AN ECONOMETRIC MODEL OF THE EUROPEAN ECONOMIC COMMUNITY'S WHEAT SECTOR

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Introduction

1.1 Background

The Common Agricultural Policy (CAP) of the European Economic Community (EC) has been the subject of controversy essentially since its inception. However, judged against the objectives of the CAP contained in the Treaty of Rome and repeated below, the cereals policy would have to be considered a success in meeting its objectives except for the last one.[1/]

(a) to increase agricultural productivity by promoting technical progress and by ensuring the rational development of agricultural production and the optimum utilization of the factors of production, in particular labour;

(b) to ensure a fair standard of living for the agricultural community, in particular by increasing the individual earnings of persons engaged in agriculture;

(c) to stabilize markets;

(d) to assure the availability of supplies; and,

(e) to ensure that supplies reach consumers at reasonable prices.

In fact, the CAP has been so successful in assuring the availability of supplies that attention has turned away from the problem of self-sufficiency to one of surplus disposal and budgetary costs.

This paper concentrates primarily on the EC wheat sector where price policies have resulted in a large exportable surplus. These surpluses are disposed of using export restitutions (subsidies) which have expanded rapidly over the 1970's and early 1980's. As shown in table 1.1 the EC was a net importer of wheat until 1973/74. However, with the entry of the United Kingdom into the EC, and the continuing improvement in wheat yields, the EC's net exports of wheat and flour were in excess of 10 mmt by 1980/81. In 1984/85, the combination of a small increase in wheat area and high yields have resulted in the Community becoming the world's second largest wheat exporter. Nonetheless, the EC continues to import some high quality wheat to blend with their domestic lower quality wheat. Gross imports of wheat by the EC have declined from nearly 10 mmt in 1970/71 to an estimated 2.7 mmt in 1984/85.

Increasing self-sufficiency is also occurring for coarse grains in the EC (table 1.2). Between the early 1960's and 1975/76 the EC's coarse grain net imports were quite stable averaging about 15 mmt per

Table 1.1: Wheat Supply and Disposition, European Community-10, 1970/71-1984/85, mmt.

Crop Year Beginning August	Crop Year							Trade Year (July-June)	
	Production	Imports[a/]	Food Demand	Feed Demand	Exports[a/]	Ending Inventory	Net Exports	Imports[b/]	Exports[b/]
1970/71	36.72	12.18	30.09	12.6	5.72	5.49	-6.46	9.5	3.4
1971/72	42.07	11.24	30.84	12.1	8.88	7.00	-2.36	6.8	4.2
1972/73	43.37	12.05	30.14	14.6	11.88	5.82	-0.16	7.0	6.0
1973/74	43.13	12.13	30.14	11.8	11.66	7.29	-0.47	5.3	5.2
1974/75	47.66	9.90	30.52	12.3	12.26	9.73	2.35	4.9	6.9
1975/76	40.18	11.95	30.58	9.4	14.51	7.53	2.55	5.4	8.6
1976/77	41.46	9.65	30.59	9.9	10.90	7.04	1.25	4.4	5.1
1977/78	40.20	12.51	30.57	10.7	12.64	6.15	0.13	5.5	5.0
1978/79	50.26	10.64	30.79	11.9	15.30	9.00	4.66	4.6	8.8
1979/80	48.84	10.86	31.02	12.3	17.50	7.77	6.64	5.3	10.4
1980/81	55.07	10.31	31.08	12.8	20.70	8.78	10.38	4.5	14.7
1981/82	54.40	11.20	30.90	13.7	22.10	7.70	10.90	4.7	15.5
1982/83	59.80	9.50	29.20	15.3	21.20	11.30	11.70	3.8	15.5
1983/84[p/]	59.30	9.80	29.50	20.0	21.80	9.00	12.00	3.6	16.0
1984/85[p/]	74.20	7.90	29.90	22.0	25.00	14.10	17.10	2.7	18.5

a/ Includes intra-EC trade
b/ Excludes intra-EC trade
p Preliminary

Source: U.S. Dept. of Agriculture. Grains. Foreign Agricultural Circular, various issues.

Table 1.2: Coarse Grains Supply and Disposition, European Community-10, 1970/71-1984/85, mmt.

Crop Year Beginning Aug. 1	Production	Imports[a/]	Food Demand	Feed Demand	Exports[a/]	Ending Inventory	Net Exports	Trade Year[c/] Imports[b/]	Trade Year[c/] Exports[b/]
1970/71	54.70	24.25	14.48	56.34	8.52	6.09	-15.73	NA	NA
1971/72	61.84	22.95	16.79	57.35	10.84	5.90	-12.11	NA	NA
1972/73	63.42	23.54	17.22	58.55	10.93	6.16	-12.61	NA	NA
1973/74	66.03	27.86	17.90	61.74	13.78	6.63	-14.08	NA	NA
1974/75	64.44	25.74	18.27	59.53	11.13	7.88	-14.61	NA	NA
1975/76	60.80	26.66	17.70	60.08	12.41	5.14	-14.24	NA	NA
1976/77	53.21	32.57	17.79	58.46	9.50	5.16	-23.07	23.2	4.0
1977/78	66.46	24.98	18.25	59.40	13.31	5.64	-11.67	14.8	5.5
1978/79	70.08	24.32	19.08	60.67	13.15	7.13	-11.16	13.5	5.5
1979/80	69.12	22.53	18.91	60.10	13.25	6.52	-9.27	13.3	5.0
1980/81	69.79	20.80	18.55	57.56	14.30	6.70	-6.50	11.1	5.6
1981/82	67.80	19.80	18.40	55.40	14.40	6.10	-5.40	8.8	4.1
1982/83	71.60	16.80	18.40	53.70	15.00	7.40	-1.80	6.5	5.2
1983/84[p/]	64.00	16.00	18.40	49.20	14.40	5.40	-1.60	5.9	3.5
1984/85[p/]	73.00	14.70	18.50	50.40	17.10	7.10	2.40	4.9	6.0

a/ Includes intra-EC trade
b/ Excludes intra-EC trade
c/ July-June through 1978/79, October-September thereafter
p/ Preliminary

Source: U.S. Dept. of Agriculture. Grains. Foreign Agricultural Circular, various issues.

year. Following an increase in net imports in 1976/77 (due to the drought in Europe) net imports have continued to decline with the EC forecast to become a net exporter of 2.4 mmt of coarse grains in 1984/85.

The U.S. has viewed the emergence of the EC as a major wheat exporter with considerable alarm and increasingly hostile rhetoric.[2/] The United States perceive the use of export subsidies by the EC as an unfair trade practice, and point out that the EC policies have contributed to world price instability. Secretary Block has argued that the U.S. may have to deviate from its "free market" stance and engage in a short-run trade war if that is what it takes to achieve the principle of free markets.[3/] More recently, Senator Quayle has indicated that the U.S. may have to resort to explicit export subsidies if other countries are unwilling to dismantle their restrictive trade practices.[4/]

During most of the 1980's the EC has faced a budgetary problem with the costs of the CAP rising more rapidly than revenues. This has resulted in (1) support price increases lower than they would have been otherwise; (2) a policy to impose production quotas on the dairy sector; (3) a delay in support payments to producers; and, (4) the introduction of guarantee thresholds for cereals.[5/] At this time it is difficult to foresee how successful the EC's efforts will be in limiting expenditures; and what their impacts will be on exports and world prices.

Canada has a large stake in the evolution of the EC from an importer of cereals to a major export competitor. Not only has Canada lost sales to what was historically one of its most important markets for high quality wheat, but now the EC is competing actively with Canada in third country markets. In addition, a EC-US trade confrontation using explicit export subsidies would damage Canadian export markets and producer welfare. Export subsidies lower the world market price for the commodity being subsidized which would be passed on directly to Canadian producers. In a battle between the EC and U.S. treasuries, the Canadian cereal producer would most likely suffer the greatest loss.

1.2 Objectives

Given the emergence of the EC as a significant wheat exporter, their internal budgetary problems, and their trade confrontation with the U.S., it is important for Canada to understand the effects of alternative policy scenarios that have or may be implemented in the future. While there have been a number of studies analyzing different aspects of the EC's economic policies, they are based on assumed (synthetic) values for the relevant supply, demand and policy parameters (Buckwell et al.; Anderson and Tyers; Rayner and Reed; Paarlberg and Sharples; Josling and Pearson). Since the evaluation of any policy change depends crucially on the values of the assumed parameters of the economic system being studied, one objective of this research is to provide reasonable estimates of the various parameters needed to evaluate the EC's wheat policy.[7/] Following the specification and estimation of the model, multipliers are presented to illustrate how the

EC's wheat sector responds to various exogenous shocks. Multipliers are presented for (1) an exogenous shock in the intervention price; (2) an exogenous shock in the threshold price; (3) a devaluation of the U.S. dollar relative to the ECU; and, (4) a decrease in the excess demand for Community wheat.

In the future, it is proposed to use the model to evaluate a number of policies which could reduce the EC's expenditures in the cereal sector including production controls, continued domestic price supports but without export subsidies, and the abolition of the "green" rate of exchange. In addition, the economic rationale of the EC's wheat policy will be evaluated in further research, and the EC wheat model will be incorporated into a larger multicountry model of world wheat trade in order to evaluate a larger range of policy issues at the international level.

An Overview of the European Community's Cereal Policy

2.1 Introduction

A brief overview of four critical aspects of EC cereal policy is provided as background to understand the model developed in section 3. Readers are advised to consult Harris, Swinbank and Wilkinson; Fennell, and the CAP Monitor for more detailed information.

The four aspects of EC policy discussed are: (1) the price structure for wheat; (2) the "silo" price system; (3) monetary compensatory amounts; and, (4) accessionary compensatory amounts.

2.2 Price Structure

There are currently five policy determined prices which influence the EC wheat market. These are the intervention price, the target price, the threshold price, and the reference price for domestically produced minimum and medium quality wheat. The values for these prices in the 1984/85 crop year are:

Target price	-	259.08 ecu
Threshold price	-	254.05 ecu
Reference price (medium quality)	-	213.14 ecu
Reference price (minimum quality)	-	195.52 ecu
Intervention price	-	182.73 ecu

Figure 2.1 shows the evolution of threshold, minimum quality reference and intervention prices since 1967/68.[8/]

Of the five prices the intervention and threshold prices are by far the most important as the intervention price sets the internal support level, and the threshold price determines the minimum import price.[9/]

The intervention price for wheat sets the minimum internal price within the EC and, when converted at green rates, is common across the individual member countries.[10/] The intervention price is maintained through intervention purchases. Wheat purchased by the EC is either sold back onto the domestic market (when domestic prices rise) or exported, usually using export restitutions, since domestic cereal prices in the EC are normally above world market prices (figure 2.2).[11/] Basically, the refunds serve to bridge the gap between the f.o.b. price of EC cereals in export position, normally Rouen for wheat, and the f.o.b. prices of other exporters, usually soft winter wheat from U.S. Gulf ports and Argentina wheat. Export subsidies for cereals represent a major cost for the Community, averaging 1.8 billion ECU between 1980 and 1982 (Commission of the European Communities).

Figure 2.1: Intervention, Reference and Threshold Price in the European Community, 1967/68 to 1983/84, ECU/mt.

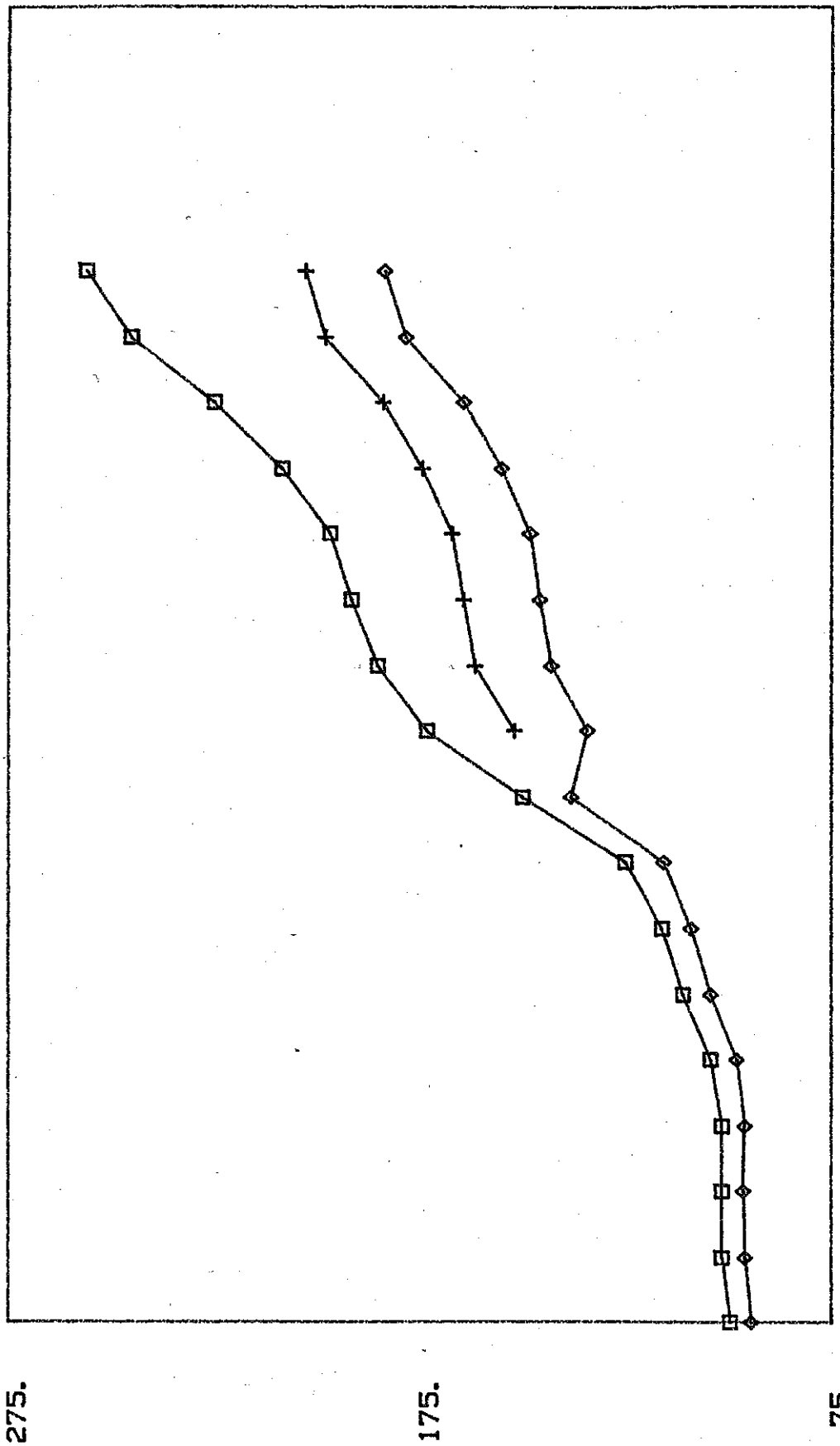
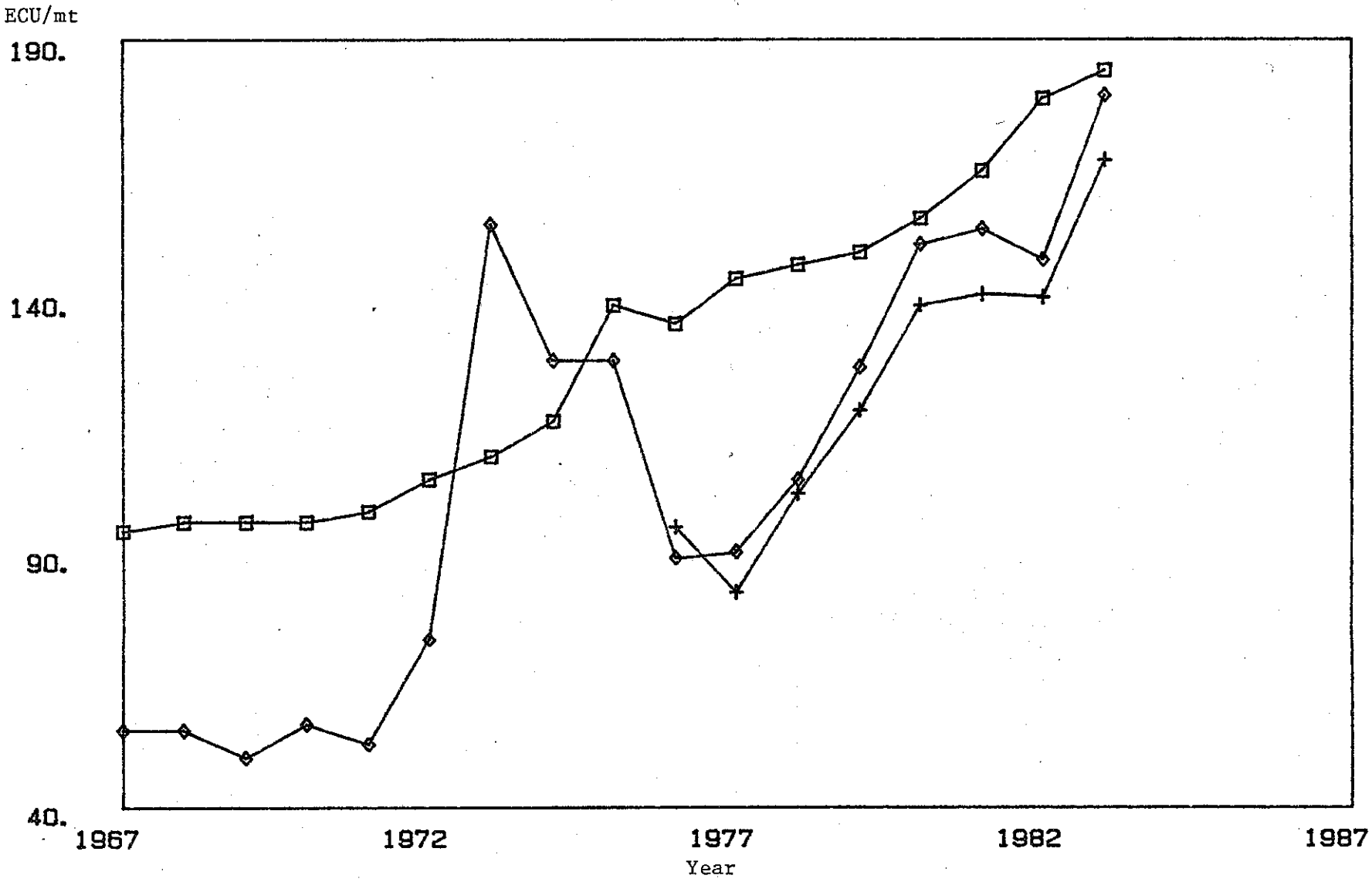


