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# An Econometric Model of the European Economic Community's Wheat Sector

By

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## Preface

This report updates and revises the author's previous study of EC wheat policy which was circulated as discussion paper 85/1 from the School of Agricultural Economics and Extension Education in January 1985.

The major change from the previous study is the method used to aggregate individual member country's prices. Other minor changes include updated data, respecified equations and the disaggregation of EC inventories into public and private stocks.

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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 since its inception. Nonetheless, the cereals policy would have to be considered a success, with the exception of consumer prices, given the objectives of the CAP contained in the Treaty of Rome:[1/]

(a) to increase agricultural productivity;

(b) to ensure a fair standard of living for the agricultural community;

(c) to stabilize markets;

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

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

Indeed, the CAP has been so successful in fulfilling objective (d) 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, the EC's net exports of wheat and flour exceeded 10 mmt by 1980/81, due in part to the entry of the United Kingdom into the EC, and the continuing improvement in wheat yields. In 1984/85, the combination of increased wheat area and yields resulted in the EC replacing Canada as the world's second largest wheat exporter. Nonetheless, the EC continues to import high quality wheat to blend with their domestically produced lower quality wheat. Imports of wheat by the EC have declined from nearly 10 mmt in 1970/71 to an estimated 2.5 mmt in 1984/85.

Increased self-sufficiency in the EC is also occurring for coarse grains (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 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 (U.S.D.A., 1984a).

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

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 | 30.80 | 13.7 | 22.10 | 7.80 | 10.90 | 4.7 | 15.5 |
| 1982/83 | 59.80 | 9.50 | 29.30 | 15.3 | 21.20 | 11.20 | 11.70 | 3.9 | 15.6 |
| 1983/84[c/] | 59.10 | 10.00 | 29.50 | 19.7 | 22.70 | 8.30 | 12.70 | 3.6 | 15.4 |
| 1984/85[c/] | 76.40 | 9.50 | 30.70 | 21.3 | 25.60 | 16.60 | 16.10 | 2.5 | 17.5 |

a/ Includes intra-EC trade
b/ Excludes intra-EC trade
c/ 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 August 1 | Crop Year | | | | | | | Trade Year[c/] | |
|---|---|---|---|---|---|---|---|---|---|
| | Production | Imports[a/] | Food Demand | Feed Demand | Exports[a/] | Ending Inventory | Net Exports | Imports[b/] | 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.

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 the EC is now competing directly with Canada for 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).[6] 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] Special features of the EC wheat market incorporated in the econometric model representation include two-way trade; imperfect substitution in demand between imported and domestically produced supplies; distinction between the threshold price and intervention price; and, imperfect price transmission between market and policy prices.

Following the specification and estimation of the model, multipliers are presented to illustrate how the EC's wheat sector responds to various exogenous shocks including changes in (1) the

intervention price; (2) the threshold price; (3) the value of the U.S. dollar relative to the ECU; and, (4) 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 the pricing structure of the EC cereal policy (including the special exchange rate or monetary compensatory amounts) 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.

### 2.2 Price Structure

Three principle policy instruments are used in the EC wheat market to maintain a domestic producer price support (intervention price):

(a) a variable levy which raises the lower world price to a higher import (threshold) price;

(b) obligatory purchases of intervention (public) stocks by member states; and,

(c) variable export restitution (subsidy) payments to dispose of wheat surplus to domestic requirements.

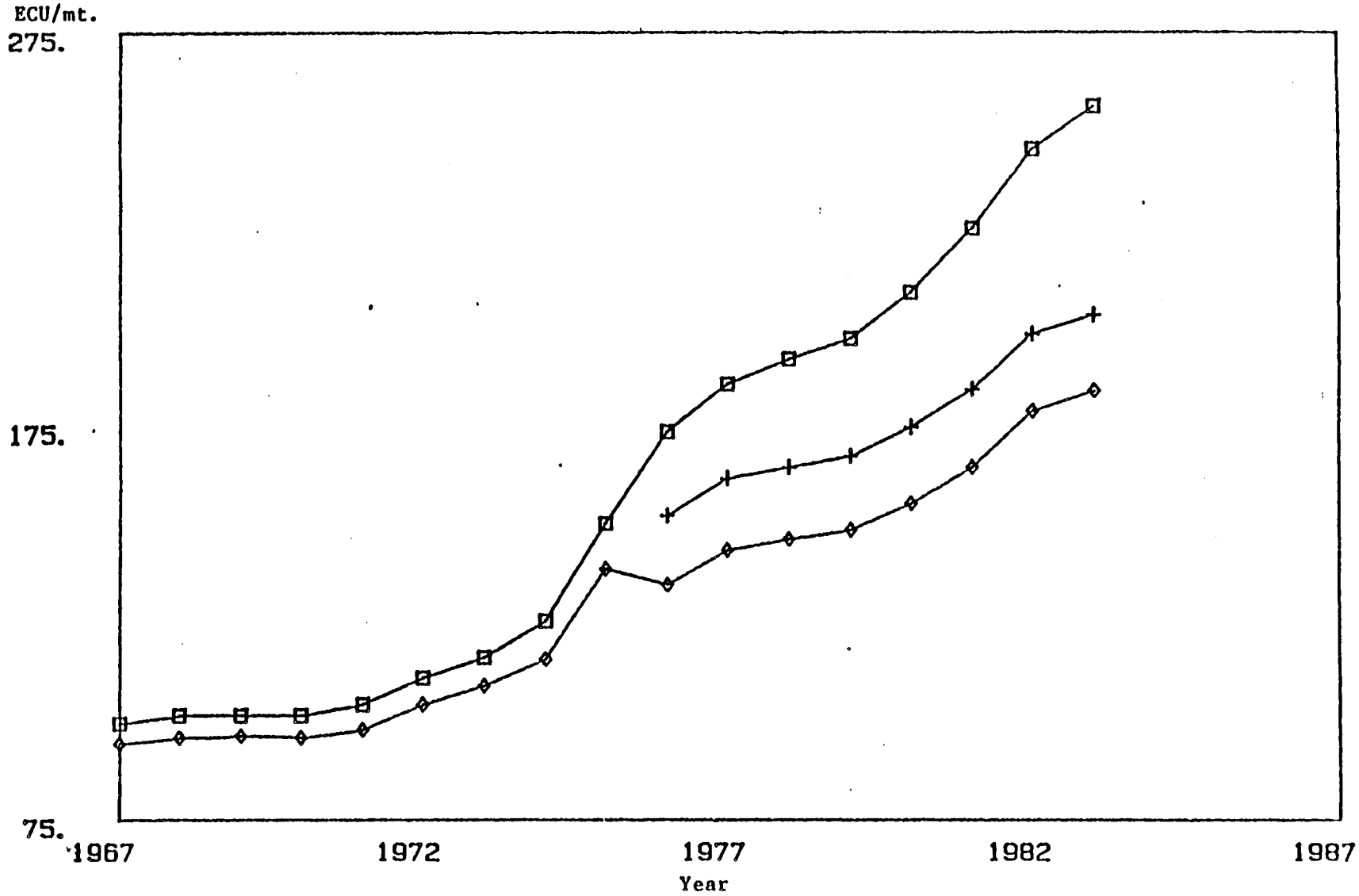
Three producer support (intervention and reference) prices are in effect for wheat reflecting domestic quality differentials. The values for these prices in the 1984/85 crop year are:[8/]

| | | |
|---|---|---|
| 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.[9/]

