Organization for Economic Cooperation and Development, Main Economic Indicators, July 1981 (Paris: OECD, 1981). The projections are based on data for 1961-73 from U.S. Department of Commerce, Bureau of the Census, *World Population 1977* (Washington, D.C.: Bureau of the Census, 1978) and for 1974-80 from OECD, *Main Economic Indicators*, July 1981. Projections are based on compound growth rates, for 1970-80 for most countries, but for 1969-79 for Belgium, Luxembourg, and Greece, and 1977-80 for the Federal Republic of Germany. The figures for total consumption are all projections based on data for 1961-77 from Food and Agriculture Organization of the United Nations, *Food Balance Sheets, 1975-77 Average and Per Caput Food Supplies, 1961-65 Average 1967 to 1977* (Rome: FAO, 1980) and for 1978 from European Community, *Crop Production*, 2-1981 (Luxembourg: Statistical Office of the European Community, 1981). The linear-functional form of projection was used for all countries.

Table 44—Oat consumption in 1980 and projected to 1985 and 1990

Country	Per Capita Consumption			Population			Total Consumption		
	1980	1985	1990	1980	1985	1990	1980	1985	1990
	(kilograms/year)			(thousands)			(metric tons)		
Belgium and Luxembourg	18.20	12.80	9.00	10,235	10,348	10,462	186,277	132,[illegible]54	94,158
Denmark	52.42	31.69	19.16	5,125	5,226	5,328	268,652	165,612	102,084
France	25.93	19.95	15.35	53,713	55,234	56,798	1,392,778	1,101,918	871,849
Germany, Federal Republic of	53.52	53.76	54.01	61,561	61,931	62,304	3,294,745	3,329,411	3,365,039
Ireland	36.17	24.22	16.22	3,428	3,693	3,978	123,991	89,444	64,523
Italy	8.77	7.48	6.38	57,042	58,803	60,619	500,258	439,846	386,749
Netherlands	2.88	1.20	0.50	14,144	14,733	15,347	40,735	17,680	7,673
United Kingdom	13.69	11.06	3.93	56,000	56,224	56,450	766,640	621,837	504,098
European Community - 9	25.15	22.16	19.89	261,248	266,192	271,286	6,574,076	5,898,202	5,396,173
Greece	9.45	7.89	6.59	9,520	9,877	10,248	89,964	77,929	67,534
European Community - 10	24.61	21.65	19.41	270,768	276,069	281,534	6,664,040	5,976,131	5,463,707

Sources: The population data for 1980, except for the United Kingdom, are from Organization for Economic Cooperation and Development, *Main Economic Indicators*, (Paris: OECD, 1981). The projections are based on data for 1961-73 from the U.S. Department of Commerce, Bureau of the Census, *World Population 1977* (Washington, D.C.: Bureau of the Census, 1978), and for 1974-80 from OECD, *Main Economic Indicators*, July 1981. Projections are based on compound growth rates, for 1970-80 for most countries, but 1969-79 for Belgium, Luxembourg, and Greece, and 1977-80 for the Federal Republic of Germany. The figures for total consumption are all projections based on data for 1961-77 from Food and Agriculture Organization of the United Nations, *Food Balance Sheets 1975-77 Average and Per Caput Food Supplies, 1961-65 Average 1967 to 1977* (Rome: FAO, 1980). The log-functional form was used for all countries.

Table 45—Effects of a reduction of European Community grain tariffs on the grain balance

Region	Grain Balance 1975-77	Change in Balance	
		Absolute	Relative
	(1,000 metric tons)		(percent)
Developed countries	78,463.00	18,492.88	23.6
Developing countries	-19,296.00	-8,717.62	45.2
Sub-Saharan Africa			
Low income	-753.00	-188.77	-15.8
High income	-1,205.00	-67.04	-5.6
Asia			
Low income	-8,045.00	-3,173.15	-39.5
High income	-2,709.00	-409.23	-15.1
North Africa/Middle East			
Low income	-3,245.00	-376.89	-11.6
High income	-5,910.00	-1,902.02	-32.2
Latin America			
Low income	-84.00	-4.11	-4.9
High income	2,632.00	2,869.91	109.0

Sources: Calculations based on data for 1955-77 from Alberto Valdés and Joachim Zietz, *Agricultural Protection in OECD Countries: Its Cost to Less-Developed Countries*, Research Report 21 (Washington, D.C.: International Food Policy Research Institute, 1980).