Figure 2.2: Wheat Price Comparisons, 1967/68 to 1983/84, ECU/mt.



□□□ - EC Intervention price for wheat
◇◇◇ - EC Import price for wheat
+++ - U.S. Export price for No. 1, S.R.W. wheat, Gulf Ports.

The threshold price (basis Rotterdam) is the minimum price at which third country wheat can be imported and is maintained by a variable levy.[12] The variable import levy for wheat is based on the minimum third country offering price to the EC, basis Rotterdam. Table 2.1 illustrates the calculation of the levy based on four different offer prices. The first step is to convert the four different types of wheat to a common quality (lines 3 and 4) using coefficients of equivalence established by the Commission. These quality standards are based on historic market price differentials and have been revised only once since 1967 (CAP Monitor). After adjusting for quality differentials, and converting the prices from U.S. dollars to ECU's, the lowest C.I.F. price in ECU/tonne (line 6) is determined. This price is then subtracted from the threshold price to determine the import levy in ECU's/tonne (line 7 and 8), which in the example given equals 98.98 ECU.[13] Levies represent a source of income to the EC averaging 1.44 billion ECU per year, for all products, during 1980 to 1982.

The variable import levy is designed to keep third country exports from undercutting the EC's price support system. However, during the commodity boom years 1973-1975 world grain prices at times rose above the EC's threshold prices. In this situation according to the principles of the EC grain market, import subsidies should have been introduced, but they were not because of the financial implications (Toepfer). Instead an export levy (tax) was applied to exports in order to keep domestic prices from increasing in line with world price changes. According to the CAP Monitor, "Unlike import levies, export levies are not fixed according to a set formula but are set according to such criteria as the need to maintain an orderly domestic market in cereals and the trends of world prices".

Reference prices for wheat of breadmaking quality were introduced in 1976/77 at the same time as the silo system. The purpose of the reference price is to provide a higher level of support for wheat of breadmaking quality than for feed wheat. Price support for breadmaking wheat is more ad-hoc than for other major grains. As stated in the CAP Monitor "...intervention A, and the other special measures, are operated when necessary at the discretion of the EEC Commission, advised by the Cereal Management Committee." Intervention A, which is the purchase of grain by intervention agencies at the reference price, providing it meets minimum quality requirements, is restricted to the first three months of the crop year and there have been limits on the quantities purchased.

Beginning in 1981/82 two quality standards were established for breadmaking wheat of medium and minimum quality. According to the CAP Monitor, "...all the support for breadmaking wheat operates at the minimum quality reference price. The medium quality reference price is retained as an indication of the price which should apply to higher quality breadmaking wheat."

2.3 The Silo System

The "silo system" for wheat was introduced in 1976/77. Prior to

Table 2.1: Example of the Calculation of the Variable Import Levy for Common Wheat

1.	Imported wheat type	Soft Red Winter 2	Hard Winter 2 Ordinary	Dark Hard Winter 2 (13.5%)	Northern Spring 2 (14%)
2.	C.i.f. price in US dollars/ tonne (ex-Rotterdam)	157.00	152.00	153.00	159.00
3.	Coefficient of equivalence				
	in ecu/tonne	(-4.54)	(-10.89)	(-13.61)	(-15.12)
	in dollars/tonne	-6.06	-14.54	-18.18	-20.20
4.	Corrected c.i.f. price in dollars/tonne (2-3)	150.94	137.46	134.82	138.80
5.	Exchange rate applicable from 25 April 1979 for converting world market price data in dollars to ecu		1 US dollar = 0.748741 ecu		
6.	C.i.f. price in ecu/tonne	113.00	102.93	100.96	103.94
7.	Threshold price in ecu/tonne	199.94	199.94	199.94	199.94
8.	Levy in ecu/tonne			98.98	

Note: Lowest offer price underlined.

Source: Commission (1979, Annex III, p. 14), as reproduced in Harris, Swinbank and Wilkinson (p. 79).

1976/77 the intervention price for wheat was above those for barley and corn, e.g., 13.5 percent higher than barley and 21.7 percent higher than for corn in 1975/76. The result of this policy was to encourage the production of high yielding feed quality wheats, which had to be exported, while discouraging the production of coarse grains which the EC has traditionally imported. Consequently, in 1976/77 the intervention price for feed quality wheat was lowered and equated to the intervention price for barley.

The intervention price for corn remained below those for barley and wheat until 1978/79 when the intervention prices for all three grains were equated. The policy of equal intervention prices for feed wheat, barley and corn appears to be a permanent policy change, consequently, one pricing decision sets the price support level for most of the cereals sector.

The reference price system was introduced at the same time as the silo system to provide additional price support for domestically produced wheat of bread making quality (see section 2.2). In the model it is assumed that imported wheat competes against domestic wheat priced at the minimum quality reference price.

2.4 Monetary Compensatory Amounts (MCA's)

Although the agricultural policy of the EC is referred to as the "Common Agricultural Policy" support prices for cereals have generally been different in the various member countries and these price differences have been maintained through the use of MCA's.[14/]

The perceived need for MCA's arose as a result of the devaluation of the French franc (11.1%) and the revaluation of the West German mark (9.3%) in late 1969. Due to these currency changes, intervention prices in France should have increased by the amount of the devaluation and fallen in West Germany by the amount of the revaluation. However, the French government decided that the intervention prices, for agricultural products, should not rise and continued to use the exchange rate prevailing prior to the devaluation in converting from units of account to French francs, despite the fact that the official exchange rate had changed. West Germany, facing the opposite situation from France, decided that the decline in agricultural product prices implied by the revaluation of the mark was inconsistent with their policy objectives. Thus, they also continued to price agricultural products using the old exchange rate, even though it no longer equalled the market determined rate.

As a result of these actions the concept of a common intervention price across the Community was fractured in 1969. Converted at market rates of exchange the intervention price in West Germany was 9.3 percent higher, and the French intervention price 11.1 percent lower, than the common intervention prices in the remainder of the member countries. If nothing had been done agricultural products would have flowed from other member countries, and particularly France whose intervention price was now 22.9 percent below West Germany's to be sold into intervention,

while all third country imports would have been channeled through France. To prevent this from happening MCA's (ie. boarder subsidies or taxes) roughly equal to the differences in intervention prices were introduced (figure 2.3). The positive MCA for West Germany implies a tax on German imports and a subsidy on German exports, while the negative MCA for France implies a tax on exports and a subsidy on imports. The MCA applies both to intra-EC and extra-EC trade in agricultural products.

The French and West Germany currency realignments were viewed as temporary in 1969 but the subsequent breakdown of the Bretten-Woods fixed exchange rate regime resulted in the widespread use of representative (green) rates of exchange for determining agricultural prices which differed from the appropriate market rate of exchange. MCA's were used to bridge the gap between these two exchange rates and their use became the rule rather than the exception. The importance of MCA's is illustrated by the fact that for a short time in 1976 support prices in West Germany were 60 percent greater than those in the United Kingdom (Harris, Swinbank and Wilkinson).

Figure 2.4 illustrates the divergence between the "common" intervention price converted to national currencies at annual average green rates and market rates (national currency/ECU) of exchange for Belgium, France, Italy, Netherlands, West Germany and the United Kingdom. The welfare impacts of MCA's, on member countries depend on whether the country is an importer or an exporter and whether their currency is revaluing or devaluing (Ritson and Tangermann). Two different situations are illustrated in figure 2.5. Country one is depicted as a weak currency (green rate < market rate) exporting country. The fact that the good is valued at Pg, using green rates, instead of Pm, using market rates means that consumers would lose PgPmBC, producers would gain PgPmED, and there would be a net gain to the country of CBED from a movement to market rates of exchange.

Country two is a strong currency (green rate > market rate) importing nation so prices converted at green rates (Pg) are above what they would be if converted at market rates (Pm). In this situation consumers gain PmPgEF, and producers lose PmPgBA from a move to market rates of exchange. Again, there is a net gain to the country, equal to ABEF. With the principles clearly established the chart given below shows the economic impacts of MCA's in four possible situations.

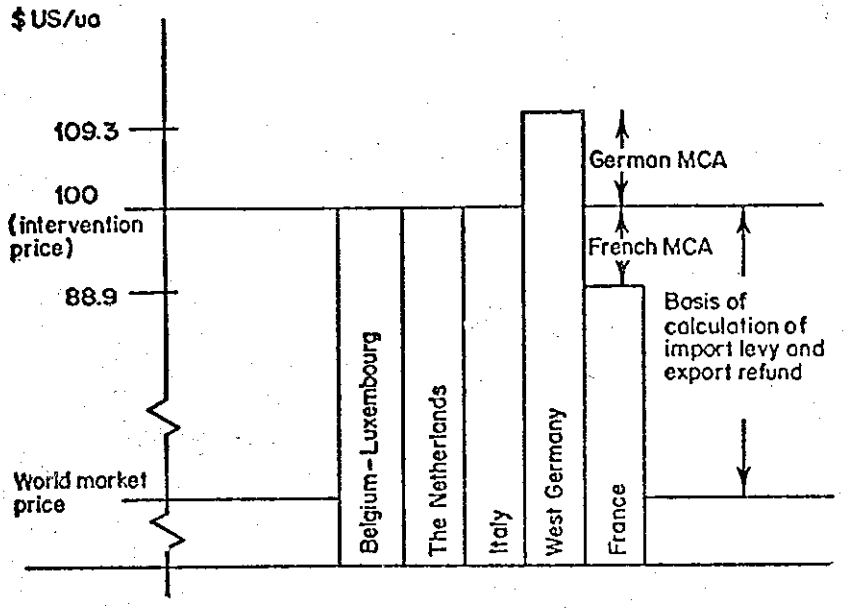
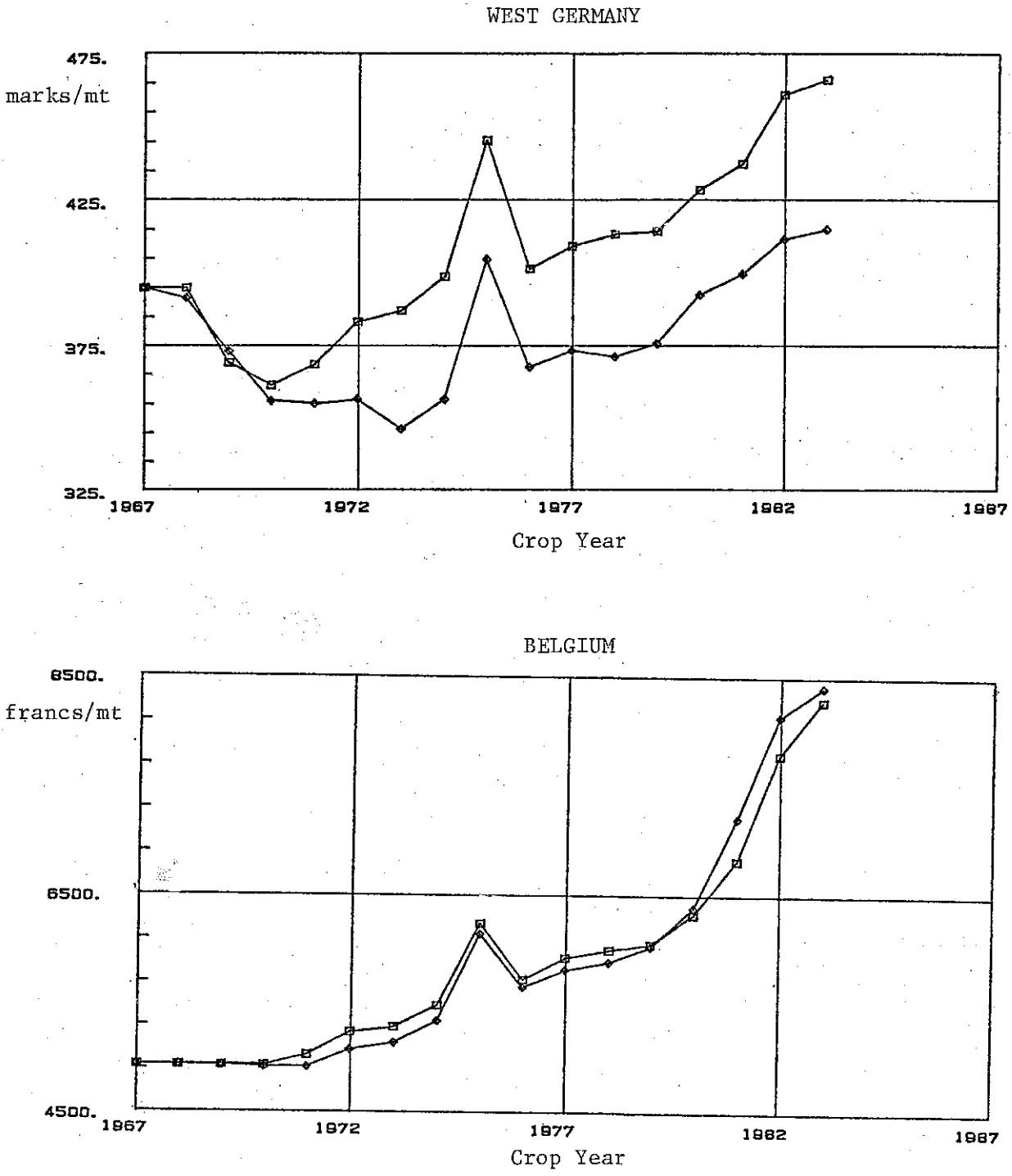


Figure 2.3 CAP pricing for intervention products—late 1969. Germany is said to have a 'positive' MCA (above the common price level) and France a 'negative' MCA (below the common price level).