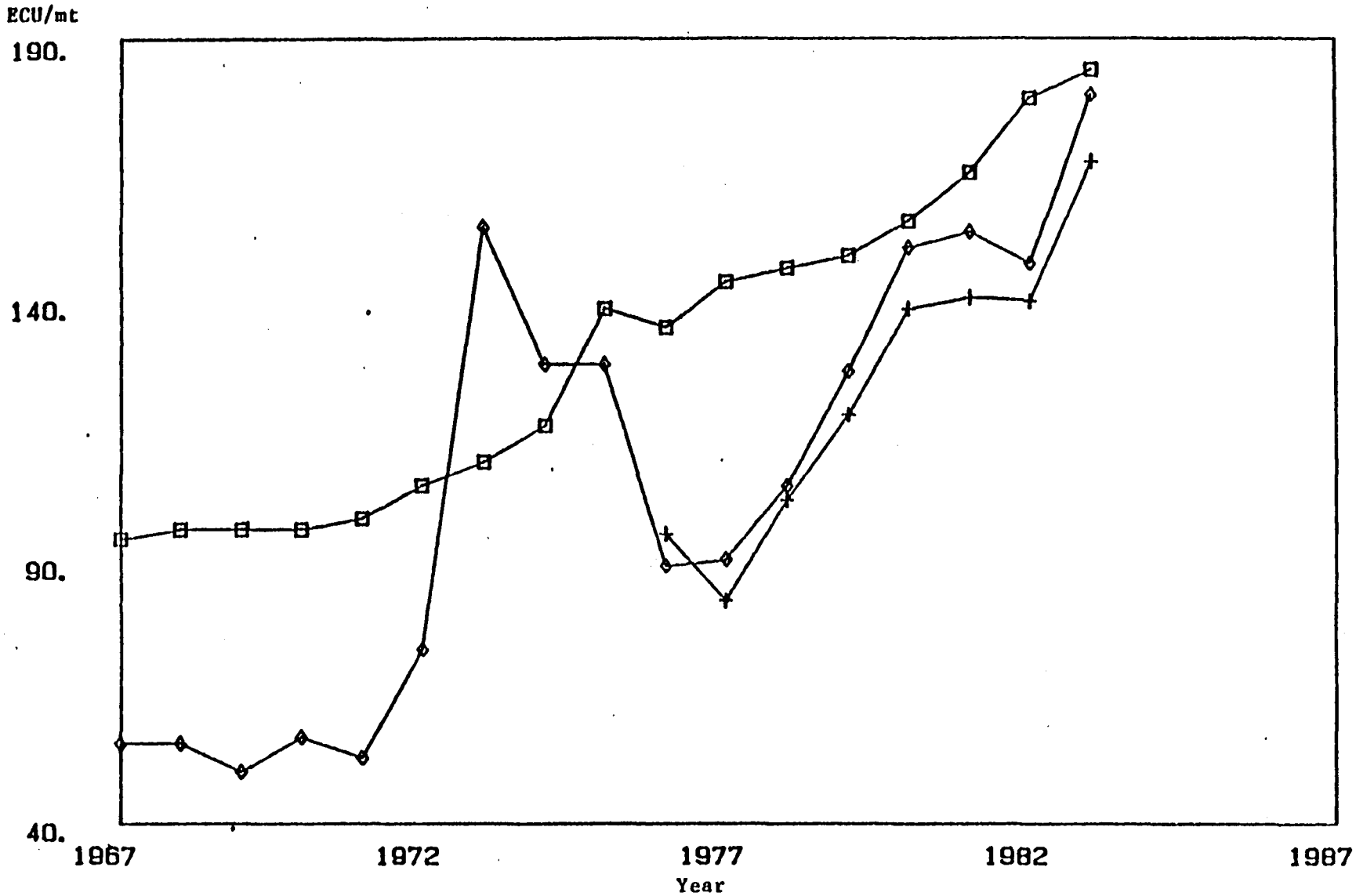
The intervention price for wheat sets the minimum internal price within the EC and, when converted at green rates, is common across the individual member countries.[10/] The intervention price is maintained through intervention purchases. Wheat purchased by the EC is either sold back onto the domestic 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.




□□□ - Threshold price
+++ - Reference price
◊◊◊ - Intervention price

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 lowest foreign offer price to the EC, basis Rotterdam. After adjusting the offer prices for quality differentials, and converting the prices from U.S. dollars to ECU's, the lowest C.I.F. price in ECU/tonne is determined. This price is then subtracted from the threshold price to determine the import levy in ECU's/tonne.[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.

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. 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. In the model it is assumed that imported wheat competes against domestic wheat priced at the minimum quality reference price (see section 2.2).

Prior to the introduction of the "silo system" in 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.

## 2.3 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 calculation and application of MCA's can be complex, however, the basic principle is that MCA's are a means of maintaining different price support levels across member countries. The final market price received by producers is influenced by the MCAs which are applied to both intervention and threshold prices in individual Member Countries (Ritson and Tangermann). MCAs are taxes or subsidies levied on intra-EC and extra-EC agricultural product trade and their levels depend on the difference between central exchange rates and the representative or "green" exchange rate used in conducting agricultural trade. This latter green exchange rate is established by national governments (at their discretion) and differs from the official rates of exchange. A country whose currency has appreciated pays the compensatory amounts on exports and levies them on imports. The opposite occurs for a country whose currency has depreciated.

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 2.3. 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.

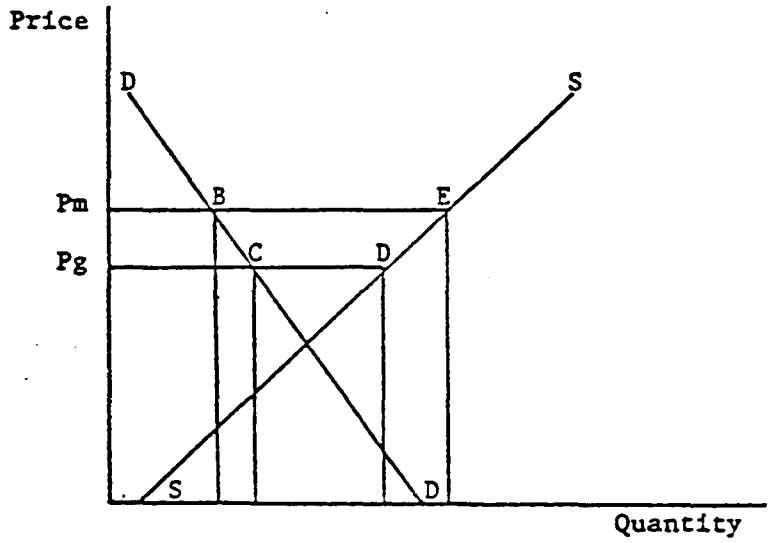
| | Impact of moving from green rates to market rates of exchange | | |
|---|---|---|---|
| | Consumers | Producers | Net Change |
| <u>Exporting nation</u>: | | | |
| green rate > market rate | gain | lose | negative |
| green rate < market rate | lose | gain | positive |
| <u>Importing nation</u>: | | | |
| 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

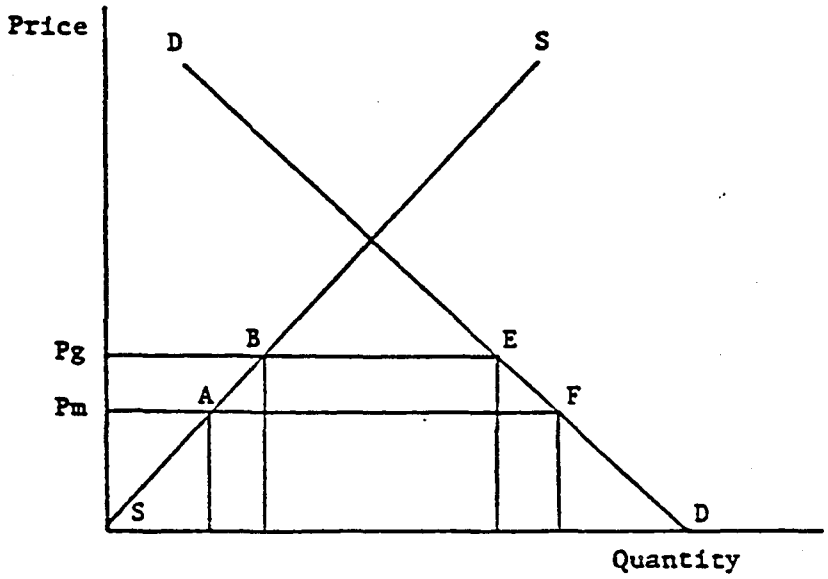
Figure 2.3

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



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 3.23 to 3.38). 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. Green rates are established by each individual member country with the only constraint on a member country in setting its green rate being 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.