Note: A positive sign indicates a surplus; a negative sign indicates a deficit.

Table 46—Effects of a reduction of European Community grain tariffs on world trade in wheat

Region	Change in Imports		Change in Exports	
	Absolute	Relative	Absolute	Relative
	(1,000 metric tons)	(percent)	(1,000 metric tons)	(percent)
Developed countries	-374.92	-5.8	8,648.76	18.2
Developing countries	-5,649.61	-21.4	879.03	24.7
Sub-Saharan Africa				
Low income	-44.85	-9.2	...	...
High income	-51.36	-4.8	...	...
Asia				
Low income	-3,134.49	-41.0	...	...
High income	-141.31	-4.7	...	...
North Africa/Middle East				
Low income	-315.96	-11.0	...	...
High income	-1,233.71	-24.2	35.28	90.5
Latin America				
Low income	-3.71	-4.5	...	...
High income	-724.21	-11.9	843.75	24.0

Sources: Calculations based on data for 1955-77 from Alberto Valdés and Joachim Zietz, *Agricultural Protection in OECD Countries: Its Cost to Less-Developed Countries*, Research Report 21 (Washington, D.C.: International Food Policy Research Institute, 1980).

Note: A positive sign indicates an increase; a negative sign indicates a decrease.

Table 47—Effects of a reduction of European Community grain tariffs on world trade in barley

Region	Change in Imports		Change in Exports	
	Absolute	Relative	Absolute	Relative
	(1,000 metric tons)	(percent)	(1,000 metric tons)	(percent)
Developed countries	-320.79	-13.8	3,698.66	56.4
Developing countries	-713.41	-77.2	355.63	160.2
Sub-Saharan Africa				
Low income	-1.00	-100.0	...	...
High income	...	...	...	...
Asia				
Low income	-1.00	-100.0	12.85	142.8
High income	-206.90	-71.6	...	...
North Africa/Middle East				
Low income	...	...	...	...
High income	-394.71	-84.3	219.95	142.8
Latin America				
Low income	...	...	...	...
High income	-109.80	-66.5	72.80	123.4
Trade Reversal	-173.00	-100.0	50.02	...

Sources: Calculations based on data for 1955-77 from Alberto Valdés and Joachim Zietz, *Agricultural Protection in OECD Countries: Its Cost to Less-Developed Countries*, Research Report 21 (Washington, D.C.: International Food Policy Research Institute, 1980).

Note: A positive sign indicates an increase; a negative sign indicates a decrease.

Table 48—Effects of a reduction of European Community grain tariffs on world trade in maize

Region	Change in Imports		Change in Exports	
	Absolute	Relative	Absolute	Relative
	(1,000 metric tons)	(percent)	(1,000 metric tons)	(percent)
Developed countries	-194.70	-2.1	3,562.42	9.0
Developing countries	-396.61	-7.2	477.37	6.3
Sub-Saharan Africa				
Low income	-46.28	-11.0	23.43	20.0
High income	-12.20	-17.2	1.80	20.0
Asia				
Low income	-1.00	-20.0	2.62	18.7
High income	-37.09	-2.4	22.57	1.1
North Africa/Middle East				
Low income	-57.30	-12.8	...	...
High income	-10.21	-2.3	...	...
Latin America				
Low income	-0.40	-20.0	...	...
High income	-232.13	-9.1	426.95	7.8

Sources: Calculations based on data for 1955-77 from Alberto Valdés and Joachim Zietz, *Agricultural Protection in OECD Countries: Its Cost to Less-Developed Countries*, Research Report 21 (Washington, D.C.: International Food Policy Research Institute, 1980).

Note: A positive sign indicates an increase; a negative sign indicates a decrease.

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