Source: Reproduced from Harris, Swinbank and Wilkinson (p. 191).

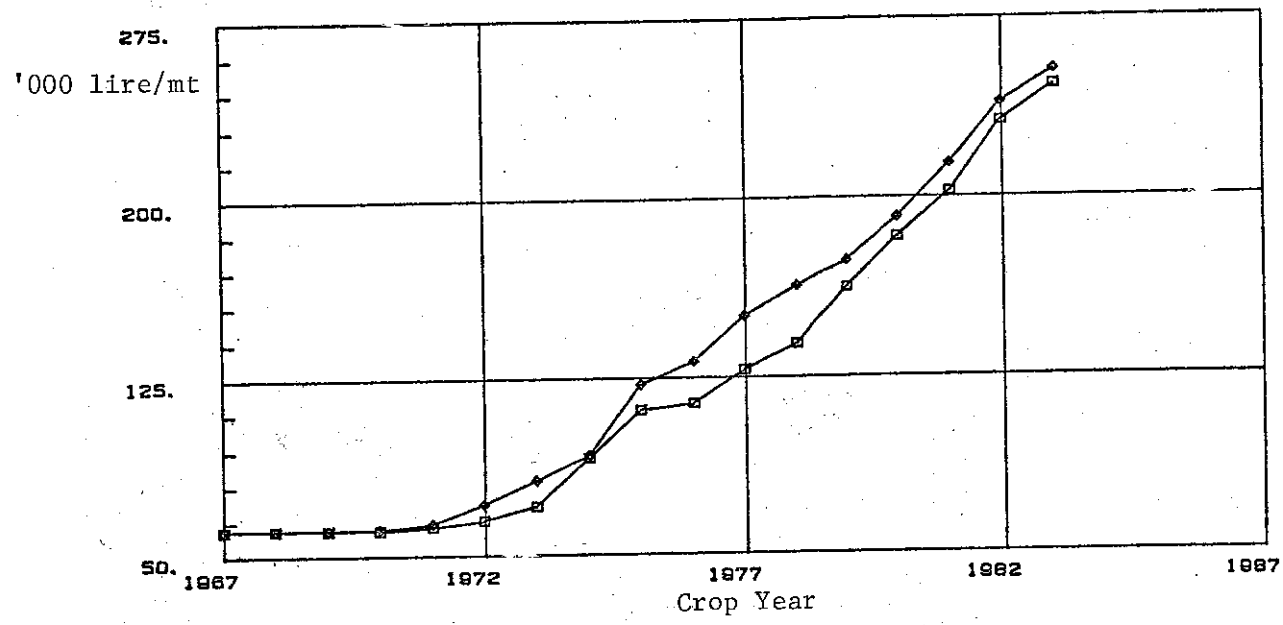
Figure 2.4: Intervention Prices for West Germany, Belgium, Italy, Netherlands, France and the United Kingdom converted at market rates and green rates of exchange



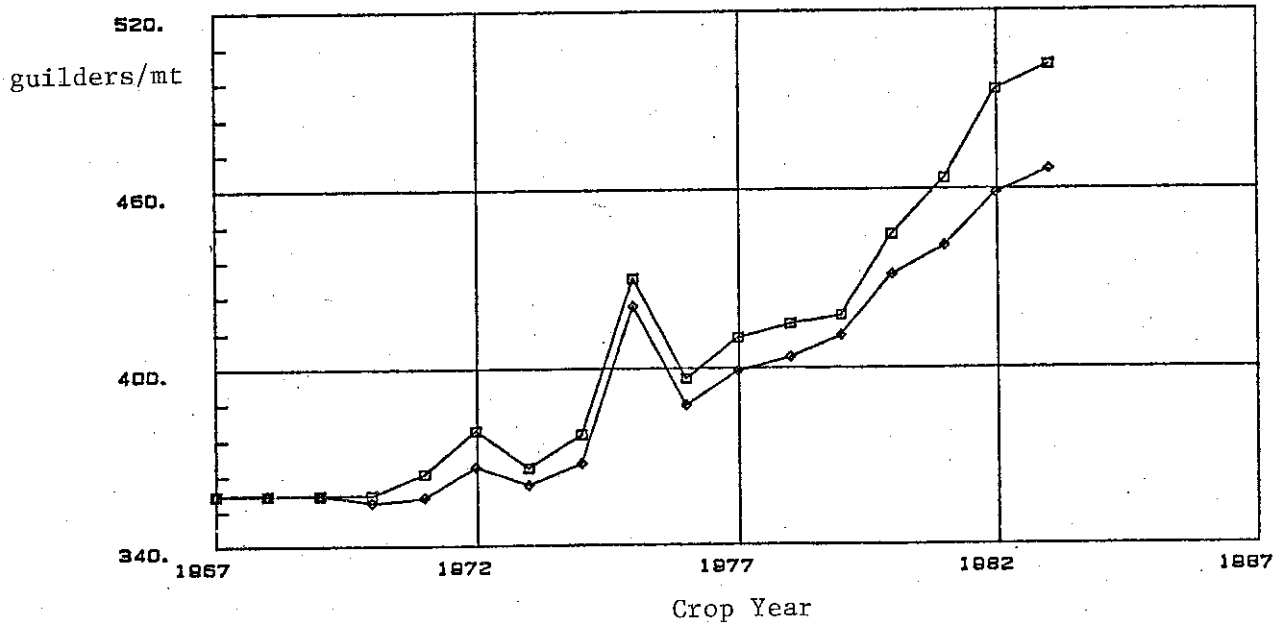
□□□ - Intervention prices converted at green rates of exchange
◊◊◊ - Intervention prices converted at market rates of exchange

Figure 2.4 continued

ITALY



NETHERLANDS

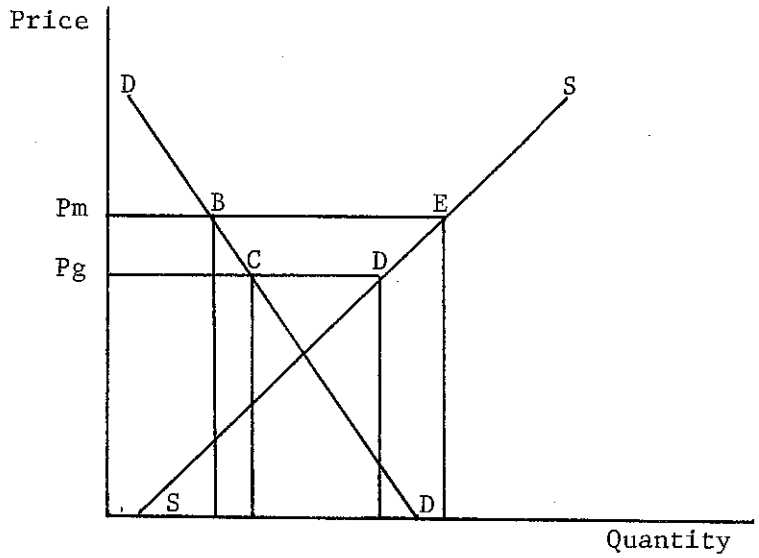


□□□Intervention prices converted at green rates of exchange
◊◊◊Intervention prices converted at market rates of exchange

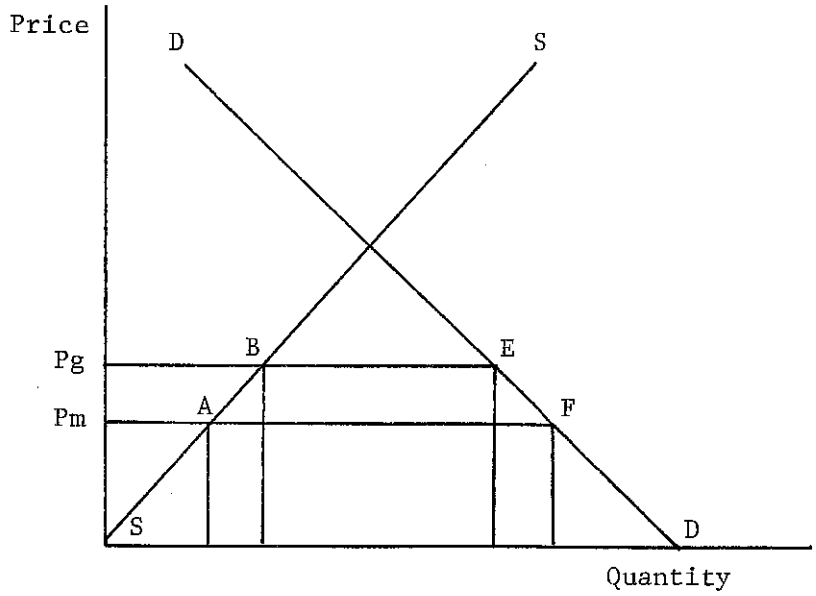
Figure 2.5

Welfare Impacts of MCA's for a Weak Currency Exporting Nation and a Strong Currency Importing Nation

Country One - Exporting Country - Green rate less than Market Rate



Country Two - Importing Country - Greenrate greater than Market Rate



Impact of moving from green rates to market rates of exchange

	Consumers	Producers	Net Change
Exporting nation:			
green rate > market rate	gain	lose	negative
green rate < market rate	lose	gain	positive
Importing nation:			
green rate > market rate	gain	lose	positive
green rate < market rate	lose	gain	negative

Clearly, a comprehensive evaluation of the welfare impacts of MCA's in the EC would have to be conducted for every country and all commodities. The scope of this study has been limited by estimating aggregate supply and demand curves for the EC as a whole. Because of this it is impossible to use the model to evaluate the impact of changes in green rates on individual member countries.[15] The model can, however, be used to analyze the impact on the Community's aggregate supply and demand quantities by simply replacing the green rates of exchange with the market rates in the member countries farm price linkage equations (see equations 18 to 33). It should be noted that there is no requirement for MCA's to sum to zero across the Community, and between 1980 and 1982 Community expenditures on MCA's averaged 283.2 million ECU's per year (Commission of the European Communities).

As a result of the breakdown in the common pricing provisions of the CAP the farm prices in the different member countries are dependent on (1) the announced "common" ECU support price; and, (2) the green rate used to translate the common price into their own currency. Since green rates are established by each individual member country, Harvey, and Tangermann have argued that the system has allowed member countries an opportunity to pursue their own individual policy objectives and influenced the setting of the common price level. About the only constraint on a member country in setting its green rate is the convention that green rate changes can only be made to reduce MCA's, e.g., green rate changes must move national prices closer to the common price level calculated at market exchange rates.

There are numerous features of the agri-monetary system which complicate the calculation and application of MCA's. However, the basic principle is that MCA's are a means of maintaining different support levels across the member countries.

2.5 Accessionary Compensatory Amounts

With the entry of the United Kingdom, Denmark and Ireland into the EC in 1973, special measures were introduced to provide for a period of transition from the individual countries cereal policy, prior to entry,

to the common agricultural policy. This transition period lasted five years and was accomplished through the use of accessionary compensatory amounts (ACA's). The ACA's were subtracted from the common support price in arriving at the price applicable to the new member country. For the case of Ireland and Denmark the ACA's were fairly small amounting to less than ten percent of the common wheat intervention price at the beginning of the transition period. However, for the United Kingdom the beginning ACA for wheat was around 40 percent of the common intervention price. ACA's were discontinued on December 31, 1977, the end of the transition period.

THE MODEL

3.1 An Overview of the Model

Table 3.1 outlines the econometric model of the EC wheat sector described in the following section. The model contains 42 endogenous variables which are explained using 26 behavioral equations, 15 identities and one market-clearing condition.

The model can be conceptualized as containing five blocks of equations. In the supply block the area of wheat harvested and total wheat production are determined. In the demand block the disappearance of wheat into food use, feed use and carry-over stocks is estimated. In addition, the share of total food use from supplies of imported wheat is determined. Total wheat imports, total wheat exports and community net exports of wheat can then be calculated using identities. The third block of equations are used to determine the values of the policy variables. The intervention, reference and threshold prices for wheat and the threshold price for barley are determined using behavioral equations, while the barley intervention price, export subsidies and levy income are determined from identities. The fourth and largest block of equations is used to determine the farm prices of wheat and barley in the individual member countries. In addition, the U.S. export price for wheat is determined from the market clearing (excess demand equals excess supply) condition. The EC import price for wheat is calculated using an identity. The final block of equations is used to calculate indices of the individual member country prices for use in the aggregate supply and demand equations discussed earlier.

The supply and demand quantities explained in this model are for the EC-10 as published by the U.S. Department of Agriculture. Data for the macroeconomic variables are normally for the EC-10, but sometimes represent the EC-9. All aggregate farm price indices are for the EC-9. Complete variable definitions, the mnemonics used, and data sources are given in Appendix I.

The model, as specified in the next section, follows rather standard model building practices (Labys). It does, however, represent an addition to the growing body of agricultural commodity models which treat policy variables as being determined endogenously (Meilke and Griffith; Sarris and Freebairn; de Gorter). It should also be noted that the model, with the exception of the Community's inventory relation, is recursive and hence with the exception of this one equation can be appropriately estimated using ordinary least squares.