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.

# 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 44 endogenous variables which are explained using 27 behavioral equations, 16 identities and one market-clearing condition.

The model contains 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 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 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 government inventory relation, is recursive and hence with the exception of this one equation, can be appropriately estimated using ordinary least squares.[16]

## 3.2 Aggregation

The supply and demand quantities explained in this model are for the EC10 as published by the U.S. Department of Agriculture. Data for all macroeconomic variables and farm prices are for the EC-9. Complete variable definitions, the mnemonics used, and data sources are given in Appendix I.

The aggregation of variables across EC member countries, in a manner to permit consistent estimation of aggregate supply and demand functions is handled in the following fashion. Consider the aggregation of two countries demand functions where the countries differ only in size, with country two being (k) times larger or smaller than country

Table 3.1: An Overview of the Model

| Endogenous Variables | Exogenous Variables |
|---|---|
| **A. Supply Variables** | |
| 1. Area harvested (AWH) | |
| 2. Total production (QWH) | 1. Indices of production costs (CSTIH) |
| **B. Demand Variables** | |
| 3. Food wheat consumption (DWHFO) | 2. Index of real personal consumption expenditures (DY) |
| 4. Feed wheat consumption (DWHFE) | 3. Population (POP) |
| 5. Import share of food wheat consumption (SHEC) | 4. Consumer price index (CPI) |
| 6. Imports of wheat (IHWH) | 5. Hog prices (FPHG) |
| 7. Commercial wheat inventory (CIWH) | 6. Denaturing premium (DENAT) |
| 8. Government wheat inventory (GIWH) | 7. Exchange rate (ECU's/US$) (EXCHRECU) |
| 9. Exports of wheat (EXWH) | |
| 10. Net exports of wheat (NEXWH) | |
| **C. Policy Variables** | |
| 11. Wheat intervention price (PWHIN) | 8. Index of green rates of exchange (EXRGR) |
| 12. Wheat threshold price (PWHTH) | 9. Dummy variable for introduction of silo system (D7682) |
| 13. Wheat reference price (PWHRE) | 10. Coefficient of equivalence for 14 percent protein spring wheat (CEQUIV) |
| 14. Barley intervention price (PBAIN) | |
| 15. Barley threshold price (PBATH) | |
| 16. Export subsidies (ECSUB) | |
| 17. Levy income (LEVYINC) | |
| 18. Net revenue (NETREV) | |
| **D. Price Variables** | |
| 19. Netherlands farm price of wheat (FPWH.NE) | 11. Netherlands, green rate of exchange (EXRGR.NE) |
| 20. Netherlands farm price of barley (FPBA.NE) | 12. France, green rate of exchange (EXRGR.FR) |
| 21. France farm price of wheat (FPWH.FR) | 13. West Germany, green rate of exchange (EXRGR.WG) |
| 22. France farm price of barley (FPBA.FR) | 14. Italy, green rate of exchange (EXRGR.IT) |
| 23. West Germany farm price of wheat (FPWH.WG) | 15. Belgium-Lux, green rate of exchange (EXRGR.BE) |
| 24. West Germany farm price of barley (FPBA.WG) | 16. United Kingdom, green rate of exchange (EXRGR.UK) |
| 25. Italy farm price of wheat (FPWH.IT) | 17. Denmark, green rate of exchange (EXRGR.DE) |
| 26. Italy farm price of barley (FPBA.IT) | 18. Ireland, green rate of exchange (EXRGR.ID) |
| 27. Belgium-Lux farm price of wheat (FPWH.BE) | 19. United Kingdom, wheat (ACA.UK) and barley (ACABA.UK) ACA's |

Table 3.1 continued

28. Belgium-Lux farm price of barley (FPBA.BE)
29. United Kingdom farm price of wheat (FPWH.UK)
30. United Kingdom farm price of barley (FPBA.UK)
31. Denmark farm price of wheat (FPWH.DE)
32. Denmark farm price of barley (FPBA.DE)
33. Ireland farm price of wheat (FPWH.ID)
34. Ireland farm price of barley (FPBA.ID)
35. EC, import price for wheat, c.i.f. (IMPWH)
36. U.S., export price for No. 2 soft red winter wheat, Gulf ports (EXPWH)

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

37. Index of farm wheat prices deflated by the cost of production requisites weighted by production shares (SPWH)

38. Index of farm barley prices deflated by the cost of production requisites weighted by production shares (SPBA)

39. Index of the weighted sum of farm and threshold wheat prices deflated by the consumer price index weighted by consumption shares (CPWH)

40. Index of farm wheat prices divided by intervention wheat prices weighted by production shares (PINV).

41. Index of wheat threshold prices divided by wheat reference prices weighted by consumption shares (PTHREF)

42. Index of farm wheat prices divided by hog prices weighted by production shares (WPHP)

43. Index of farm barley prices divided by hog prices weighted by production shares (BPHP)

44. Rest of world excess demand (EDROW).

one. Demand in countries one ($D_1$) and two ($D_2$) are specified as functions of real prices ($P_1/CPI_1$, $P_2/CPI_2$) and real incomes ($DY_1/CPI_1$, $DY_2/CPI_2$) in each country (equations 3.1 and 3.2).

$$(3.1) \quad D_1 = a + b\ P_1/CPI_1 + c\ DY_1/CPI_1$$

$$(3.2) \quad D_2 = ka + kb\ P_2/CPI_2 + kc\ DY_2/CPI_2$$

The two countries are identical except that $D_1 = kD_2$. Adding the two demand functions together ($D_T$) gives,

$$(3.3) \quad D_T = a + ka + b\ P_1/CPI_1 + kb\ P_2/CPI_2 + c\ DY_1/CPI_1 + kc\ DY_2/CPI_2\ .$$

Factoring out the common slope term gives,

$$(3.4) \quad D_T = a + ka + b(P_1/CPI_1 + k\ P_2/CPI_2) + c\ (DY_1/CPI_1 + k\ DY_2/CPI_2)$$

Equation (3.4) shows that aggregate demand can be estimated using weighted averages of price and income variables for the various member countries. The weights used in constructing these variables are either 1968 to 1981 production or consumption shares, whichever is most appropriate. 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 |

In situations where a price or income variable, which is measured in domestic currency units, is deflated by a general price index the price and income variables are also put in index form before the variable is deflated. This avoids the problem of aggregating prices measured in different currency units.

## 3.3 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 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.

### 3.3.1 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 (SPWH) and the lagged deflated farm price of barley (SPBA), where both prices are deflated by an index of prices paid by farmers for production requisites.

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 (3.5).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (3.5) | AWH | = | 4.28 | + | 3.27 SPWH(-1) | + | 6.38 SPWH(-2) |
| | t-value | | (0.43) | | (1.34) | | (2.85) |
| | elasticity | | | | [0.34] | | [0.67] |

| | | | |
|---|---|---|---|
| - | 7.18 SPBA(-1) | + | 0.065 Trend |
| | (-3.71) | | (0.79) |
| | [-0.75] | | |

$R^2 = 0.66$ D.W. = 2.70 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 (3.5) it entered with a very low t-value and was excluded from the final specification. Equation (3.5) 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 0.67. The cross price elasticity with respect to the barley price is -0.75. 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, the lagged deflated price of wheat a

linear time trend (Trend) and a zero-one dummy variable (D76) to represent the drought in 1976.

| | | | | | | |
|---|---|---|---|---|---|---|
| (3.6) | QWH | = | -166.54 | + 6.00 AWH | + 15.27 SPWH(-1) | |
| | t-value | | (-3.11) | (5.88) | (0.91) | |
| | elasticity | | | [1.60] | [0.40] | |
| | | | + 1.62 Trend | - 4.61 D76 | | |
| | | | (3.28) | (-2.13) | | |

$R^2 = 0.96$ D.W. = 1.37 Sample = 1968/69 - 1982/83

Equation (3.6) shows that there has been a strong trend in wheat production equalling 1.62 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. The variable representing changes in the price of wheat relative to the cost of inputs has a small t-value but the authors feel prices have played a role in increasing yields.

### 3.3.2 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 29.3 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 (PCDY). 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 (SHEC) 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 (CPWH) is a blend price equal to the threshold price for imported wheat and the local price for domestic wheat. 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.

| | | | | | |
|---|---|---|---|---|---|
| (3.7) | DWHFO/POP | = | 0.140 | - 0.009 CPWH | - 0.016 PCDY |
| | t-value | | (11.58) | (-1.38) | -2.81 |
| | | | | [-0.09] | [-0.12] |

$R^2 = 0.51$ D.W. = 2.04 Sample = 1968/69 - 1981/82

The results of estimating the food demand for wheat are about as expected with a very inelastic (-0.09) direct price elasticity and a negative, but small (-0.12), 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 (WPHG), the price of barley deflated by the price of hogs (BPHG), real income (DY), 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 (3.8).

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| (3.8) | DWHFE = | -12.72 | - | 10.93 WPHP | + | 9.76 BPHP | + | 0.31 DENAT |
| | t-value | (-1.68) | | (-2.21) | | (1.93) | | (6.66) |
| | elasticity | | | [-1.37] | | [1.13] | | [0.17] |

| | | | | | | |
|---|---|---|---|---|---|---|
| + | 16.88 DY | + | 0.14 QWH | | | |
| | (3.76) | | (2.07) | | | |
| | [1.23] | | [0.52] | | | |

$R^2 = 0.82$ D.W. = 2.39 RHO = -0.56 Sample = 1968/69 - 1980/81

Equation (3.8) 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 -1.37 and a cross price elasticity with respect to the barley price of 1.13. 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 (3.7), 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 (SHEC) is specified to be a function of the threshold price relative to the reference price (PTHREF). In earlier specifications the domestic supply of wheat and real income were included in equation (3.9) but neither entered with a large t-value.

$$(3.9) \quad \underset{\text{t-value}}{\text{Ln(SHEC)}} = \underset{(7.94)}{0.87} - \underset{(-8.11)}{4.35} \text{ Ln(PTHREF)}$$

$R^2 = 0.82$ D.W. = 1.82 Sample = 1968/69 - 1983/84

The results presented in equation (3.9) indicate that wheat imports have been very sensitive to the ratio of threshold to reference prices for wheat, with an estimated elasticity of -4.35 (Richardson). Equation (3.9) 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 (3.10).

$$(3.10) \quad \text{IMWH} = \text{DWHFO} * \text{SHEC}$$

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.

There would appear to be three main factors influencing the level of government stocks. First, the ending inventory of wheat is expected to increase with total production. Second, government inventories 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 are expected to decline as intervention stocks are exported.

Commercial stocks of wheat may be a function of the same factors

that influence government stocks, but the possibility of price speculation, given the EC's grain regime would appear quite limited. In addition, the EC has some power to effect the allocation of wheat between commercial and government inventories through the use of "intervention B", where private stock holders are paid to hold grain off the market (CAP Monitor). However, it is expected that commercial stocks will be negatively correlated with government stocks.

Stock estimates represent the EC6 until 1972/73 and the EC10 thereafter. In order to obtain reasonable estimates of the equations over the 1969/70 - 1982/83 time period the production variable (QWH) for the EC10 has been adjusted by subtracting a quantity equal to production in the four new member countries (DIWH) between 1969/70 and 1972/73.

The coefficient values in the estimated government inventory equation (3.11) all have the correct signs but the t-value on the world price/intervention price variable is small. However, if the coefficient on this variable is zero then the Community's exports of wheat during the crop year would be completely inelastic, given the structure of the rest of the model, which seems unrealistic. The government inventory equation is estimated in log-linear form so as to avoid generating negative estimated values.

$$
\begin{array}{lll}
(3.11) & \text{Ln(GIWH)} = & -14.89 - 0.20\ \text{Ln(IMPWH/PWHIN)} \\
 & \text{t-value} & \quad (-5.09) \quad (-0.43) \\
 & & -5.02\ \text{Ln(PINV)} + 4.12\ \text{Ln(QWH-DIWH)} \\
 & & \quad (-2.97) \qquad\qquad (5.32)
\end{array}
$$

$R^2 = 0.80$ D.W. = 2.55 Sample = 1969/70 - 1982/83

No price responsiveness could be identified in the commercial inventory (CIWH) equation (3.12) but a strong transactions demand and an important negative relationship with government stocks was detected. A dummy variable (D74) was included to account for an outlying observation in 1974/75.

$$
\begin{array}{lll}
(3.12) & \text{CIWH} = & -0.93 - 0.63\ \text{GIWH} + 1.76\ \text{D74} \\
 & \text{t-value} & \quad (-0.71) \quad (-2.93) \qquad (2.15) \\
 & \text{elasticity} & \qquad [-0.21] \\
 & & +0.15\ (\text{QWH+CIWH(-1)-DIWH}) \\
 & & \quad (4.76) \\
 & & \quad [1.36]
\end{array}
$$

$R^2 = 0.75$ D.W. = 2.19 Sample = 1969/70 - 1982/83

The demand block of the model is completed with the addition of two identities. The first identity (equation 3.13) equates total supply and total demand.

(3.13) QWH + CIWH(-1) + GIWH(-1) = DWHFO + DWHFE + CIWH + GIWH + DISCEC + NEXWH

The second identity (equation 3.14) 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 (3.13), is based on a August-July year.

(3.14) NEXWH = EXWH - IMWH - DISCEX

### 3.3.3 Policy Block

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 share of imported food wheat in equation (3.9).

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

| | | | | | | |
|---|---|---|---|---|---|---|
| (3.15) | PWHIN = | 154.4 | - 87.2 EXRGR | + 1.28 CPI(-1) | - 1.28 NEXWH(-2) | |
| | t-value | (8.17) | (-3.91) | (17.06) | (-2.74) | |
| | elasticity | | [-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.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (3.16) | PWHTH | = | -21.82 | + | 17.23 D7682 | + | 0.027 IMPWH(-1) |
| | t-value | | (-4.14) | | (5.47) | | (1.15) |
| | elasticity | | | | | | [0.02] |

$$+ 0.92\ PWHIN + 0.63\ NEXWH(-1) + 0.32\ PWHTH(-1)$$
$$(9.44) \quad (2.83) \quad (4.46)$$
$$[0.76] \quad [0.01]$$

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

Equation (3.16) 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 (3.16) 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.

$$(3.17) \quad PWHRE = 16.62 + 0.958\ PWHIN + (1 - 0.958)\ PWHTH$$
$$\text{t-value} \quad (19.72) \quad (61.9) \quad \text{(constrained)}$$

$R^2 = 0.99$ 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 3.18).

$$(3.18) \quad PBAIN = PWHIN + DISCBA$$

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 (3.19).

(3.19) PBATH = -1.77 + 0.92 (PWHTH)
t-value (-1.29) (96.34)
elasticity [1.01]

$R^2$ = 0.99 D.W. = 1.59 RHO = 0.31 Sample = 1968/69 to 1983/84

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 3.20).

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

Import levy (LEVYINC) income is approximated as the difference between, the threshold price plus the average intra-year price increase (THADJ) and the EC's import price for wheat multiplied by gross imports (equation 3.21).

(3.21) LEVYINC = (PWHTH + THADJ - 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 3.22) as the difference between levy income and export subsidies converted to U.S. dollars.