3.2 Equation Estimates

The next five sections discuss the specification and estimation results for the behavioral equations, dealing in turn with the supply block, demand block, policy block, price block, identities and the linkage to the rest of the world. All of the equations have been estimated using ordinary least squares or nonlinear least squares to

Table 3.1: An Overview of the Model

Endogenous Variables	Exogenous Variables[a/]
A. Supply Variables	
1. Area harvested (AWH)	1. Index of production costs (CSTIN)
2. Total production (QWH)	
B. Demand Variables	
3. Food wheat consumption (DWHFO)	2. Real personal consumption expenditures (DY)
4. Feed wheat consumption (DWHFE)	3. Population (POP)
5. Import share of food wheat consumption (SHWHIM)	4. Consumer price index (CPI)
6. Imports of wheat (IMWH)	5. Hog price index (FPHG)
7. Wheat inventory (IWH)	6. Denaturing premium (DENAT)
8. Exports of wheat (EXWH)	7. Exchange rate (ECU's/US$) (EXCHRECU)
9. Net exports of wheat (NEXWH)	
C. Policy Variables	
10. Wheat intervention price (PWHIN)	8. Index of green rates of exchange (EXRGR)
11. Wheat threshold price (PWHTH)	9. Dummy variable for introduction of silo system (D7682)
12. Wheat reference price (PWHRE)	10. Coefficient of equivalence for 14 percent protein spring wheat (CEQUIV)
13. Barley intervention price (PBAIN)	
14. Barley threshold price (PBATH)	
15. Export subsidies (ECSUB)	
16. Levy Income (LEVYINC)	
17. Net revenue (NETREV)	

Table 3.1 continued

D. Price Variables

18. Netherlands farm price of wheat (FPWH.NE)
19. Netherlands farm price of barley (FPBA.NE)
20. France farm price of wheat (FPWH.FR)
21. France farm price of barley (FPBA.FR)
22. West Germany farm price of wheat (FPWH.WG)
23. West Germany farm price of barley (FPBA.WG)
24. Italy farm price of wheat (FPWH.IT)
25. Italy farm price of barley (FPBA.IT)
26. Belgium-Lux farm price of wheat (FPWH.BE)
27. Belgium-Lux farm price of barley (FPBA.BE)
28. United Kingdom farm price of wheat (FPWH.UK)
29. United Kingdom farm price of barley (FPBA.UK)
30. Denmark farm price of wheat (FPWH.DE)
31. Denmark farm price of barley (FPBA.DE)
32. Ireland farm price of wheat (FPWH.ID)
33. Ireland farm price of barley (FPBA.ID)
34. EC, import price for wheat, c.i.f. (IMPWH)
35. U.S., export price for No. 2 soft red winter wheat, Gulf ports (EXPWH)

11. Netherlands, green rate of exchange (EXRGR.NE)
12. France, green rate of exchange (EXRGR.FR)
13. West Germany, green rate of exchange (EXRGR.WG)
14. Italy, green rate of exchange (EXRGR.IT)
15. Belgium-Lux, green rate of exchange (EXRGR.BE)
16. United Kingdom, green rate of exchange (EXRGR.UK)
17. Denmark, green rate of exchange (EXRGR.DE)
18. Ireland, green rate of exchange (EXRGR.ID)
19. United Kingdom, wheat (ACA.UK) and barley (ACABA.UK) ACA's
20. Denmark, wheat (ACA.DE) and barley (ACABA.DE) ACA's
21. Ireland, wheat (ACA.ID) and barley (ACABA.ID) ACA's
22. Margin between EC wheat import price and U.S. wheat export price (MMIMP)

E. Identities

36. Index of farm wheat prices weighted by production shares (FPWH)
37. Index of farm wheat prices weighted by consumption shares (CPWH)
38. Index of farm barley prices weighted by production shares (FPBA)
39. Index of wheat intervention prices weighted by production shares (PWHINF)
40. Index of wheat reference prices weighted by consumption shares (PWHREC)
41. Index of wheat threshold prices weighted by consumption shares (PWHTHC)
42. Rest of the world excess demand (EDROW)

a/ Trend and dummy variables have been omitted from the list of exogenous variables.

correct for autocorrelation (Fair), with the coefficient of determination (R^2), Durbin-Watson statistic (D.W.), correction for autocorrelation (RHO) and sample period given below each equation. Student t-values are given in parentheses and elasticities, calculated at mean values, below the estimated coefficients.

3.2.1 Supply Block

The quantity of wheat produced in the EC is determined by estimating area response and a total production function. The area planted to wheat in the EC has been fairly stable since 1960, varying from a low of 10.977 million hectares in 1977 to an estimated 13.4 million hectares in 1984. The area sown to wheat (AWH) has, however, responded to changes in the lagged deflated farm price of wheat (FPWH) and the lagged deflated farm price of barley (FPBA), where both prices are deflated by an index of prices paid by farmers for production requisites (CSTIN).

Because the Community raises both winter and spring wheat the price of wheat lagged both one and two years was included in the area response equation (1).

(1) AWH = 3.38 + 212.39 FPWH(-1)/CSTIN(-1)
t-value (0.39) (1.42)
elasticity [0.34]

+ 389.63 FPWH(-2)/CSTIN(-2)
(2.84)
[0.63]

- 383.01 FPBA(-1)/CSTIN(-1) + 0.066 Trend
(-3.06) (1.06)
[-0.64]

R^2 = 0.65 D.W. = 2.77 Sample = 1964/65 - 1981/82

The Community also raises spring and winter barley but when the barley price lagged two years was included in equation (1) it entered with a very low t-value and was excluded from the final specification. Equation (1) indicates that wheat area is quite responsive to price changes with a direct price elasticity, in the first year following a price change, of 0.34 and in the second year of 0.63. The cross price elasticity with respect to the barley price is -0.64. The estimate of the direct price elasticity is considerably smaller than that estimated by Ames, et al. but slightly larger than the ones used by Rojko, et al.

Total wheat production (QWH) is determined by regressing wheat production against wheat area, a linear time trend (Trend) and a zero-one dummy variable (D76) to represent the drought in 1976.

(2) QWH = -119.09 + 6.30 AWH + 1.18 Trend - 5.72 D76
t-value (-9.83) (5.56) (11.12) (-3.23)
elasticity [1.68]

R^2 = 0.95 D.W. = 1.55 Sample = 1968/69 - 1982/83

Equation (2) shows that there has been a strong trend in wheat production equalling 1.18 mmt/year between 1968/69 and 1982/83. This is consistent with the growth in average wheat yields which have increased from less than 2.5 mt/ha in the early 1960's to over 4.5 mt/ha by the early 1980's. Although changes in the price of wheat relative to the cost of inputs (particularly fertilizer) may have played a role in increasing yields, no statistically significant relationship was found between wheat production and wheat price deflated by input costs.

3.2.2 Demand Block

Wheat is used in the EC both for human food and in animal feeds. The total domestic disappearance of wheat has increased from approximately 37 mmt in the early 1960's to 50 mmt by the mid-1980's. Nearly all of this demand growth has been for feed wheat, since wheat for food purposes, between 1960 and 1983, has only varied from a high of 31.2 mmt in 1965 to a low of 29.4 mmt in 1982.

Following conventional demand theory the per capita demand for food wheat (DWHFO/POP) is assumed to be a function of the real price of wheat and real per capita consumption expenditures (DY/POP). Before presenting the estimated equation a brief discussion of the price variable is necessary. Even though the EC has recently been a net exporter of wheat it has continued to import high quality wheat, from the rest of the world, to blend with its domestically grown wheats to improve their milling qualities. The share of imported wheat, as a fraction of total food use (SHWHIM) has declined from over 25 percent in the late 1960's to slightly more than ten percent by the early 1980's. The price paid by millers for wheat is a blend price equal to the threshold price for imported wheat (PWHTHC) and the local price for domestic wheat (CPWH). Consequently, in order to use a realistic price in the EC's food demand equation a weighted average of the threshold price and the domestic price is used, where the weights are determined by the share of total food wheat use represented by imported wheat.

(3) DWHFO/POP = 0.130 - 0.30 (CPWH*(1-SHWHIM)
(18.10) (-1.32)
[-0.07]

+ PWHTHC*SHWHIM/CPI - 2.31 DY/POP
(-2.94)
[-0.07]

R^2 = 0.46 D.W. = 2.08 Sample = 1968/69 - 1981/82

The results of estimating the food demand for wheat are about as expected with a very inelastic (-0.07) direct price elasticity and a negative, but small (-0.07), income elasticity. The coefficient of determination for the equation is small but this is largely due to the small variations in per capita wheat use over the sample period.

The demand for feed wheat (DWHFE) is derived from the demand for animal products and is consequently a function of the price of wheat deflated by the price of hogs (FPHG), the price of barley deflated by the price of hogs, real income, to represent the growth in the demand for meat, and a variable to represent the denaturing premium (DENAT) paid to EC feed compounders. The premium was paid to lower the effective price of wheat, thus making it competitive with barley as a feed grain, and was discontinued in 1974. In theory the denaturing premium should be incorporated in the feed demand equation by adjusting the feed wheat price downward by the amount of the effective subsidy. However, the data required to make this adjustment, i.e. the quantity of feed wheat on which the denaturing premium was paid in each member country, was not available and consequently the premium was included as a separate variable.

The quantity of wheat produced in the Community is also included in the feed wheat demand equation. This variable is justified on the grounds that the intervention price mechanism may prevent domestic prices from reflecting the true supply and demand situation in the Community. For example, if both wheat and coarse grain production are surplus to local needs prices are not allowed to reflect the relative scarcity of the different grains because of intervention buying. Consequently, relative price changes are muted and more wheat may be fed during large production years than would be indicated by relative price changes. The feed wheat demand estimates are presented in equation (4).

(4)	DWHFE	=	-11.48	- 17.65 FPWH/FPHG	+ 13.04 FPBA/FPHG		
	t-value		(-1.48)	(-2.05)	(1.94)		
	elasticity			[-1.35]	[1.20]		
			+ 0.31 DENAT	+ 16.61 DY	+ 0.14 QWH		
			(6.54)	(3.62)	(1.98)		
			[0.19]	[1.21]	[0.52]		

R^2 = 0.81 D.W. = 2.36 RHO = -0.56 Sample = 1968/69 - 1980/81

Equation (4) shows, as expected, that the demand for feed wheat is quite price elastic, compared with food wheat demand, having an estimated direct price elasticity of -1.35 and a cross price elasticity with respect to the barley price of 1.20. It also appears that the denaturing premium had a significant impact on feed wheat demand, since a one ECU/tonne subsidy led to a 0.31 mmt increase in wheat feeding. Similarly a one tonne increase in wheat production leads to a 0.14 tonne increase in wheat feeding.

In equation (3), in order to calculate the price of food wheat, the share of imported wheat relative to the food use of wheat is needed. This import share (SHWHIM) is specified to be a function of the threshold price (PWHTHC) relative to the reference price (PWHREC), and the total supply (QWH + IWH(-1)) of domestically produced wheat. While it would have been preferable to use the supply of locally produced high quality wheat, which substitutes more directly for imported wheat, the authors were unable to locate any data that classified EC wheat production by grade.

(5) Ln(SHWHIM) = 0.84 - 2.90 Ln(PWHTHC/PWHREC) - 0.59 Ln(QWH + IWH(-1))
t-value (0.63) (-3.14) (-1.69)

R^2 = 0.80 D.W. = 1.41 Sample = 1970/71 - 1982/83

The results presented in equation (5) indicate that wheat imports have been very sensitive to the ratio of threshold to reference prices for wheat, with an estimated elasticity of -2.90 (Richardson). In addition, increases in the domestic supply of wheat have also been responsible for the declining share of imported wheat with every one percent increase in domestic wheat supply reducing the import share by 0.59 percent. Equation (5) has been specified as being linear in the logarithms of the variables since the estimated share cannot be less than zero.

The communities total imports of wheat (IMWH) can be calculated by multiplying the estimated import share by the total demand for food wheat, as in equation (6).

(6) IMWH = DWHFO * SHWHIM

In order to complete the demand side of the model it is necessary to estimate a behavioral equation for either wheat inventory or wheat exports, since the other component can be determined as the residual in the supply-disposition identity. The decision was made to estimate wheat stocks directly and let exports be the residual demand. This appears to correspond with EC policy to subsidize exports rather than build intervention stocks.

Wheat stocks are held in the EC both by private stockholders and by the public in the form of intervention stocks, which are purchased to support the price of wheat at the intervention level. Unfortunately, the authors were unable to locate data on the quantity of wheat held in intervention stocks at the end of the crop year. Consequently, a total stocks function is estimated. There would appear to be three main factors influencing the stock level. First, the total ending inventory of wheat is expected to increase with the total available supply as intervention purchases increase. Second, the inventory should decline as local farm prices rise relative to intervention prices, and intervention stocks are reduced by selling on the domestic market.

Third, increases in the world price of wheat relative to the intervention price reduces the need for export subsidies and inventories would be expected to decline as intervention stocks are exported.

Attempts to estimate the inventory relation were not very successful. In particular the estimates were quite sensitive to the choice of sample period. Consequently, a very short sample period (1973/74 - 1981/82) was chosen to avoid estimation problems caused by combining data, prior to, and following the entry of the three new member countries in 1973. In addition, the coefficient on the world price/intervention price ratio was constrained to equal -0.1. This coefficient value, which because the equation is estimated in logarithms is also an elasticity, can only be justified on the grounds that the supply of exports from the EC probably responds some, but not by very much, to world prices. If the coefficient on this variable, in the inventory equation, is set equal to zero the Community's exports of wheat, during the crop year, would be completely inelastic given the structure of the rest of the model.

The coefficient values in the estimated inventory equation (7) all have the correct signs but the t-value on the farm price/intervention price is less than one.

$$
\begin{array}{lll}
(7) & \text{Ln(IWH)} & = -0.86 - 0.49\ \text{Ln(FPWH/PWHINF)} \\
 & \text{t-value} & \quad (-0.65) \quad (-0.80) \\
 & & -0.10\ \text{Ln(IMPWH/PWHIN)} \\
 & & \text{(constrained)} \\
 & & + 0.74\ \text{Ln(QWH + IWH(-1))} + 0.24\ \text{D74} \\
 & & \quad (2.28) \qquad\qquad\qquad (2.22)
\end{array}
$$

$R^2 = 0.68$ D.W. = 2.75 Sample = 1973/74 - 1981/82

Clearly, supply fluctuations are the largest contributor to inventory variations with an estimated coefficient of 0.74. A dummy variable (D74) was included in the equation to account for an outlying observation.

The demand block of the model is completed with the addition of two identities. The first identity (equation 8) equates total supply and total demand.

$$(8) \quad \text{QWH} + \text{IWH}(-1) = \text{DWHFO} + \text{DWHFE} + \text{IWH} + \text{DISCEC} + \text{NEXWH}$$

The second identity (equation 9) defines net exports (NEXWH) as the difference between gross exports (EXWH) and gross imports (IMWH), and a statistical discrepancy variable (DISCEX) which is necessary because gross imports and gross exports are measured on a July-June crop year

while the net export figure, calculated from equation (8), is based on a August-July year.

(9) NEXWH = EXWH - IMWH - DISCEX

3.2.3 Policy Block

The intervention and threshold prices are the key instruments used in determining wheat (cereal) policy in the EC. The intervention price sets the minimum internal price level and the threshold price the minimum import price level. In addition, an equation to explain the reference price for wheat is required since it affects the relative share of imports in equation (5).

The EC policy makers objective function is assumed to be one of maximizing the income transfer from consumers and taxpayers to producers, subject to both an internal budget constraint, and external and internal political constraints.[17] Therefore, five factors can be identified as influences on the setting of intervention prices. First, the inflation rate in the Community is important in determining the nominal price increases necessary to maintain the real price of cereals (Josling and Pearson). Second, revenues, in the form of variable levy income, are received for imported cereals, mainly wheat and corn, and consequently serve to offset the budget constraint. Third, revenue is expended on export subsidies for wheat and barley, resulting in increased budgetary pressures. Fourth, the cost of the EC's price support system for commodities other than wheat, particularly dairy products, can have an effect on the cereals sector by reducing the funds available for the support of cereals. Finally, variations in the "green rates" of exchange can have an impact on the setting of the common intervention price. Ritson has argued that green rate devaluations, which serve to increase cereal prices denoted in local currencies, have in the past removed much of the pressure to increase the common intervention price while Tangermann (p. 43) states, "the rates by which the Council of Ministers increases support prices annually are not independent of developments of exchange rates."