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

### 3.3.4 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.

<u>Netherlands</u>:

(3.23) FPWH.NE = 46.66 + 0.88 (PWHIN * EXRGR.NE)
t-value (1.49) (10.51)
elasticity [0.84]

+ 37.27 D7682 + 24.99 D76
(5.22) (2.60)

$R^2$ = 0.98 D.W. = 2.16 Sample = 1968/69 - 1982/83

(3.24) FPBA.NE = 3.64 + 1.01 (PBAIN * EXRGR.NE) + 53.60 D7682
t-value (0.13) (13.99) (3.30)
elasticity [0.98]

$R^2$ = 0.95 D.W. = 1.60 Sample = 1968/69 - 1982/83

France:

(3.25) FPWH.FR = 5.89 + 0.87 (PWHIN * EXRGR.FR) + 105.02 D7682
t-value (0.20) (11.90) (4.20)
elasticity [0.91]

$R^2$ = 0.99 D.W. = 1.61 RHO = 0.42 Sample = 1968/69-1982/83

(3.26) 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:

(3.27) FPWH.WG = 99.19 + 0.79 (PWHIN * EXRGR.WG)
t-value (1.53) (4.75)
elasticity [0.71]

+ 56.74 D7682 + 43.09 D76
(5.73) (2.76)

$R^2$ = 0.94 D.W. = 1.37 Sample = 1968/69 - 1982/83

(3.28) FPBA.WG = 88.30 + 0.87 (PBAIN * EXRGR.WG) + 57.60 D76
t-value (2.22) (8.49) (3.30)
elasticity [0.78]

$R^2$ = 0.88 D.W. = 1.50 Sample = 1968/69 - 1982/83

Italy:

(3.29) FPWH.IT = 8260.6 + 0.99 (PWHTH)*EXRGR.IT
t-value (1.74) (34.90)
[0.94]

$R^2$ = 0.99 D.W. = 1.35 Sample = 1968/69 - 1982/83

(3.30) FPBA.IT = 11222.7 + 0.90 (PBATH)*EXRGR.IT
t-value (3.36) (41.14)
elasticity [0.91]

$R^2$ = 0.99 D.W. = 1.34 Sample = 1968/69 - 1982/83

Belgium-Lux:

(3.31) FPWH.BE = - 156.27 + 1.01 (PWHIN * EXRGR.BE) + 940.1 D7682
t-value (-0.46) (15.94) (9.52)
elasticity [0.95]

$R^2$ = 0.99 D.W. = 1.71 Sample = 1968/69 - 1982/83

(3.32) FPBA.BE = 87.71 + 0.98 (PBAIN * EXRGR.BE) + 714.7 D76
t-value (0.21) (13.5) (2.51)
elasticity [0.97]

$R^2$ = 0.94 D.W. = 1.67 Sample = 1968/69 - 1982/83

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 for barley in France and Italy.

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 coefficient for wheat in the United Kingdom of 0.67 seemed unreasonably low. Consequently, this coefficient was 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:

(3.33) FPWH.UK = 12.13 + 0.90 (PWHIN - ACA.UK)*EXRGR.UK + 5.70 D7682
t-value (4.22) (constrained) (1.65)
elasticity [0.81]

$R^2$ = 0.95 D.W. = 2.07 Sample = 1973/74 - 1982/83

(3.34) FPBA.UK = 20.34 + 0.78 (PBAIN - ACABA.UK)*EXRGR.UK + 6.66 D76
t-value (5.89) (17.95) (1.95)
elasticity [0.73]

$R^2$ = 0.98 D.W. = 2.32 Sample = 1973/74 - 1982/83

Denmark:

(3.35) FPWH.DE = 80.14 + 0.90 (PWHIN - ACAWH.UK)*EXRGR.DE
t-value (6.56) (constrained)
elasticity [0.86]

+ 0.25 (PWHTH - PWHIN) * EXRGR.DE
(6.74)
[0.06]

$R^2$ = 0.99 D.W. = 1.45 Sample = 1973/74 - 1982/83

(3.36) FPBA.DE = 72.10 + 0.93 (PBAIN - ACABA.DE)*EXRGR.DE + 116.60 D76
t-value (1.69) (23.52) (3.63)
elasticity [0.92]

$R^2$ = 0.99 D.W. = 1.01 Sample = 1973/74 - 1982/83

Ireland:

(3.37) FPWH.ID = 225.90 + 1.0 (PWHIN - ACAWH.ID)*EXRGR.ID
t-value (3.82) (constrained)
elasticity [1.04]

- 3.06 Trend + 11.66 D7682
(-3.84) (2.33)

$R^2$ = 0.97 D.W. = 2.99 Sample = 1973/74 - 1982/83

(3.38) FPBA.ID = 150.3 + 0.9 (PBAIN - ACABA.ID) EXRGR.ID - 1.93 Trend
t-value (5.53) (constrained) (-5.50)
elasticity [0.99]

$R^2$ = 0.98 D.W. = 1.88 Sample = 1973/74 - 1982/83

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.

### 3.3.5 Identities

The individual member countries intervention and threshold prices for wheat and barley are aggregated into a set of index numbers, using a series of identities, which are then used in the aggregate EC relationships as discussed in section 3.2.

Equation (3.39) is used to calculate the supply price of wheat, equation (3.40) the supply price of barley and equation (3.41) the consumption price of wheat.

(3.39) SPWH = 0.0206*(FPWHL.BE/7100/CWTIN.BE)+0.4378*(FPWHL.FR/878.2/CSTIN.FR)+0.1881*(FPWHL.IT/253920/CSTIN.IT)+0.0173*(FPWHL.NE/459.5/CSTIN.NE)+0.1703*(FPWHL.WG/495/CSTIN.WG)+0.0143*(FPWHL.DE/1270.8/CSTIN.DE)+0.0053*(FPWHL.ID/90/CSTIN.ID)+0.1463*(FPWHL.UK/98.88/CSTIN.UK)

(3.40) SPBA = 0.0206*(FPBAL.BE/6120/CSTIN.BE)+0.4378*(FPBAL.FR/787.9/CSTIN.FR)+0.1881*(FPBAL.IT/205000/CSTIN.IT)+0.0173*(FPBAL.NE/438.5/CSTIN.NE)+0.1703*(FPBAL.WG/448/CSTIN.WG)+0.0143*(FPBAL.DE/1182.1/CSTIN.DE)+0.0053*(FPBAL.ID/85.8/CSTIN.ID)+0.1463*(FPBAL.UK/92.68/CSTIN.UK)

(3.41) CPWH = 0.0324*((SHEC*(PWH.ECTH+CEQUIV)*EXRGR.BE+(1-SHEC)*(FPWHL.BE)/70.7736/CPI.BE)+0.0121*((SHEC*(PWH.ECTH-ACA.DE+CEQUIV)*EXRGR.DE+(1-SHEC)*FPWHL.DE)/12.5417/CPI.DE)+0.2517*((SHEC*(PWH.ECTH+CEQUIV)*EXRGR.FR+(1-SHEC)*FPWHL.FR)/8.74223/CPI.FR)+0.2573*((SHEC*(PWH.ECTH+CEQUIV)*EXRGR.IT+(1-SHEC)*FPWHL.IT)/2314.58/CPI.IT)+0.1853*((SHEC*(PWH.ECTH+CEQUIV)*EXRGR.WG+(1-SHEC)*FPWHL.WG)/4.9448/CPI.WG)+0.0113*((SHEC*(PWH.ECTH-ACA.ID+CEQUIV)*EXRGR.ID+(1-SHEC)*FPWHL.ID)/0.88306/CPI.ID)+0.2166*((SHEC*(PWH.ECTH-ACA.UK+CEQUIV)*EXRGR.UK+(1-SHEC)*FPWHL.UK)/0.978658/CPI.UK)+0.0333*((SHEC*(PWH.ECTH+CEQUIV)*EXRGR.NE+(1-SHEC)*FPWHL.NE)/4.6749/CPI.NE

An index of farm prices divided by intervention prices using production (equation 3.42) weights is needed for the inventory equation and an index of threshold prices divided by reference prices using consumption weights is used in the import share equation (equation 3.43).[20/] Similarly an index of wheat and barley prices divided by hog prices (equations 3.44 and 3.45) is needed in the feed demand equation.

(3.42) PINV = 0.0206*(FPWHL.BE/(PWH.ECIN*EXRGR.BE))+0.4378*(FPWHL.FR/(PWH.ECIN*EXRGR.FR))+0.1881*(FPWHL.IT/(PWH.ECIN*EXRGR.IT))+0.0173*(FPWHL.NE/(PWH.ECIN*EXRGR.NE))+0.1703*(FPWHL.WG/(PWH.ECIN*EXRGR.WG))+0.0143*(FPWHL.DE/((PWH.ECIN-ACA.DE)*EXRGR.DE))+0.0053*(FPWHL.ID/((PWH.ECIN-ACA.ID)*EXRGR.ID))+0.1463*(FPWHL.UK/((PWH.ECIN-ACA.UK)*EXRGR.UK))

(3.43) PTHREF = 0.0324*(PWH.ECTH+CEQUIV)/PWH.ECRE+0.0121*(PWH.ECTH+CEQUIV-ACA.DE)/(PWH.ECRE-ACA.DE)+0.2517*(PWH.ECTH+CEQUIV)/PWH.ECRE+0.2573*(PWH.ECTH+CEQUIV)/PWH.ECRE+0.1853*(PWH.ECTH+CEQUIV)/PWH.ECRE+0.0113*(PWH.ECTH+CEQUIV-ACA.ID)/(PWH.ECRE-ACA.ID)+0.2166*(PWH.ECTH+CEQUIV-ACA.UK)/(PWH.ECRE-ACA.UK)+0.0333*(PWH.ECTH+CEQUIV)/PWH.ECRE

(3.44) WPHP = 0.0206*(FPWHL.BE/FPHG.BE)+0.4378*(FPWHL.FR/FPHG.FR)+0.1881*(FPWHL.IT/FPHG.IT)+0.0173*(FPWHL.NE/FPHG.NE)+0.1703*(FPWHL.WG/FPHG.WG)+0.0143*(FPWHL.DE/FPHG.DE)+0.0053*(FPWHL.ID/FPHG.ID)+0.1463*(FPWHL.UK/FPHG.UK)

(3.45) BPHP = 0.0206*(FPBAL.BE/FPHG.BE)+0.4378*(FPBAL.FR/FPHG.FR)+0.1881*(FPBAL.IT/FPHG.IT)+0.0173*(FPBAL.NE/FPHG.NE)+0.1703*(FPBAL.WG/FPHG.WG)+0.0143*(FPBAL.DE/FPHG.DE)+0.0053*(FPBAL.ID/FPHG.ID)+0.1463*(FPBAL.UK/FPHG.UK)

### 3.3.6 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 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,

(3.46) EDROW = IROW - 1.14 EXPWH , and

(3.47) 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 (3.47) 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 (3.48).

(3.48) 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 square percentage error (RMSPE).[21] It is clear that most of the endogenous variables validate very well with 26 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 mean errors in production (-0.24) and imports (-0.17). 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 3.4 mmt. The largest error (1.05 mmt) in predicting imports occurred in 1979. The average percentage error over the last three years was (-11.9), but in volume terms this error represented only 0.59 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 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

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 Square Percentage Error |
|---|---|---|---|---|---|
| Endogenous Variables: | | | | | |
| Area | 12.04 mil. ha. | 11.93 | -0.11 | -0.8 | 2.5 |
| Production | 48.37 mmt | 48.13 | -0.24 | -0.5 | 4.1 |
| Feed Demand | 11.88 mmt | 11.87 | -0.02 | 0.1 | 4.1 |
| Food Demand | 30.81 mmt | 30.75 | -0.05 | -0.2 | 0.6 |
| Exports | 9.92 mmt | 9.32 | -0.60 | -5.9 | 17.6 |
| Imports | 4.83 mmt | 4.66 | -0.17 | -2.8 | 13.5 |
| Net Exports | 5.66 mmt | 5.23 | -0.43 | 89.8 | 316.4 |
| Inventory (Commercial & Government) | 7.76 mmt | 7.80 | 0.04 | 0.7 | 11.8 |
| EC Wheat Supply Price | 106.33 percent | 106.23 | -0.09 | 0.1 | 2.0 |
| EC Barley Supply Price | 108.70 percent | 108.71 | * | 0.1 | 2.8 |
| Wheat Intervention Price | 149.37 ECU/mt | 150.32 | 0.95 | 0.6 | 1.8 |
| Wheat Threshold Price | 197.45 ECU/mt | 198.84 | 1.39 | 0.7 | 1.4 |
| Wheat Import Price | 119.40 ECU/mt | 119.76 | 0.36 | 0.3 | 1.1 |
| Wheat Export Price | 137.33 dol/mt | 137.71 | 0.38 | 0.3 | 1.1 |
| Wheat Export Refunds | 307.45 mil. ECU | 305.06 | -2.38 | -5.0 | 22.1 |
| Wheat Levy Revenue | 427.44 mil. ECU | 419.63 | -7.80 | -1.7 | 13.0 |
| Net Revenue | 146.67 mil. dol. | 137.17 | -9.48 | -43.3 | 113.6 |
| Farm Wheat Price, Belgium | 6978.3 francs | 7011.5 | 33.2 | 0.4 | 1.8 |
| Farm Wheat Price, Denmark | 1162.2 kroner | 1164.5 | 2.3 | 0.1 | 2.7 |
| Farm Wheat Price, France | 822.3 francs | 833.4 | 11.1 | 1.1 | 2.2 |
| Farm Wheat Price, Ireland | 92.9 pounds | 93.5 | 0.6 | 0.8 | 2.9 |
| Farm Wheat Price, Italy | 217617.0 lire | 213455.0 | -4161.1 | -2.2 | 4.2 |
| Farm Wheat Price, Netherlands | 460.0 guilders | 462.3 | 2.3 | 0.5 | 1.5 |
| Farm Wheat Price, United Kingdom | 90.8 pounds | 90.6 | -0.2 | -0.6 | 3.8 |
| Farm Wheat Price, West Germany | 498.2 marks | 495.8 | -2.4 | -0.5 | 1.6 |

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 | 6296.4 | 73.1 | 1.1 | 2.5 |
| Farm Barley Price, Denmark | 1105.3 kroner | 1123.4 | 18.1 | 1.7 | 2.6 |
| Farm Barley Price, France | 748.1 francs | 753.2 | 5.1 | 0.5 | 2.9 |
| Farm Barley Price, Ireland | 86.2 pounds | 85.5 | -0.6 | -0.8 | 4.2 |
| Farm Barley Price, Italy | 182333.0 lire | 182038.0 | -295.3 | -0.5 | 4.1 |
| Farm Barley Price, Netherlands | 444.2 guilders | 445.8 | 1.6 | 0.3 | 1.7 |
| Farm Barley Price, United Kingdom | 85.2 pounds | 85.2 | * | -0.2 | 2.9 |
| Farm Barley Price, West Germany | 468.7 marks | 465.8 | -3.0 | -0.6 | 2.7 |

* less than 0.05.