The next step is to determine variables which can act as proxies for the factors considered above.[18] The task is complicated by the fact that there are only a limited number of observations available, since common intervention prices were first announced in 1967/68. The variables chosen to represent the net cost of the EC's wheat policy were: (1) the net exports of wheat (NEXWH) lagged two years, and (2) the ratio of last year's intervention price relative to last year's CIF import price, measured in ECU's, PWHIN(-1)/IMPWH(-1). As net wheat exports increase, and as the intervention price rises relative to the import price, the cost of export restitutions increases and there is both internal budget, and external political pressure to moderate further increases. Variables similar to those constructed for wheat could be used to represent the feed grain sector, however, in this case it would probably be best to use the relationship of the threshold price

of corn to the world price of corn as a proxy for the levy revenue earned on corn imports. Unfortunately, attempts to incorporate variables related to the feed grain sector in the equation explaining the intervention price for wheat were unsuccessful. Invariably these variables entered the explanatory equation with low t-values, and consequently, no variables related to the feed grain sector appear in the wheat intervention price equation.

A weighted average of the consumer price indices in the EC (CPI) is used as the measure of inflation in the Community. The postulated relationship between inflation and the intervention price is positive.

A weighted average of green rates of exchange (EXRGR) is used to reflect the impact that changes in the green rates may have had on the intervention price. An increase in the index of green rates represents a devaluation of member countries currencies relative to the ECU. Thus, increases in the index of green rates should result in lower intervention prices.[197]

No measure of general EC budget pressure, or proxies for the cost of the CAP for other commodities, are included in the estimated equation. This decision was taken to conserve degrees of freedom and to maintain the partial equilibrium nature of the model. It is, however, an area worthy of further attention.

Equation (10) illustrates the results of estimating the function to explain the intervention price of wheat.

(10)	PWHIN	=	154.4	- 87.2 EXRGR	+ 1.28 CPI(-1)	- 1.28 NEXWH(-2)
	t-values		(8.17)	(-3.91)	(17.06)	(-2.74)
	elasticities			[-0.71]	[0.64]	[-0.02]

- 8.91 PWHIN(-1)/IMPWH(-1)
(-3.06)
[-0.10]

R^2 = 0.99 D.W. = 2.61 Sample = 1968/69 - 1982/83

All of the coefficients have the expected signs and in general the t-values are large. The elasticity with respect to the world wheat price variable is quite interesting because it implies a one percent change in the ratio of intervention to world market price this year leads to a 0.10 percent change, in the opposite direction, in the intervention price next year. While the elasticity is small it does substantiate a link between world market prices and price changes within the Community. It is also clear that changes in green rates have influenced the intervention price with an estimated elasticity of -0.71. Similarly, increasing wheat exports have put downward pressure on the intervention price.

The other policy variable of importance in the wheat sector is the threshold price. Theoretically, both the threshold and intervention

prices are related by "market elements" to the target price, the price in the most deficit grain producing region in Germany. However, there appears to be considerable political discretion in setting the value of the "market elements". The economic impact of increases in the threshold price is to reduce the competitiveness of third country grains in the EC. Over time the gap between intervention and threshold prices has widened considerably, from 5.4 ECU in 1967/68 to 66.3 ECU in 1982/83.

As stated in the CAP Monitor the threshold price decision will depend largely on the intervention price,

> "through the setting of the target price, but the ministers can nevertheless use their powers to set the target price so as to increase or decrease the competitiveness of third country grain on the Community market. Since the threshold price is directly linked to the target price the ministers can change the relative competitive positions of EEC and third country grains by changing the target prices by more, or less, than the intervention prices. This can be done by adjusting the "market element" at Ormes, which is the only arbitrary element in the link between the intervention, target and threshold prices for grain. The other elements of the calculation (transport costs, trading margins, etc.) are either known from the trade or measured by surveys. In recent years there has been a tendency for threshold prices to rise by more than intervention prices. This has helped to price third country grain out of the EEC market and increase the use of domestic grain, thus curbing support buying and subsidized exports."

Following from this the threshold price equation has been specified to be consistent with an objective of minimizing the budgetary costs of the EC's wheat policy. As such the threshold price is specified to be a function of (1) the CIF import price of wheat; (2) net exports of wheat; and, (3) the intervention price of wheat. In addition, two other variables are included in the equation, a lagged dependent variable to represent the influence of past decisions and adjustment constraints; and, a dummy variable to account for the introduction of the silo system. Equation (11) shows the estimation results.

(11)	PWHTH	=	-21.82	+	17.23 D7682	+	0.027 IMPWH(-1)	
	t-values		(-4.14)		(5.47)		(1.15)	
	elasticity						[0.02]	
			+ 0.92 PWHIN	+	0.63 NEXWH(-1)	+	0.32 PWHTH(-1)	
			(9.44)		(2.83)		(4.46)	
			[0.76]		[0.01]			

R^2 = 0.99 D.W. = 1.84 Sample = 1968/69 - 1982/83

Equation (11) shows that a one ECU increase in the intervention price results in a 0.92 ECU (this value is not significantly different from one) increase in the threshold price. The t-statistic on the world price variable is only slightly larger than one and the coefficient estimate indicates world price changes have only a weak influence on threshold prices. The impact of increasing net exports has been to increase the threshold price but again, the short-run impact of this variable, while statistically significant is not large. The long-run impacts calculated from equation (12) will be about 1.5 times larger than the short-run impacts.

The reference price for wheat, which was introduced in 1976/77, is between the threshold and intervention prices. It is specified as a function of the threshold and intervention price with the coefficients on the two prices constrained to sum to one. In this way it is guaranteed that if both the threshold and intervention prices increase by one ECU, the reference price will also increase by one ECU. The equation estimate is given below.

(12) PWHRE = 16.62 + 0.958 PWHIN + (1 - 0.958) PWHTH
t-values (19.72) (61.9) (constrained)

R^2 = 0.99 D.W. = 1.15 Sample = 1976/77 - 1983/84

In order to conduct meaningful simulations of the EC wheat model the farm, intervention and threshold prices for barley must be endogenized. The farm barley price is the key variable since it is an important determinant of both wheat area and wheat feeding. As stated previously the barley and common wheat intervention prices have been the same since the introduction of the silo system in 1976/77. Consequently, the intervention price for barley (PBAIN) is calculated using an identity with an exogenous variable (DISCBA) equal to the difference between the two series prior to 1976/77 (equation 13).

(13) PBAIN = PWHIN + DISCBA

The threshold prices for barley and wheat are not equal, but they have tended to move together. Consequently, the barley threshold price (PBATH) is linked to the wheat threshold price (PWHTH) in equation (14).

(14) PBATH = -0.22 + 0.91 (PWHTH)
t-value (-0.27) (128.6)
[1.00]

R^2 = 0.99 D.W. = 2.68 RHO = 0.39 Sample = 1968/69 to 1982/83

Two other variables of policy interest are the cost of EC export subsidies and the levy revenue obtained from wheat exports and imports,

respectively. Since the values for these variables are not reported it is only possible to provide approximations. Export subsidies (ECSUB) are calculated by multiplying the difference between the EC's intervention price and the U.S. export price (measured in ECU's) by gross exports (equation 15).

(15) ECSUB = (PWHIN - EXPWH * EXCHRECU) * EXWH

Import levy (LEVYINC) income is approximated as the difference between, the threshold price plus the coefficient of equivalence (CEQUIV), and the EC's import price for wheat multiplied by gross imports (equation 16).

(16) LEVYINC = (PWHTH + CEQUIV - IMPWH) * IMWH

In the simulations presented in section 4 the net revenue (NETREV) from the EC's wheat policy is reported. It is calculated (equation 17) as the difference between levy income and export subsidies converted to U.S. dollars.

(17) NETREV = (LEVYINC - ECSUB)/EXCHRECU

3.2.3 Price Block

The farm prices of wheat and barley in the individual member countries of the EC are normally between the intervention price and the threshold price. Farm prices can, however, fall slightly below the intervention price because of marketing charges and taxes levied against farmers, and subtracted from the intervention price. The level of domestic farm prices and their reaction to changes in the level of intervention prices is of crucial importance because these are the prices which enter individual countries supply and demand functions.

Prior to 1976/77 it seemed clear that a one unit change in the intervention price, measured in the countries own currency, would result in close to a one unit change in the countries domestic price level, assuming the margin between the intervention and threshold prices remained constant. However, with the widening of the gap between threshold and intervention prices it is less obvious that changes in the intervention price will lead to changes in the domestic price of an equal magnitude, unless the farm price is very close to the intervention price. To put it another way, there is considerably more latitude for local supply and demand conditions to influence the local price level, now, than when the difference between intervention and threshold prices were much smaller. In examining the data, however, only in 1976/77 when the EC's production of feed grains fell 12.5 percent from the year earlier level is there strong evidence of upward pressure on domestic wheat and barley prices caused by local supply and demand conditions,

and even in this case it is not consistent across all countries.

In order to model the relationship between the EC's original six member countries farm prices, for wheat and barley, and the common intervention prices a set of four variables were included in the specification of each equation. First, the intervention price multiplied by the individual countries green rate. The coefficient for this variable determines the degree of price transmission from the intervention price to the farm price. As argued by Coleman the coefficient is expected to be less than one. Second, a dummy variable (D7682) equal to zero prior to 1976/77 and one thereafter is included to account for the introduction of the silo system and reference price mechanism. Third, the ratio of EC wheat and/or feed grain production to EC domestic wheat and/or feed grain consumption is used to reflect the general supply and demand condition within the Community. A negative relationship between the farm price and this measure of excess supply is expected. Fourth, the difference between the threshold and intervention price measures the degree of protection from third country imports. As the threshold price rises relative to the intervention price third country imports are discouraged and this should serve to increase the domestic farm price. The results of these regressions for both wheat and barley are given below.

Netherlands:

(18) FPWH.NE = 45.67 + 0.88 (PWHIN * EXRGR.NE)
t-value (1.13) (8.13)
elasticity [0.85]

+ 37.18 D7682 + 25.03 D76
(4.74) (2.47)

R^2 = 0.98 D.W. = 2.08 Sample = 1968/69 - 1981/82

(19) FPBA.NE = - 6.97 + 1.04 (PBAIN * EXRGR.NE) + 52.24 D7682
t-value (-0.21) (11.77) (3.11)
elasticity [1.00]

R^2 = 0.93 D.W. = 1.58 Sample = 1968/69 - 1981/82

France:

(20) FPWH.FR = 22.56 + 0.82 (PWHIN * EXRGR.FR) + 109.67 D7682
t-value (0.06) (9.35) (4.23)
elasticity [0.86]

R^2 = 0.98 D.W. = 1.65 RHO = .47 Sample = 1968/69 - 1981/82

(21) FPBA.FR = 53.36 + 0.84 (PBAIN * EXRGR.FR) + 82.9 D76
t-value (1.25) (13.1) (1.97)
elasticity [0.91]

R^2 = 0.94 D.W. = 1.68 Sample = 1968/69 - 1981/82

Germany:

(22) FPWH.WG = 21.13 + 0.99 (PWHIN * EXRGR.WG)
t-value (0.40) (7.41)
elasticity [0.89]

+ 55.75 D7682 + 41.46 D76
(7.82) (3.69)

R^2 = 0.97 D.W. = 1.55 Sample = 1968/69 - 1981/82

(23) FPBA.WG = 50.44 + 0.98 (PBAIN * EXRGR.WG) + 53.07 D76
t-value (1.24) (9.10) (3.34)
elasticity [0.87]

R^2 = 0.91 D.W. = 1.45 Sample = 1968/69 - 1981/82

Italy:

(24) FPWH.IT = 4096.1 + 1.03 (PWHTH)*EXRGR.IT
t-value (0.93) (35.16)

R^2 = 0.99 D.W. = 1.65 Sample = 1968/69 - 1981/82

(25) FPBA.IT = 9563.2 + 0.92 (PBATH)*EXRGR.IT
t-value (2.68) (35.27)
elasticity [0.92]

R^2 = 0.99 D.W. = 1.38 Sample = 1968/69 - 1981/82

Belgium-Lux:

(26) FPWH.BE = -321.7 + 1.04 (PWHIN * EXRGR.BE) + 919.1 D7682
t-value (0.64) (10.9) (8.22)
elasticity [0.99]

R^2 = 0.99 D.W. = 1.83 Sample = 1968/69 - 1981/82

(27) FPBA.BE = 42.5 + 0.99 (PBAIN * EXRGR.BE) + 708.6 D76
t-value (0.08) (10.1) (2.36)
elasticity [0.98]

R^2 = 0.91 D.W. = 1.67 Sample = 1968/69 - 1981/82

Several general comments with respect to the estimated price link equations can be made. First, in no case was it possible to identify the influence of EC supply and demand conditions on local farm prices. A dummy variable (D76) for 1976/77 was included in most of the equations to account for the one year in which a supply shortfall clearly raised farm prices. Second, the introduction of the silo system (D7682) clearly raised the farm price of wheat relative to the intervention price in all countries except Italy. In Italy, which is a deficit grain producing area farm prices are close to the threshold prices, and consequently the farm price has been linked to the threshold price instead of the intervention price. Third, changes in the margin between threshold and intervention prices had no statistically significant impact on farm prices in any of the countries. Fourth, most of the coefficients of price transmission were within two standard deviations of 1.0, the exceptions being France for both wheat and barley and Italy for barley.

Estimation of the price linkage equations for the three countries, (United Kingdom, Denmark, Ireland) entering the EC in 1973 presents severe difficulties because of the limited degrees of freedom available to estimate the relationship. In addition, for each country five years elapsed before they were fully integrated within the CAP. During this transition period intervention prices for the three new countries were adjusted downwards by an accessionery compensatory amount (ACA). Consequently, in the price link equations the ACA, expressed in ECU's, are subtracted from the intervention price before being multiplied by the green rate. However, other than this adjustment these price link equations are specified in a manner consistent with those for the other members of the Community.

Initial estimates of the price coefficients for both wheat and barley in the United Kingdom, of 0.67 and 0.77 respectively, seemed unreasonably low. Consequently, these coefficients were constrained to equal 0.90 in the empirical estimates presented below. A similar problem occurred in Ireland but in this case the coefficient in the wheat price equation was unrealistically high at 1.43 and the coefficient for barley too low at 0.67. Therefore the wheat price coefficient was constrained to equal 1.0 and the barley coefficient 0.90. Again in the wheat price equation for Denmark the coefficient was constrained to equal 0.90. While these constraints are somewhat arbitrary they are consistent with the coefficients estimated for the other six member countries using much longer data series. The estimated price equations for the United Kingdom, Denmark and Ireland are presented below.

United Kingdom:

(28) FPWH.UK = 12.13 + 0.90 (PWHIN - ACA.UK)*EXRGR.UK + 6.30 D7682
t-value (4.11) (constrained) (1.74)
elasticity [0.80]

R^2 = 0.94 D.W. = 2.13 Sample = 1973/74 - 1981/82

(29) FPBA.UK = 11.98 + 0.90 (PBAIN - ACABA.UK)*EXRGR.UK + 8.32 D76
t-value (7.87) (constrained) (1.82)
elasticity [0.83]

R^2 = 0.94 D.W. = 1.40 Sample = 1973/74 - 1981/82

Denmark:

(30) FPWH.DE = 77.79 + 0.90 (PWHIN - ACAWH.UK)*EXRGR.DE
t-value (5.79) (constrained)
elasticity [0.86]

+ 0.26 (PWHTH - PWHIN) * EXRGR.DE
(5.81)
[0.06]

R^2 = 0.99 D.W. = 1.42 Sample = 1973/74 - 1981/82

(31) FPBA.DE = 99.32 + 0.90 (PBAIN - ACABA.DE)*EXRGR.DE + 116.31 D76
t-value (1.97) (18.23) (3.63)
elasticity [0.89]

R^2 = 0.98 D.W. = 1.21 Sample = 1973/74 - 1981/82

Ireland:

(32) FPWH.ID = 345.28 + 1.0 (PWHIN - ACAWH.ID)*EXRGR.ID
t-value (5.41) (constrained)
elasticity [1.05]

- 4.67 Trend + 16.82 D7682
(-5.43) (3.56)

R^2 = 0.97 D.W. = 2.86 Sample = 1973/74 - 1981/82

(33) FPBA.ID = 169.5 + 0.9 (PBAIN - ACABA.ID) EXRGR.ID - 2.18 Trend
t-value (4.38) (constrained) (-4.35)
elasticity [0.98]

R^2 = 0.96 D.W. = 1.24 Sample = 1973/74 - 1981/82

The specifications of, and results for these equations are consistent with those estimated earlier, with the exception of a linear trend variable included in both equations for Ireland. This variable captures a downward trend in the farm price relative to the intervention price over the sample period.