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.[22] 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 3.46. 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 $8.77/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 average decline in net exports is only 0.06 mmt and 0.03 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 (7.9 percent on average) the net cost of the EC's wheat policy increases by 76.9 million dollars (81.1 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, 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 9.2

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 | Percent | Unit | Percent | Unit | Percent |
| Endogenous Variables: | | | | | | | |
| Production | 49.84 mmt | 0.0 | 0.0 | -0.08 | -0.2 | -0.04 | -0.1 |
| Feed Demand | 12.35 mmt | 0.0 | 0.0 | * | * | * | * |
| Food Demand | 30.80 mmt | 0.0 | 0.0 | 0.01 | * | 0.01 | * |
| Exports | 10.41 mmt | * | -0.1 | -0.06 | -0.6 | -0.04 | -0.3 |
| Imports | 4.51 mmt | 0.0 | 0.0 | 0.02 | 0.5 | 0.03 | 0.7 |
| Net Exports | 6.33 mmt | * | -0.1 | -0.06 | -0.6 | -0.04 | -0.3 |
| Wheat Supply Price | 104.16 percent | 0.0 | 0.0 | -0.35 | -0.3 | -0.25 | -0.3 |
| Barley Supply Price | 106.50 percent | 0.0 | 0.0 | -0.38 | -0.3 | -0.27 | -0.3 |
| Wheat Intervention Price | 158.49 ECU/mt | 0.0 | 0.0 | -0.57 | -0.4 | -0.50 | -0.3 |
| Wheat Threshold Price | 211.48 ECU/mt | 0.0 | 0.0 | -1.05 | -0.5 | -1.09 | -0.4 |
| Wheat Import Price | 131.15 ECU/mt | -7.75 | -8.4 | -7.89 | -6.0 | -10.40 | -5.7 |
| Wheat Export Price | 137.24 dol/mt | -8.77 | -7.9 | -8.70 | -6.3 | -8.72 | -6.1 |
| Wheat Export Refunds | 322.34 mil. ECU | 25.79 | 19.1 | 76.84 | 23.8 | 131.89 | 55.2 |
| Wheat Levy Revenue | 413.34 mil. ECU | 41.11 | 8.3 | 32.86 | 7.9 | 40.03 | 11.4 |
| Net Revenue | 106.46 mil. dol | 17.73 | 4.3 | -45.19 | -42.4 | -76.94 | -81.08 |

* 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 | Percent | Unit | Percent | Unit | Percent |
| Endogenous Variables: | | | | | | | |
| Production | 49.84 mmt | 0.0 | 0.0 | -0.12 | -0.2 | -0.12 | -0.2 |
| Feed Demand | 12.35 mmt | 0.0 | 0.0 | * | * | * | * |
| Food Demand | 30.80 mmt | 0.0 | 0.0 | 0.01 | * | 0.01 | * |
| Exports | 10.41 mmt | * | -0.1 | -0.09 | -0.9 | -0.10 | -0.7 |
| Imports | 4.51 mmt | 0.0 | 0.0 | 0.04 | 0.8 | 0.05 | 1.2 |
| Net Exports | 6.45 mmt | * | -0.3 | -0.13 | -2.0 | -0.15 | -1.5 |
| Wheat Supply Price | 104.16 percent | 0.0 | 0.0 | -0.56 | -0.5 | -0.42 | -0.4 |
| Barley Supply Price | 106.50 percent | 0.0 | 0.0 | -0.60 | -0.6 | -0.44 | -0.4 |
| Wheat Intervention Price | 158.49 ECU/mt | 0.0 | 0.0 | -0.93 | -0.6 | -0.82 | -0.4 |
| Wheat Threshold Price | 211.48 ECU/mt | 0.0 | 0.0 | -1.68 | -0.8 | -1.88 | -0.8 |
| Wheat Import Price | 131.15 ECU/mt | -9.16 | -10.0 | -13.02 | -9.9 | -17.97 | -9.9 |
| Wheat Export Price | 137.25 dol/mt | * | * | 0.11 | 0.1 | 0.13 | 0.1 |
| Wheat Export Refunds | 322.34 mil. ECU | 32.44 | 23.9 | 123.31 | 38.2 | 211.51 | 88.6 |
| Wheat Levy Revenue | 413.34 mil. ECU | 48.58 | 9.9 | 53.69 | 13.0 | 69.91 | 13.9 |
| Net Revenue | 106.46 mil. dol. | 65.23 | 16.1 | -68.72 | -64.5 | -121.24 | -127.76 |

* less than 0.05.

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 121.24 million dollars, a 127.8 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 5.5 percent increase in the barley farm price. Wheat production expands, but the expansion is modest, averaging two percent. Food and feed demand change only slightly and exports increase by 9.9 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 2.5 percent.

Export refunds jump substantially, averaging 41.8 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 92.61 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 7.41 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 11.41 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 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.

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 | Percent | Unit | Percent | Unit | Percent |
| Endogenous Variables: | | | | | | | |
| Production | 49.84 mmt | 0.0 | 0.0 | 1.01 | 2.0 | 1.07 | 1.9 |
| Feed Demand | 12.35 mmt | -0.13 | -1.2 | 0.02 | 0.1 | 0.03 | 0.2 |
| Food Demand | 30.80 mmt | -0.15 | -0.5 | -0.11 | -0.4 | -0.08 | -0.3 |
| Exports | 10.41 mmt | 0.60 | 17.9 | 1.03 | 9.9 | 1.07 | 7.9 |
| Imports | 4.51 mmt | 0.34 | 6.4 | -0.05 | -1.0 | -0.10 | -2.5 |
| Net Exports | 6.45 mmt | 0.26 | 18.5 | 1.07 | 16.6 | 1.17 | 11.3 |
| Wheat Supply Price | 104.16 percent | 6.25 | 5.6 | 4.82 | 4.6 | 3.39 | 3.6 |
| Barley Supply Price | 106.50 percent | 6.68 | 5.5 | 5.14 | 4.8 | 3.61 | 3.7 |
| Wheat Intervention Price | 158.49 ECU/mt | 10.00 | 7.3 | 8.41 | 5.3 | 7.41 | 4.0 |
| Wheat Threshold Price | 211.48 ECU/mt | 9.20 | 5.2 | 11.53 | 5.5 | 11.41 | 4.5 |
| Wheat Import Price | 131.15 ECU/mt | -0.20 | -0.2 | -0.87 | -0.7 | -1.22 | -0.7 |
| Wheat Export Refunds | 322.34 mil. ECU | 64.62 | 47.7 | 134.74 | 41.8 | 144.16 | 60.4 |
| Wheat Levy Revenue | 413.34 mil. ECU | 84.77 | 17.2 | 50.90 | 12.3 | 40.64 | 11.5 |
| Net Revenue | 106.46 mil. dol | 22.86 | 5.6 | -92.61 | -87.0 | -86.70 | -91.4 |

* less than 0.005.

### 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 22.2 percent on average. Domestic farm prices for wheat increase by 0.9 percent in the first period and only slightly more on average. Domestic demand contracts slightly and gross exports decline, but not by as much as gross imports, so net exports increase. The small increase in net exports causes world prices to decline very slightly.

Both levy income and export refunds decline resulting in a net budget cost of 17.6 million dollars on average.

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 | Percent | Unit | Percent | Unit | Percent |
| Endogenous Variables: | | | | | | | |
| Production | 49.84 mmt | 0.00 | 0.0 | 0.24 | 0.5 | 0.28 | 0.5 |
| Feed Demand | 12.35 mmt | -0.04 | -0.4 | -0.03 | -0.2 | -0.02 | -0.2 |
| Food Demand | 30.80 mmt | -0.04 | -0.1 | -0.03 | -0.1 | -0.02 | -0.1 |
| Exports | 10.41 mmt | -0.95 | -28.2 | -0.70 | -6.7 | -0.46 | -3.4 |
| Imports | 4.51 mmt | -1.04 | -19.6 | -1.00 | -22.2 | -0.80 | -20.0 |
| Net Exports | 6.45 mmt | 0.09 | 6.7 | 0.30 | 4.6 | 0.34 | 3.3 |
| Wheat Supply Price | 104.16 percent | 0.99 | 0.9 | 1.06 | 1.0 | 0.75 | 0.8 |
| Barley Supply Price | 106.50 percent | 1.01 | 0.8 | 1.07 | 1.0 | 0.75 | 0.8 |
| Wheat Intervention Price | 158.49 ECU/mt | 0.00 | 0.0 | -0.27 | -0.2 | -0.55 | -0.3 |
| Wheat Threshold Price | 211.48 ECU/mt | 10.00 | 5.7 | 13.72 | 6.5 | 14.33 | 5.6 |
| Wheat Import Price | 131.15 ECU/mt | -0.07 | -0.1 | -0.24 | -0.2 | -0.20 | -0.2 |
| Wheat Export Refunds | 322.34 mil. ECU | -38.07 | -28.1 | -27.5 | -8.5 | -10.71 | -4.5 |
| Wheat Levy Revenue | 413.34 mil. ECU | -53.80 | -10.9 | -43.03 | -10.4 | -23.21 | -6.6 |
| Net Revenue | 106.46 mil. dol | -17.79 | -4.4 | -17.57 | -16.5 | -10.47 | -11.04 |

* 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.

Finally, 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.

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 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/ A fifth price, the target price (259.08 ecu in 1984/85) 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.

9/ 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).

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.).

BPHP — A weighted average of EC-9 member countries producer prices for wheat divided by their producer prices for hogs, using wheat production shares as weights (see equation 3.45).

CIWH — Commercial inventories of wheat, end of crop year, EC-6 until 1972-73, EC-10 thereafter, mmt. Calculated by subtracting government inventories from total inventory (Home Grown Cereals Authority; U.S.D.A., 1984a).

CPWH — A weighted average of EC-9 member countries producer price and threshold price indices for wheat deflated by their consumer price indices, using wheat consumption shares as weights (see equation 3.41), crop year, 1980=1.00.

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.).

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).

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).

GIWH Government inventories of wheat, end of crop year, EC-6 until

1972-73, EC-10 thereafter, mmt (Home Grown Cereals Authority; U.S.D.A., 1984a).

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).

LEVYINC A proxy for the income earned from variable levies on wheat, EC-10, crop year, million ECU. Calculated as the difference between the annual average threshold price (PWHTH+THADJ) minus the EC's import price for wheat, times the quantity of wheat imported.

NETREV Levy income from wheat less export subsidies for wheat converted to U.S. dollars, crop year, million dollars.

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/]

PINV A weighted average of EC-9 member countries producer prices for wheat divided by their intervention prices for wheat, using wheat production shares as weights (see equation 3.42), crop year.

PTHREF A weighted average of EC-9 member countries threshold prices plus the coefficient of equivalence divided by their reference price, using wheat consumption shares as weights (see equation 3.43), crop year. NOTE: The threshold and reference prices for wheat in the United Kingdom, Denmark and Ireland prior to 1973 was assumed to equal their domestic producer price.

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.

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

SHEC EC-10 wheat imports divided by domestic food use, crop year, percent. Calculated as IMWH/DWHFO.

SPBA A weighted average of EC-9 member countries producer price indices for barley deflated by the cost of production requisites, using wheat production shares as weights (see equation 3.40), crop year, 1980=1.00.

SPWA A weighted average of EC-9 member countries producer price indices for wheat deflated by the cost of production requisites, using wheat production shares as weights (see equation 3.39), crop year, 1980=1.00.

WPHP A weighted average of EC-9 member cuntries producer prices for wheat divided by their producer prices for hogs, using wheat production shares as weights (see equation 3.44), crop year.

## 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=100 (I.M.F. 1984).[b/]

CPI.BE Consumer price index for Belgium, crop year, calendar year 1980=100 (I.M.F., 1984).[b/]

CPI.DE Consumer price index for Denmark, crop year, calendar year 1980=100 (I.M.F., 1984).[b/]

CPI.FR Consumer price index for France, crop year, calendar year 1980=100 (I.M.F., 1984).[b/]

CPI.ID Consumer price index for Ireland, crop year, calendar year 1980=100 (I.M.F., 1984).[b/]

CPI.IT Consumer price index for Italy, crop year, calendar year 1980=100 (I.M.F., 1984).[b/]

CPI.NE Consumer price index for Netherlands, crop year, calendar year 1980=100 (I.M.F., 1984).[b/]

CPI.UK Consumer price index for United Kingdom, crop year, calendar year 1980=100 (I.M.F., 1984).[b/]

CPI.WG Consumer price index for West Germany, crop year, calendar year 1980=100 (I.M.F., 1984).[b/]

CSTIN.BE Prices paid for production requisites, Belgium, calendar year 1980=1.00 (F.A.O.; Eurostat). NOTE: Data are from F.A.O. until 1974 and from Eurostat (1983) for good and services currently consumed in agriculture since 1975.

CSTIN.DE Prices paid for production requisites, Denmark, calendar year 1980=1.00 (F.A.O.).

CSTIN.FR Prices paid for production requisites, France, calendar year 1980=1.00 (F.A.O.).

CSTIN.ID Prices paid for production requisites, Ireland, calendar year 1980=1.00 (F.A.O.).

CSTIN.IT Prices paid for production requisites, Italy, calendar year 1980=1.00 (F.A.O.; Eurostat). NOTE: Data are from F.A.O. until 1974 and from Eurostat (1983) for goods and services currently consumed in agriculture since 1975.

CSTIN.NE Prices paid for production requisites, Netherlands, calendar year 1980-1.00 (F.A.O.).

CSTIN.UK Prices paid for fertilizer, United Kingdom, calendar year 1980=1.00 (F.A.O.).

CSTIN.WG Prices paid for production requisites, West Germany, calendar year 1980=1.00 (F.A.O.).

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

DISCEC Statistical discrepancy variable used to account for any errors in the wheat supply-demand identity, crop year, mmt. Calculated using equation 3.13.

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 3.14.

DISCIN Variable measuring the difference between wheat and barley

intervention prices, crop year, ECU/mt.[a/] Calculated using equation 3.18.

DIWH Discrepancy variable to account for the difference in wheat production in the EC-6 and EC-10 between 1968/69 and 1972/73, and zero thereafter.

DY A weighted average of EC-9 member countries indices of personal consumption expenditures divided by the consumer price index, using wheat consumption shares as weights, crop year, calendar year 1980 = 1.00 (I.M.F.)[b/]

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.).[b/]

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.BE Producer price of hogs, Belgium, national currency per metric ton, crop year (Herlihy et al.).

FPHG.DE Producer price of hogs, Denmark, national currency per metric ton, crop year (Herlihy et al.).

FPHG.FR Producer price of hogs, France, national currency per metric ton, crop year (Herlihy et al.).

FPHG.ID Producer price of hogs, Ireland, national currency per metric ton, crop year (Herlihy et al.).

FPHG.IT Producer price of hogs, Italy, national currency per metric ton, crop year (Herlihy et al.).

FPHG.NE Producer price of hogs, Netherlands, national currency per metric ton, crop year (Herlihy et al.).

FPHG.UK Producer price of hogs, United Kingdom, national currency per metric ton, crop year (Herlihy et al.).

FPHG.WG Producer price of hogs, West Germany, national currency per metric ton, crop year (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 3.48.

PCDY A weighted average of EC-9 member countries indices of per capita personal consumption expenditures deflated by their consumer price indices, using wheat consumption shares as weights, crop year, calendar year 1980=1.00 (I.M.F.).[b/]

POP Population in the EC-10, crop year, millions (I.M.F.).[b/]

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 were converted to ECU's using the annual UA/ECU exchange rates reported in Eurostat, 1981.

b/ Crop year data is approximated by taking 0.417 of the current calendar year plus 0.583 of the next calendar year.

## 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 $E^d_{pi}$ for demand prices and $E^s_{pi}$ 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 (3.46)). 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* |
|---|---|---|---|---|---|
| EC | 53,690 | 11,675 | 4,404 | 7,270 | 46,692 |
| 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) | 3,156 | 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 |
| Oceania (excl. Australia) | 325 | 1 | 215 | -214 | 528 |
| World Total excluding 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* | Transmission Elasticity Demand | Transmission Elasticity 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 |
| Oceania (excl. Australia) | -0.3 | 0.5 | 0.5 | 0.9 |

* With respect to domestic prices.