3.2.5 Identities

The individual member countries wheat, barley, intervention and threshold prices are aggregated into a set of index numbers, using a series of identities, which are then used in the aggregate EC relationships estimated previously.

The indices are aggregated using either average wheat production, or consumption, shares over the period 1968 to 1981 as weights. The production and consumption weights are given below.

Country	Wheat Production Share	Wheat Consumption Share
	Percent	
Belgium-Lux.	2.06	3.24
Denmark	1.43	1.21
France	43.78	25.17
Ireland	0.53	1.13
Italy	18.81	25.73
Netherlands	1.73	3.33
United Kingdom	14.63	21.66
West Germany	17.03	18.53
	100.00	100.00

Equation (34) is used to calculate the farm price of wheat, equation (35) the farm price of barley and equation (36) the consumption price of wheat.

(34) FPWH = 0.0206*FPWHL.BE/4550+0.4378*FPWHL.FR/378.1+
0.1881*FPWHL.IT/67970+0.0173*FPWHL.NE/306.3+0.1703*
FPWHL.WG/407+0.0143*FPWHL.DE/501.8+0.0053*FPWHL.ID/25.4+
0.1463*FPWHL.UK/26.19

(35) FPBA = 0.0206*FPBAL.BE/3400+0.4378*FPBAL.FR/310+0.1881*FPBAL.IT/
49550+0.0173*FPBAL.NE/267.7+0.1703*FPBAL.WG/428+0.0143*
FPBAL.DE/402.4+0.0053*FPBAL.ID/21.5+0.1463*FPBAL.UK/27.03

```
(36)  CPWH   =  0.0324*FPWHL.BE/4550+0.251.7*FPWHL.FR/378.1+0.2573*
                FPWHL.IT/67970+0.0333*FPWHL.NE/306.3+0.1853*FPWHL.WG/
                407+0.0121*FPWHL.DE/501.8+0.0113*FPWHL.ID/25.4+0.2166*
                FPWHL.UK/26.19
```

An index of intervention prices using production (equation 37) weights is needed for the inventory equation and an index of reference prices using consumption weights is used in the import share equation (equation 38).[207] Similarly an index of threshold prices (equation 39) is needed in the import share and food demand equations. In this set of identities farm prices for wheat in the United Kingdom, Ireland and Denmark were used until 1973.

```
(37)  PWHINF  =  0.0206*PWH.ECIN*EXRGR.BE/4937.5+0.0143*(PWH.ECIN
                -ACA.DE)*EXRGR.DE/507.2+0.4378*PWH.ECIN*EXRGR.FR
                /487.529+0.0053*(PWH.ECIN-ACA.ID)*EXRGR.ID/31.7+0.1881
                *PWH.ECIN*EXRGR.IT/61718.7+0.0173*PWH.ECIN*EXRGR.NE
                /357.475+0.1463*(PWH.ECIN-ACA.UK)*EXRGR.UK/25.31+
                0.1703*PWH.ECIN*EXRGR.WG/395
```

```
(38)  PWHREC  =  0.0324*PWH.ECIN*EXRGR.BE/4937.5+0.0121*(PWH.ECIN-
                ACA.DE)*EXRGR.DE/507.2+0.2517*PWH.ECIN*EXRGR.FR/
                487.529+0.0113*(PWH.ECIN-ACA.ID)*EXRGR.ID/31.7+
                0.2573*PWH.ECIN*EXRGR.IT/61718.7+0.0333*PWH.ECIN*
                EXRGR.NE/357.475+0.2166*(PWH.ECIN-ACA.UK)*EXRGR.UK/
                25.31+0.1853*PWH.ECIN*EXRGR.WG/395
```

```
(39)  PWHTHC  =  0.0324*(PWH.ECTH+CEQUIV)*EXRGR.BE/5819+0.0121*
                (PWH.ECTH+CEQUIV-ACA.DE)*EXRGR.DE/507.2+0.2517*
                (PWH.ECTH+CEQUIV)*EXRGR.FR/574.568+0.0113*(PWH.
                ECTH+CEQUIV-ACA.ID)*EXRGR.ID/31.7+0.2573*(PWH.
                ECTH+CEQUIV)*EXRGR.IT/72737.4+0.0333*(PWH.ECTH+
                CEQUIV)*EXRGR.NE/421.295+0.2166*(PWH.ECTH+CEQUIV
                -ACA.UK)*EXRGR.UK/25.31+0.1853*(PWH.ECTH+CEQUIV)
                *EXRGR.WG/465.52
```

3.2.6 Rest of the World

There are at least three options with regard to the way the rest of the world could be incorporated into the model. First, the world price could be assumed exogenous. However, the impact of EC policy changes on the world wheat price is of primary interest. Second, the EC model could be combined with a disaggregated world wheat model but this requires further research. A third option is used in this study, whereby a synthetic excess demand function with a price elasticity consistent with the EC's trade share and assumed rest of world supply and demand elasticities is used to close the model (Appendix II). The intercept of the excess demand function is then chosen so that the world price will equal its actual value if the EC's net exports are estimated without

estimated without error. The elasticity of excess demand facing the Community was calculated to equal -19.9 when evaluated at average prices and quantities for the 1978-1982 time period. To incorporate this elasticity in the model the following two equations are added,

(40) EDROW = IROW - 1.14 EXPWH , and

(41) EDROW = NEXWH ,

where EDROW is the excess demand facing the EC. The value of -1.14 was calculated to impose an elasticity of -19.9 and IROW was calculated to satisfy the identity. Equation (41) closes the model by equating excess demand and excess supply.

The model solves for the export price of No. 1, soft red winter wheat, at the U.S. Gulf ports. However, the EC policy equations are based on the communities CIF import price of wheat. Consequently, the EC import price (in ECU's) is linked to the U.S. export price (in U.S. dollars) through an identity with the margin (MMIMP) between the two price series considered exogenous (42).

(42) IMPWH/EXCHRECU = EXPWH + MMIMP .

Model Validation and Multipliers

4.1 Model Validation

It is well known that individual equations which appear satisfactory when estimated individually may exhibit undesirable properties when combined in a dynamic simulation model. The purpose, of this section, is to examine the ability of the model to track the historical observations from which the equations were estimated.

The model was validated over the period 1976 through 1981, the longest period for which actual values of all of the endogenous variables were available. Table 4.1 contains the following descriptive statistics: (1) mean of the actual values; (2) mean of the simulated values; (3) mean error; (4) mean of the percentage errors; and, (5) root mean squared percentage error (RMSPE).[21/] It is clear that most of the endogenous variables validate very well with 25 of the 34 variables presented having RMSPEs of less than five percent. All of the variables with large RMSPEs are based on either wheat imports, wheat exports or both. Consequently, some discussion of the validation performance of these variables is in order.

Exports of wheat are the residual item in the Community's supply-demand identity and therefore contain all of the errors made in predicting the other quantity variables. Exports are underpredicted, on average, by 0.60 mmt over the simulation period. Most of this error was caused by the small (-0.28) mean errors in production and imports (-0.22). In general, the model tracked the level of exports quite well with the largest error (both in actual and percentage terms) occurring in 1976 when actual exports were 5.1 mmt and the estimated figure was 2.8 mmt. The largest error (1.19 mmt) in predicting imports also occurred in 1976 largely as a result of underpredicting production by 7.4 percent in that year. The average percentage error over the last three years was (-15.7), but in volume terms this error represented only 0.75 mmt/year.

Net exports and net revenue have large mean percentage and RMSPEs because some of the actual observations are close to zero, which results in large percentage errors, even when the absolute error is relatively small.

In general, the model seems to track the endogenous variables quite well. In section 4.2 several multipliers for the model are presented which illustrate the reaction of the model to exogenous shocks.

4.2 Multipliers

In tables 4.2 to 4.5 impact, average and eighth year cumulative multipliers are presented for selected variables. Since the model is

Table 4.1 Dynamic Validation Statistics, 1976 to 1981

	Mean of Actual Values		Mean of Simulated Values	Mean Error	Mean of Percentage Errors	Root Mean Squared Percentage Error
Endogenous Variables:						
Area	12.04	mil. ha.	11.95	-0.09	-0.7	2.5
Production	48.37	mmt	48.10	-0.28	-0.5	4.4
Feed Demand	11.88	mmt	11.91	0.03	0.4	3.7
Food Demand	30.83	mmt	30.75	-0.07	-0.2	0.5
Exports	9.92	mmt	9.32	-0.60	-5.1	24.7
Imports	4.83	mmt	4.61	-0.22	-3.9	16.2
Net Exports	5.66	mmt	5.28	-0.37	151.5	490.1
Inventory	7.74	mmt	7.76	0.02	1.3	10.0
EC Wheat Farm Price	237.97		238.90	0.94	0.2	2.1
EC Barley Farm Price	252.29	percent	253.95	1.65	0.5	3.1
Wheat Intervention Price	149.37	ECU/mt	150.22	0.85	0.6	2.1
Wheat Threshold Price	197.45	ECU/mt	198.78	1.33	0.7	1.6
Wheat Import Price	119.40	ECU/mt	119.74	0.34	0.3	1.5
Wheat Export Price	137.33	dol/mt	137.66	0.32	0.3	1.4
Wheat Export Refunds	307.45	mil. ECU	310.22	2.78	-4.6	31.0
Wheat Levy Revenue	427.44	mil. ECU	415.60	-11.81	-3.0	15.5
Net Revenue	146.67	mil. dol.	124.70	-21.94	-72.7	165.9
Farm Wheat Price, Belgium	6978.3	francs	7015.3	36.9	0.5	2.0
Farm Wheat Price, Denmark	1162.2	kroner	1166.1	3.9	0.3	2.9
Farm Wheat Price, France	822.3	francs	828.0	5.7	0.6	1.3
Farm Wheat Price, Ireland	90.8	pounds	91.4	0.5	0.6	2.9
Farm Wheat Price, Italy	217617.0	lire	217338.0	-278.7	-0.5	3.8
Farm Wheat Price, Netherlands	460.0	guilders	462.1	2.1	0.4	1.5
Farm Wheat Price, United Kingdom	90.8	pounds	91.2	0.4	*	3.5
Farm Wheat Price, West Germany	498.2	marks	500.6	2.4	0.5	1.9

Table 4.1 Continued

	Mean of Actual Values	Mean of Simulated Values	Mean Error	Mean of Percentage Errors	Root Mean Squared Percentage Error
Endogenous Variables:					
Farm Barley Price, Belgium	6223.3 francs	6301.6	78.2	1.2	2.7
Farm Barley Price, Denmark	1105.3 kroner	1116.3	11.1	1.1	2.5
Farm Barley Price, France	748.1 francs	752.7	4.6	0.5	2.9
Farm Barley Price, Ireland	85.1 pounds	84.6	-0.5	-0.6	5.2
Farm Barley Price, Italy	182333.0 lire	182694.0	360.9	-0.1	4.1
Farm Barley Price, Netherlands	444.2 guilders	447.5	3.4	0.7	1.8
Farm Barley Price, United Kingdom	85.2 pounds	86.4	1.2	1.1	4.2
Farm Barley Price, West Germany	468.7 marks	471.2	2.5	0.5	2.6

nonlinear the multipliers are not unique, and depend on the size of the change in the exogenous variable and the starting values used for the endogenous variables (Pindyck and Rubinfeld, 1981, p. 393).

To calculate the multipliers, the model was simulated over the 1976 to 1983 time period to create a base simulation.[227] The exogenous variable was then changed, by a constant amount for the years 1976 to 1983, and the model resimulated. The difference between the base simulation and the new simulation shows the effect of the change in the exogenous variable on all of the endogenous variables (Labys). The change in the endogenous variables, in the first time period, is called the impact multiplier. In each time period thereafter a cumulative multiplier can be calculated. In the tables the multiplier for the eighth year is presented. In addition, an average multiplier is also presented which gives the average change in the endogenous variables over the eight year simulation period.

4.2.1 Excess Demand Multiplier

The multipliers in table 4.2 show the reaction of the Community to a sustained decline of 10 mmt in their excess demand curve. This was accomplished by subtracting 10 from the intercept (IROW) in equation 40. This could correspond to persistent production increases in the rest of the world, or as a result of policy actions which decreased the domestic demand for wheat outside the Community.

As shown in table 4.2 the decline in excess demand lowers the world price by $8.72/mt in the first time period (the decline in price is nearly constant over the entire simulation). This price change has almost no effect on the quantity variables in the EC. The "largest" impact is on net exports which decline by 0.06 mmt in the first period and 0.04 in the eighth period. Intervention and threshold prices are likewise effected only marginally, falling by less than 0.5 percent by the eighth year of the simulation.

The only variables reflecting large changes are those related to trade policy. Wheat export subsidies are up substantially (23.8 percent on average) and while levy income is also up (7.7 percent on average) the net cost of the EC's wheat policy increases by 86.8 million dollars (124.1 percent) by the eighth year of the simulation.

In summary, world price changes are reflected only marginally in domestic prices, and exports are maintained by increasing export subsidies.

4.2.2 ECU/U.S. Dollar Exchange Rate Multiplier

Table 4.3 gives the multipliers for a 0.10 decrease in the ECU/dollar exchange rate. This represents a devaluation of the U.S. dollar or a revaluation of the ECU. Again quantity variables and domestic prices change little in the face of a revaluation of the ECU,

Figure 4.2 Multipliers for a 10 mmt Decrease in the Excess Demand Facing the EC

	Base Value	Multipliers					
		Impact		Average		Eighth Year Cumulative	
		Unit Δ	Percent Δ	Unit Δ	Percent Δ	Unit Δ	Percent Δ
Endogenous Variables:							
Production	49.62 mmt	0.0	0.0	-0.05	-0.1	-0.03	-0.1
Feed Demand	12.39 mmt	0.0	0.0	*	*	*	*
Food Demand	30.80 mmt	0.0	0.0	0.01	*	0.01	*
Exports	10.45 mmt	-0.06	-2.1	-0.05	-0.5	-0.03	-0.2
Imports	4.44 mmt	0.0	0.0	0.01	0.3	0.02	0.4
Net Exports	6.33 mmt	-0.06	-2.6	-0.07	-1.1	-0.04	-0.4
Wheat Farm Price	260.70 percent	0.0	0.0	-0.93	-0.3	-1.01	-0.3
Barley Farm Price	278.10 percent	0.0	0.0	-1.04	-0.3	-1.14	-0.3
Wheat Intervention Price	158.44 ECU/mt	0.0	0.0	-0.59	-0.4	-0.53	-0.3
Wheat Threshold Price	211.41 ECU/mt	0.0	0.0	-1.06	-0.5	-1.13	-0.4
Wheat Import Price	131.20 ECU/mt	-7.71	-8.4	-7.90	-6.0	-10.43	-5.7
Wheat Export Price	137.27 dol/mt	-8.72	-7.8	-8.71	-6.3	-8.73	-6.1
Wheat Export Refunds	324.90 mil. ECU	18.78	16.9	77.28	23.8	141.60	55.0
Wheat Levy Revenue	406.52 mil. ECU	43.12	8.3	31.51	7.7	38.00	11.1
Net Revenue	95.10 mil. dol	27.53	6.0	-47.26	-49.7	-86.80	-124.1

* less than 0.005 for unit values and less than 0.05 for percentage values.

Table 4.3 Multipliers for a 0.10 Decrease in the ECU/U.S. Dollar Exchange Rate

	Base Value	Multipliers					
		Impact		Average		Eighth Year Cumulative	
		Unit Δ	Percent Δ	Unit Δ	Percent Δ	Unit Δ	Percent Δ
Endogenous Variables:							
Production	49.62 mmt	0.0	0.0	-0.09	-0.2	-0.14	-0.3
Feed Demand	12.39 mmt	0.0	0.0	0.01	*	-0.01	*
Food Demand	30.80 mmt	0.0	0.0	0.02	*	0.01	*
Exports	10.45 mmt	-0.8	-2.9	-0.10	-0.9	-0.11	-0.7
Imports	4.44 mmt	0.0	0.0	0.03	0.6	0.04	1.0
Net Exports	6.33 mmt	-0.10	-3.6	-0.13	-2.0	-0.15	-1.5
Wheat Farm Price	260.70 percent	0.0	0.0	-1.82	-0.7	-0.02	-0.7
Barley Farm Price	278.10 percent	0.0	0.0	-2.04	-0.7	-0.02	-0.7
Wheat Intervention Price	158.44 ECU/mt	0.0	0.0	-1.15	-0.1	-0.71	-0.4
Wheat Threshold Price	211.41 ECU/mt	0.0	0.0	-2.05	-0.9	-1.85	-0.7
Wheat Import Price	131.20 ECU/mt	-10.39	-11.2	-14.40	-11.0	-15.03	-8.3
Wheat Export Price	137.27 dol/mt	0.07	0.1	0.11	0.1	0.13	0.1
Wheat Export Refunds	324.90 mil. ECU	26.84	24.1	131.10	40.4	188.75	73.3
Wheat Levy Revenue	406.52 mil. ECU	58.10	11.2	56.66	13.9	55.55	16.3
Wheat Export Refunds	368.46 mil. dol.	50.32	39.9	212.75	57.7	192.26	89.1
Wheat Levy Revenue	463.56 mil. dol.	148.65	25.5	134.58	29.0	76.89	26.9
Net Revenue	95.10 mil. dol.	98.33	21.5	-78.17	-82.2	-115.37	-164.9

* less than 0.05.

although as expected net exports do decline slightly (1.5 percent by the eighth year).

The Community's import price, measured in ECU's, declines by 10.4 ECU's/mt initially, because of the revaluation of the ECU, while export prices measured in dollars rise marginally. The big changes are again reflected in the variables related to trade policy.

The devaluation of the ECU causes the Community's export subsidies (measured in ECU) to increase, because the world market price (measured in ECU) is now lower than it was previously, and to increase by even more when measured in dollars. While levy income is up, for reasons opposite to those given above, the net cost of a 0.10 devaluation of the dollar with respect to the ECU is 115.37 million dollars, a 164.9 percent change, by the eighth year.

It is interesting to note that between 1979/80 and 1983/84 the U.S. dollar has revalued by 0.47 ECU/dollar, or 65.2 percent. Using the multipliers presented above it is clear this has saved the EC many millions of dollars in budget costs. If the value of the dollar declines in the future, as many believe it must, it will put considerable additional pressure on the Community's budget.

4.2.3 Multipliers for Intervention Price Shock

One of the purposes of calculating multipliers is to see if the model responds to external shocks in ways consistent with a priori beliefs. In this spirit the intercept in the intervention price equation is shocked by adding 10 ECU to it. Table 4.4 illustrates the results of this test. The intervention price increase (7.3 percent in the first period) feeds through to a farm wheat price increase of 5.6 percent in the first time period and a 5.7 percent increase in the barley farm price. Wheat production expands, but the expansion is modest, averaging only slightly more than one percent. Food and feed demand decline slightly and exports increase by 11.8 percent, on average. Imports increase initially, but given time for the threshold price to adjust to the higher intervention price, by the eighth year imports are down by 0.10 mmt or 2.6 percent.

Export refunds jump substantially, averaging 37.5 percent more than in the base simulation. Import levy income also goes up, but on average the cost of subsidies is greater than the increase in levy income by 78.95 million dollars.

Although a constant 10 ECU is added to the intervention price equation, in each time period, feedback through the net export and the lagged intervention price in the equation results in an intervention price only 7.61 ECU greater than the base in the eighth year of the simulation. In contrast, the impact multiplier for the threshold price is 9.2 ECU/mt and rises to 11.57 ECU/mt by the eighth year.

In general, all of the multipliers have the expected signs and the magnitudes of the values seem reasonable. The small production response

Table 4.4 Multipliers for a 10 ECU Increase in the Intercept of the Intervention Price Equation

	Base Value	Multipliers					
		Impact		Average		Eighth Year Cumulative	
		Unit Δ	Percent Δ	Unit Δ	Percent Δ	Unit Δ	Percent Δ
Endogenous Variables:							
Production	49.62 mmt	0.0	0.0	0.60	1.2	0.77	1.4
Feed Demand	12.39 mmt	-0.15	-1.4	-0.05	-0.4	*	*
Food Demand	30.80 mmt	-0.13	-0.4	-0.11	-0.4	-0.88	-0.3
Exports	10.45 mmt	0.41	14.5	0.70	6.7	0.79	5.5
Imports	4.44 mmt	0.23	4.2	-0.04	-0.9	-0.10	-2.6
Net Exports	6.33 mmt	0.17	7.7	0.75	11.8	0.89	9.3
Wheat Farm Price	260.70 percent	11.20	5.6	12.40	4.8	12.80	3.8
Barley Farm Price	278.10 percent	12.60	5.7	14.00	5.0	14.50	4.0
Wheat Intervention Price	158.44 ECU/mt	10.00	7.3	8.73	5.5	7.61	4.1
Wheat Threshold Price	211.41 ECU/mt	9.20	5.2	11.70	5.5	11.57	4.5
Wheat Import Price	131.20 ECU/mt	-0.13	-0.1	-0.61	-0.5	-0.93	-0.5
Wheat Export Refunds	324.90 mil. ECU	48.60	43.7	121.92	37.5	143.80	55.8
Wheat Levy Revenue	406.52 mil. ECU	75.30	14.7	49.50	12.2	38.80	11.4
Net Revenue	95.10 mil. dol	30.90	6.8	-78.95	-83.0	-87.91	-125.7

* less than 0.005.

may be somewhat surprising but the small value follows directly from the fact that wheat and barley intervention, and hence farm prices are linked together because of the silo system.

4.2.4 Multipliers for Threshold Price Shock

The threshold price is shocked by adding 10 ECU's to the intercept of the threshold price equation (table 4.5). As expected the increase in the threshold price lowers imports by 15.5 percent on average. Since this represents less than one million metric tonnes of wheat the world price is affected only slightly by this change. Domestic farm prices for wheat and barley increase by 1.2 percent in the first period and slightly more in latter periods. Domestic demand contracts slightly and gross exports decline, but not by as much as gross imports, so net exports increase.

It is quite interesting that export subsidies decline by more than levy income so the threshold price increase results in a net budget savings of 6.55 million dollars on average.

Again all of the multipliers seem reasonable based on a priori judgements.

Table 4.5 Multipliers for a 10 ECU Increase in the Intercept of the Threshold Price Equation

	Base Value	Multipliers					
		Impact		Average		Eighth Year Cumulative	
		Unit Δ	Percent Δ	Unit Δ	Percent Δ	Unit Δ	Percent Δ
Endogenous Variables:							
Production	49.62 mmt	0.00	0.0	0.20	0.4	0.29	0.5
Feed Demand	12.39 mmt	-0.04	-0.3	-0.02	-0.2	-0.01	*
Food Demand	30.80 mmt	-0.05	-0.2	-0.05	-0.2	-0.05	-0.1
Exports	10.45 mmt	-0.65	-23.1	-0.41	-3.9	-0.20	-1.4
Imports	4.44 mmt	-0.77	-13.8	-0.69	-15.5	-0.56	-14.2
Net Exports	6.33 mmt	0.13	5.7	0.28	4.5	0.35	3.7
Wheat Farm Price	260.70 percent	2.45	1.2	4.19	1.6	4.89	1.4
Barley Farm Price	278.10 percent	2.68	1.2	4.58	1.6	5.34	1.5
Wheat Intervention Price	158.44 ECU/mt	0.00	0.0	-0.24	0.1	-0.61	-0.3
Wheat Threshold Price	211.41 ECU/mt	10.00	5.7	13.74	6.5	14.33	5.6
Wheat Import Price	131.20 ECU/mt	-0.10	-0.1	-0.24	-0.2	-0.37	-0.2
Wheat Export Refunds	324.90 mil. ECU	-25.45	-22.9	-17.33	-5.3	-7.05	-2.7
Wheat Levy Revenue	406.52 mil. ECU	-22.79	-4.4	-11.83	-2.9	0.69	0.2
Net Revenue	95.10 mil. dol	3.01	0.6	6.55	6.9	6.48	9.3

* less than 0.05.

Conclusions

This study has focused on the cereal sector of the EC. This focus is justified because of the EC's tremendous growth in cereal production over the past 15 years, which has resulted in their becoming, in 1984/85, the world's second largest exporter of wheat and a net exporter of coarse grain. These gains in production and exports have been achieved by providing EC cereal producers with prices which are normally well above world market levels. As a result cereals can only be exported through the use of export subsidies, and imports are restricted through the use of variable import levies. The continued and increasing use of export subsidies by the EC has been viewed, particularly by the United States, as an unfair trade practice. On several occasions the U.S. has threatened to match the EC's subsidies with export subsidies of their own. It is this threat of a trade war between the U.S. and EC which has the greatest potential for damaging the Canadian grain producer. Consequently, it is important for Canada to understand the cereal policies of the EC, and the economic forces which have shaped and influenced their policy formulation. In addition, it is important to understand, and to have quantitative measures of, the effects of alternative policy options which may be implemented in the future.

As a first step towards meeting the above objectives the key elements of the EC cereal policy have been outlined. This information is then used to specify and estimate an econometric model of the EC wheat market. The model was then validated and a series of multipliers calculated to show how the Community's wheat sector responds to exogenous shocks. This analysis highlights several fundamental features of Community policy.

First, while the Community does adjust their internal price level in response to world price changes, the response, particularly in the short-run is very small. Thus, world price changes are reflected in the Community primarily through changes in the cost of export subsidies and in levy income.

Second, the strength of the U.S. dollar relative to the ECU, since 1980, has resulted in large budget savings for the EC. In fact, in 1984/85, with the Community facing the largest exportable surplus of cereals in their history, the strength of the U.S. dollar has reduced export subsidies to insignificant levels.

Third, common cereal prices have not prevailed across the Community's member countries since 1969. The so-called "common" price level is converted to domestic currencies using green rates of exchange which differ from market rates of exchange. Consequently, member countries farm prices depend as much on changes in their green rates as on changes in the announced intervention price. Changes in green rates, in turn, influence the setting of the announced intervention price.

Fourth, changes in intervention prices for wheat have only a small

impact on the area planted to wheat since common wheat and coarse grain intervention prices have been linked together through the operation of the "silo" price system.

Finally, it appears that threshold prices for wheat have been set at a level lower than what would have been optional to minimize budget costs.

In summary, it appears that the model developed in this paper will be a useful tool in evaluating a range of policy options which may be pursued by the EC. Some of these alternatives which will be addressed in future papers are: production controls, domestic price supports but no export subsidies, and the elimination of green rates of exchange.

Footnotes

1/ Buckwell et al. provides a recent assessment of the welfare effects of the common agricultural policy.

2/ Barichello et al. provides a recent review of US/EC trade relations.

3/ Paraphrased from reprints of several of Secretary Block's speeches.

4/ Paraphrased from remarks given by Senator Quayle at the U.S. Department of Agriculture's outlook conference, December, 1984.

5/ The guarantee threshold requires intervention and reference prices for cereals to be cut if grain production exceeds a predetermined quantity (Toepfer). Tangermann (p. 48) argues however that "the form of the provisions appears to indicate that for the time being they (guarantee thresholds) are merely paying lip-service to the need of market adjustment."

6/ Josling and Pearson have examined the EC's budgetary problem from a macroeconomic framework; and, one of the purposes of this research is to examine some of the proposals for the cereal sector in a more comprehensive fashion.

7/ The model is developed to analyze the aggregate effects of EC policy changes and provides little or no information on the distribution of costs or benefits between member countries in the EC.

8/ Monetary variables in the EC were denoted in units of account (UA) until 1978/79, following which the numeraire currency was changed to the European currency unit (ECU). All monetary variables in this study have been converted from UA's to ECU's using the annual exchange rates reported by Eurostat (1981).

9/ The target price represents the price the Commission would like to prevail in Duisburg, West Germany, the most deficit area in the Community. The target price is, at least in theory, the price from which the threshold and intervention prices are derived. This is based on the cost of shipping grain from import positions to Duisburg, for the threshold price; and, from Ormes, France (the main grain surplus area) to Duisburg for the intervention price. In fact, political factors are important in determining both the threshold and intervention prices. Consequently, the target price, and the margins between the target and the threshold and intervention prices are simply adjusted to accommodate the desired price levels.

10/ Prior to 1976 there were regional intervention prices for common wheat (Harris, Swinbank and Wilkinson, pp. 67-68). This

complication is not introduced in the econometric model where farm prices are related to a common intervention price.

11/ Harris, Swinbank and Wilkinson (pp. 77-78) describe the method used by the Commission to set the level of refunds.

12/ The theory of variable import levies has been discussed by Sampson and Snape.

13/ Harris, Swinbank and Wilkinson (pp. 73-76) outline some problems and complications which arise in the course of calculating the levy.

14/ Harris, Swinbank and Wilkinson; Fennel, and the Cap Monitor provide some of the history and a description of the system of monetary compensatory amounts. Ritson and Tangermann; Harvey; Schmitz; and Langworthy, Pearson and Josling provide economic analyses of various aspects of the MCA system.

The calculation of MCA's involves a number of complex operational details, special rates and special circumstances. For details see the Cap Monitor.

15/ See the references given in footnote 14 for analysis of the redistributional effects of MCA's.

16/ Given the limited degrees of freedom available to estimate the inventory equation, it was decided to estimate this equation by ordinary least squares.

17/ The formulation is consistent with the arguments of Bale and Koester, and Tangermann.

18/ Koester (p. 19-21) argues that "there is no method for making reasonable predictions of EC grain prices." However, much of his argument rests on the difficulty of predicting green rates and other national policies which influence individual member countries. Bale and Koester specify pricing objectives consistent with the specification used for intervention prices in this paper.

19/ The weights attached to the member countries green rates should be proportional to the countries influence in determining intervention prices for cereals. Since these weights are unknown wheat production shares are used as a proxy.

20/ Prior to 1976/77 when the reference price was introduced, the reference price was assumed to equal the intervention price. For the three new member countries intervention prices were assumed to equal farm prices prior to entry.

21/ Some of the endogenous variables, primarily price variables using different weighting schemes, are omitted from table 4.1 No important information is lost or hidden by not reporting these variables.

22/ Data for most of the exogenous variables were available through 1982/83 and for some through 1983/84. Missing values were estimated using trend projections and preliminary estimates contained in Green Europe.

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Appendix I

Mnemonics and Variable Definitions

Endogenous Variables

AWH — EC-10 wheat area, million hectares (U.S.D.A., 1984a Herlihy, et al.).

CPWH — A weighted average of EC-9 member countries producer price indices for common wheat, using wheat consumption shares as weights (see equation 36), crop year, 1960 = 1.00 (Herlihy et al.; Commission of the European Communities, 1984).

DWHFE — Quantity of wheat used for feed in the EC-10, crop year, mmt (U.S.D.A., 1984a, Herlihy et al.).

DWHFO — Quantity of wheat used for food in the EC-10, crop year, mmt (U.S.D.A., 1984a, Herlihy et al.).

ECSUB — A proxy for the cost of export subsidies for wheat, EC-10, crop year, million ECU. Calculated as the difference between the intervention price and the U.S. export price for wheat (converted to ECU's), times the EC-10's gross exports of wheat.

EDROW — Exess demand facing the EC-10, crop year, mmt. Calculated to equal NEXWH.

EXPWH — U.S. export price for No. 1 soft red winter wheat, Gulf ports, June-May, dollars/mt (U.S.D.A., 1984b).

EXWH — EC-10 wheat exports (excluding intra-EC trade), July-June, mmt (U.S.D.A., 1984a, Herlihy et al.).

FPBA — A weighted average of EC-9 member countries producer price indices for barley, using barley production shares as weights (see equation 35), crop year, 1960 = 1.00 (Herlihy et al.; Commission of the European Communities, 1984).

FPBAL.BE — Producer price of barley, Belgium/Lux., crop year, francs/mt (Herlihy et al.; Commission of the European Communities, 1984).

FPBAL.DE — Producer price of barley, Denmark, crop year, kroner/mt (Herlihy et al.; Commission of the European Communities, 1984).

FPBAL.FR — Producer price of barley, France, crop year, francs/mt (Herlihy et al.; Commission of the European Communities, 1984).

FPBAL.ID — Producer price of barley, Ireland, crop year, pounds/mt

(Herlihy, et al.; Commission of the European Communities, 1984).

FPBAL.IT Producer price of barley, Italy, crop year, lire/mt (Herlihy et al.; Commission of the European Communities, 1984).

FPBAL.NE Producer price of barley, Netherlands, crop year, guilders/mt (Herlihy et al.; Commission of the European Communities, 1984).

FPBAL.UK Producer price of barley, United Kingdom, crop year, pounds/mt (Herlihy et al.; Commission of the European Communities, 1984).

FPBAL.WG Producer price of barley, West Germany, crop year, marks/mt (Herlihy et al.; Commission of the European Communities, 1984).

FPWH A weighted average of EC-9 member countries producers price indices for common wheat, using wheat production shares as weights (see equation 34), crop year, 1960 = 1.00 (Herlihy et al.; Commission of the European Communities, 1984).

FPWHL.BE Producer price of common wheat, Belgium/Lux., crop year, francs/mt (Herlihy et al.; Commission of the European Communities, 1984).

FPWHL.DE Producer price of common wheat, Denmark, crop year, kroner/mt (Herlihy et al; Commission of the European Communities, 1984).

FPWHL.FR Producer price of common wheat, France, crop year, francs/mt (Herlihy et al.; Commission of the European Communities, 1984).

FPWHL.ID Producer price of common wheat, Ireland, crop year, pounds/mt (Herlihy et al.; Commission of the European Communities, 1984).

FPWHL.IT Producer price of common wheat, Italy, crop year, lire/mt (Herlihy et al.; Commission of the European Communities, 1984).

FPWHL.NE Producer price of common wheat, Netherlands, crop year, guilders/mt (Herlihy et al.; Commission of the European Communities, 1984).

FPWHL.UK Producer price of common wheat, United Kingdom, crop year, pounds/mt (Herlihy et al.; Commission of the European Communities, 1984).

FPWHL.WG Producer price of common wheat, West Germany, crop year, marks/mt (Herlihy et al.; Commission of the European Communities, 1984).

IMPWH EC, C.I.F. import price for common wheat, crop year, ECU/mt (Commission of the European Communities, Agricultural Markets).[a/]

IMWH EC-10 wheat imports (excluding intra-EC trade), July-June, mmt (Herlihy et al, U.S.D.A. 1984a).

IWH EC-10 wheat ending inventory, crop year, mmt (Herlihy et al., U.S.D.A. 1984a).

LEVYINC A proxy for the income earned from variable levies on wheat, EC-10, crop year, million ECU. Calculated as the difference between the threshold price plus the coefficient of equivalence minus the EC's import price for wheat, times the quantity of wheat imported.

NETREV Levy income from wheat less export subsidies for wheat, crop year, million ECU.

NEXWH Net exports of wheat, crop year, mmt, 1966 to 1973 for the EC-6 and for the EC-10 thereafter (U.S.D.A. 1984a).

QWH EC-10 wheat production, mmt (U.S.D.A., 1984a Herlihy et al.).

PBAIN Intervention price for barley, crop year, ECU/mt (Herlihy et al.; CAP Monitor).[a/]

PBATH Threshold price for barley, crop year, ECU/mt (Herlihy et al.; CAP Monitor).[a/]

PWHIN Intervention price for wheat, crop year, ECU/mt (Herlihy et al.; CAP Monitor).[a/]

PWHRE Reference price for minimum quality bread making wheat, crop year, ECU/mt, (Herlihy et al.; Toepfer).[a/] NOTE: Prior to 1976/77, when the reference price was introduced, the reference price is assumed to equal the intervention price.

PWHREC A weighted average of EC-9 member countries reference price indices, for minimum quality bread making wheat, using wheat consumption shares as weights (see equation 38), crop year, 1967 = 1.00.

PWHTH Threshold price for wheat, crop year, ECU/mt (Herlihy et al.; CAP Monitor).[a/]

PWHTHC A weighted average of EC-9 member countries threshold price indices for common wheat, using wheat consumption shares as weights (see equation 39), crop year, 1967 = 1.00. NOTE: The threshold price for wheat in the United Kingdom, Denmark and Ireland prior to 1973 was assumed to equal their domestic producer price.

PWHINF A weighted average of EC-9 member countries intervention price

indices for common wheat, using wheat production shares as weights (see equation 37), crop year, 1967 = 1.00. NOTE: The intervention price for wheat in the United Kingdom, Denmark and Ireland, prior to 1973, was assumed to equal their domestic producer price.

SHWHIN EC-10 wheat imports as a function of domestic food use, crop year, percent. Calculated as IMWH/DWHFO.

Exogenous Variables

ACAWH.DE Accessionary compensatory amount for wheat, Denmark, crop year, ECU/mt (U.S.D.A. 1980).[a/]

ACAWH.ID Accessionary compensatory amount for wheat, Ireland, crop year, ECU/mt (U.S.D.A. 1980).[a/]

ACAWH.UK Accessionary compensatory amount for wheat, United Kingdom, crop year, ECU/mt (U.S.D.A. 1980).[a/]

ACABA.DE Accessionary compensatory amount for barley, Denmark, crop year, ECU/mt (U.S.D.A. 1980).[a/]

ACABA.ID Accessionary compensatory amount for barley, Ireland, crop year, ECU/mt (U.S.D.A. 1980).[a/]

ACABA.UK Accessionary compensatory amount for barley, United Kingdom, crop year, ECU/mt (U.S.D.A. 1980).[a/]

CEQUIV Coefficient of equivalence for 14 percent protein spring wheat, crop year, ECU/mt (CAP Monitor).

CPI A weighted average of EC-9 member countries consumer price indices, using wheat consumption shares as weights, crop year, calendar year 1980 = 1.00 (I.M.F. 1984). NOTE: The crop year index is calculated by taking 0.417 of the current calendar year plus 0.583 of the next calendar year.

CSTIN A weighted average of EC-9 member countries indices of the prices paid for production requisites, using wheat production shares as weights, calendar year, 1975 = 1.00 (F.A.O.; Eurostat). NOTE: Data for the United Kingdom are for fertilizer prices. Data for Belgium and Italy are taken from the F.A.O. until 1974. From 1975 onward data is from Eurostat (1983) and applies to goods and services currently consumed in agriculture.

DENAT Wheat, denaturing premium, crop year, ECU/mt (CAP Monitor).[a/]

DISCEC Statistical discrepancy variable used to account for any errors in the wheat supply-demand identity, crop year, mmt. Calculated using equation 8.

DISCEX Statistical discrepancy variable used to account for the difference in net wheat exports based on July-June and August-July crop years, mmt. Calculated using equation 9.

DISCIN Variable measuring the difference between wheat and barley intervention prices, crop year, ECU/mt.[a/] Calculated using equation 13.

DY A weighted average of EC-9 member countries indices of personal consumption expenditures divided by the consumer price index, using wheat production shares as weights, crop year, calendar year 1980 = 1.00 (I.M.F.) NOTE: The crop year index is calculated by taking 0.417 of the current calendar year plus 0.583 of the next calendar year.

D74 A zero-one variable equal to one in 1974 and zero otherwise.

D76 A zero-one variable equal to one in 1976 and zero otherwise.

D7682 A zero-one variable representing the introduction of the silo system, equal to one from 1967/68 to 1975/76 and zero thereafter.

EXCHRECU Rate of exchange between the European Currency Unit and the U.S. dollar, crop year, ECU/dollar (Eurostat, 1983; I.M.F.). NOTE: The crop year data is calculated by taking 0.417 of the current calendar year plus 0.583 of the next calendar year.

EXRGR.BE Belgium, green rate of exchange, crop year, francs/ECU (CAP Monitor).[a/]

EXRGR.DE Denmark, green rate of exchange, crop year, kroner/ECU (CAP Monitor).[a/]

EXRGR.FR France, green rate of exchange, crop year, francs/ECU (CAP Monitor).[a/]

EXRGR.ID Ireland, green rate of exchange, crop year, pounds/ECU (CAP Monitor).[a/]

EXRGR.IT Italy, green rate of exchange, crop year, lire/ECU (CAP Monitor).[a/]

EXRGR.NE Netherlands, green rate of exchange, crop year, guilders/ECU (CAP Monitor).[a/]

EXRGR.UK United Kingdom, green rate of exchange, crop year, pounds/ECU (CAP Monitor).[a/]

EXRGR.WG West Germany, green rate of exchange, crop year, marks/ECU (CAP Monitor).[a/]

EXRGR9 A weighted average of EC-9 member countries indices of green rates of exchange, using wheat production shares as weights,

crop year, 1972 = 1.00, (CAP Monitor).[a/] NOTE: For the United Kingdom, Ireland and Denmark the values for their green rates of exchange were set equal to the 1972/73 value for the years 1967/68 to 1971/72.

FPHG — A weighted average of EC-9 member countries indices of producer prices for hogs, using wheat production shares as weights, crop year, 1960 = 1.00 (Herlihy et al.).

MMIMP — The difference between the EC import price for wheat and the U.S. export price for wheat, crop year, dollars/mt. Calculated according to equation 42.

POP — Population in the EC-10, crop year, millions (I.M.F.). NOTE: The crop year data is calculated by taking 0.417 of the current calendar year plus 0.583 of the next calendar year.

THADJ — Variable to account for the difference between beginning of the year threshold prices and the crop year average threshold price which includes the monthly storage increment, crop year (CAP Monitor; Commission of the European Communities, Agricultural Markets).

TREND — A linear time trend equal to 60 in 1960, 61 in 1961, etc.

a/ Variables reported in units of account until 1978/79 where converted to ECU's using the annual UA/ECU exchange rates reported in Eurostat, 1981.

Appendix II

Calculation of the Excess Demand Curve for Wheat Facing the EEC

The appropriate expression for the elasticity of export demand for a commodity is (Bredahl, Meyers and Collins; Cronin):

$$N_{ef} = \sum_i \left[N_{di} \, E^d_{pi} \, \frac{Q_{di}}{Q_{ef}} - N_{si} \, E^s_{pi} \, \frac{Q_{si}}{Q_{ef}} \right] ,$$

where N_{ef} is the elasticity of export demand, N_{di} and N_{si} are the elasticities of domestic demand and supply in country i; Q_{di} and Q_{si} are the i^{th} country's level of demand and supply, and Q_{ef} is the level of EC exports. The elasticities of price transmission (response of the i^{th} country's price to changes in the EC export price, which is assumed to equal the world (U.S.) export price) are E_{pi} for demand prices and E^d_{pi} for supply prices. Using the five year average supply/demand balance sheet reported in Table A.1 and the estimates for the various elasticities reported in Table A.2, the derived excess demand elasticity for wheat facing the EC (using the above formula) was 19.9 (and forms the basis for the coefficient on price in equation (40)). This elasticity was calculated by assuming that 20 percent of world wheat is consumed as livestock feed and this demand is evenly distributed across all regions with a demand elasticity of -1.5.

Appendix Table A.1

Wheat Trade, Consumption and Production, 5 year Average:
Crop Years 1978-79 to 1982-83 (000 metric tonnes)

	Production	Exports	Imports	Net Exports	Consumption*
Western Europe (excl. EC)	12,860	1,679	2,508	-829	13,689
Eastern Europe	27,749	1,827	4,906	-3,079	30,828
USSR	94,865	956	14,281	-13,325	108,190
Canada	21,816	15,856	55	15,801	6,015
USA	64,746	39,950	18	39,932	24,814
North & Central America (excl. Canada & USA)	3,101	7	3,419	-3,412	6,513
Argentina	9,456	4,748	1	4,747	4,709
Brazil	2,458	—	4,186	-4,186	6,644
South America (excl. Argentina & Brazil)	1,372	18	3,855	-3,837	5,209
China	59,968	—	11,322	-11,322	71,290
India	34,517	237	1,577	-1,340	35,857
Indonesia	—	—	1,423	-1,423	1,423
Japan	564	27	5,664	-5,637	6,201
Asia (excl. China, India, Indonesia & Japan)	41,734	861	15,752	-14,891	56,625
Egypt	1,908	—	5,930	-5,930	7,838
Africa (excl. Egypt)	7,100	98	8,928	-8,830	15,930
Australia	14,079	10,727	—	10,727	3,352
World Total including intra EC Trade	452,360	89,730	89,730	0	452,360

* Domestic disappearance including change in stocks.

Source: World Wheat Statistics (Annual), International Wheat Council (various issues).

Appendix Table A.2

Supply, Demand and Domestic-World Price Transmission Elasticities for Food Wheat

	Elasticity of Demand*	Elasticity of Supply*	Domestic to World Price Transmission Elasticity	
			Demand	Supply
EC	-0.1	0.9	0.3	0.3
Western Europe (excl. EC)	-0.2	0.6	0.3	0.3
Eastern Europe	-0.1	0.2	0.3	0.3
USSR	-0.5	0.1	0.3	0.3
Canada	-0.2	0.8	0.7	0.9
USA	-0.25	0.8	0.9	0.7
North & Central America (excl. Canada & USA)	-0.36	0.6	0.5	0.7
Argentina	-0.2	0.2	0.9	0.7
Brazil	-0.12	0.5	0.9	0.7
South America (excl. Argentina & Brazil)	-0.25	0.2	0.9	0.9
China	-0.2	0.3	0.3	0.3
India	-0.4	0.4	0.3	0.3
Indonesia	-0.6	0.1	0.9	0.9
Japan	-0.33	0.1	0.2	0.2
Asia (excl. China, India, Indonesia & Japan)	-0.3	0.1	0.5	0.3
Egypt	-0.45	0.5	0.1	0.3
Africa (excl. Egypt)	-0.3	0.2	0.5	0.3
Australia	-0.3	0.5	0.5	0.9

* With respect to domestic prices.