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IMPACT ON U. K. WHEAT IMPORT PATTERNS FROM ENTRY INTO THE EC; PROJECTIONS TO 1980

by

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January 1, 1973, the United Kingdom entered the European Community (the EC). As a result of entrance, the U.K. agreed to adopt the EC's Common Agricultural Policy (CAP) in six stages between February 1973 and 1977. This agreement means a movement toward an increased protectionist agricultural support policy. Under the CAP, support is to come increasingly from high agricultural prices ensured by a guaranteed minimum producer price and import levies. This contrasts with the previous method of direct payments to farmers to supplement market receipts.

This study will investigate the alteration of the U.K.'s import pattern for a particular commodity, wheat, due to her entrance into the EC and subsequent adoption of the CAP's alternative farm support program. Before the model is presented, salient points of the CAP will be discussed. This will allow for better understanding of the needs of an estimation model. Then the model will be presented. Coefficient estimates will subsequently be presented, and from these, simulations will be conducted. Finally, conclusions will be presented and evaluations made.

THE EC COMMON AGRICULTURAL POLICY FOR GRAIN

The heart of the Common Agricultural Policy is a common pricing scheme with, for example, within-EC wheat prices, in general, double the world market prices. The common grain pricing program requires three

different types of prices for grains (Butterwick and Rolfe). These are: (1) a target or standard price at which the grain in question is to sell on the domestic EC market, (2) an intervention price, slightly below the target price, at which the EC will buy all grain offered by producers, and (3) a threshold price establishing a floor on prices of imported grains. These prices are set in units of account, a bookkeeping device, and not a medium of exchange, and then translated into member currencies through special exchange rates. This conversion ensures that relative agricultural prices are uniform throughout the EC (Irving and Fearn, 1975). In order to maintain the threshold prices for grains, variable levies are applied to imported grain to compensate for the lower world prices. The variable levy amounts to the difference between the lowest c.i.f. Rotterdam grain price and the threshold price after adjustments are made for differences in quality between the grain with the lowest world price and EC produced wheat. Rotterdam is chosen because it is the port serving Duisburg, the most deficit food consumption area in the EC. The variable levies are calculated each business day as the Rotterdam market price changes, but they are a function of the world price because the threshold, intervention and target prices are fixed yearly. The variable levies apply community wide.

The intervention prices, on the other hand, have a hierarchy of values. The Duisburg, Germany price is referred to as the basic intervention price. From this price, derived intervention prices are calculated for the other intervention centers throughout the Member countries. These derived intervention prices are never more than the basic intervention price. The difference between the basic and derived

intervention prices should reflect only the transportation costs incurred. Since these intervention prices become gradually lower as one moves closer to the producing areas and further from the largest deficit consumption area, an advantage is gained by EC produced wheat because the varaible levy does not change with location and is calculated based on the location with the highest prices. With this type system, if wheat were of uniform quality, there would be no imports of wheat by the EC until all domestic production had been exhausted. This results because the price support system guarantees that domestically produced wheat sells at a lower price in any location except Duisburg, where it sells for the same price as imported wheat. But wheat is not homogenous, thus it does become important to develop a model which allows for differences in the quality of wheat. The model developed in this study is able to distinguish wheat by place of origin.

METHOD OF ANALYSIS

The model developed to accommodate the features of the CAP is based on a multi-stage framework similar to work done by Resnick and Truman (1973, 1974). Their work concerned the determination of trade patterns of Western Europe for all non-food items. They first determined total imports, then allocated these imports to various sources. They used three stages to accomplish this allocation.

The present U. K. wheat import study first determines total U. K. wheat imports in stage one and then in a second stage these total imports are allocated to the wheat exporting countries. The simplifying assumption is made that total import needs of wheat are determined based on the economic interrelationships of wheat to other products, and then these

wheat needs are allocated to various sources based on relative prices and quality aspects which are embedded in historic import patterns.

The stage analyses discussed above can be grounded in utility theory via a separability framework. In this framework commodities are grouped according to need or use. These groups are referred to as goods. The commodities within a good group will be referred to as products. Thus, wheat is a good and U. S. wheat is a product.[1] The aggregate utility of U. K. demanders will be assumed to be of the form:

$$U(q_1, q_2, \ldots, q_n) = U(U^1(q_1), U^2(q_2), \ldots, U^n(q_n)) \qquad (1)$$

where

$$U^i(q_i) = U^i(q_{i1}, q_{i2}, \ldots, q_{in_i}) \quad i = 1, 2, \ldots, n$$

is the utility associated with the ith good group. Given this form, there are n goods consumed by U. K. demanders with the ith product group having n_i products. For wheat, the n_i wheat types assumed in this paper are U. K., Canadian, Australian, European Community, and wheat from the rest of the world (ROW).

Taking equation 1, a two stage utility maximization process is postulated. This maximization process results in demand equations at two levels. These are: (1) the good level and (2) the product level. The first stage allocates total national expenditure, (Y), to the various goods. These goods, q_i, are quantity indexes of products that satisfy like wants or needs. The first stage maximization is given as:

$$\text{Max } U = U(U^1(q_1), \ldots, U^n(q_n)), \qquad (2)$$

$$\text{S. T. } Y = \sum_{i=1}^{n} p_i q_i$$

where

P_i = price index of good i.

The resulting demand functions are of the form:

$$q_i = q_i(p_1, p_2, \ldots, p_n, Y). \tag{3}$$

The first stage allocates expenditures to each good. The next stage takes this allocation and maximizes utility by arranging the distribution among the various products in each group. The second stage maximaization is given as:

$$\text{Max } U^i(q_i) = U^i(q_{i1}, q_{i2}, \ldots, q_{in_i}) \tag{4}$$

$$\text{S. T. } y_i = \sum_{j=i}^{N_i} p_{ij}q_{ij}$$

where

y_i = expenditures on the ith good, and

$j = 1, 2, \ldots, n_i$.

The resulting product demand functions are of the form:

$$q_{ij} = q_{ij}(q_i, p_{i1}, p_{i2}, \ldots, p_{in_i}). \tag{5}$$

The next section presents the statistical estimation model used. Several alterations to equations 3 and 5 are made in order to facilitate estimation.

STATISTICAL ESTIMATION

Stage one determines the United Kingdom's import demand for wheat. The equation used for this stage is postulated to be:

$$QUK = QUK\left(\frac{PBAR}{PUK}, \frac{PCR}{PUK}, \frac{Y}{PUK}, \frac{PBC}{PUK}, \frac{PB_{-1}}{PUK}, \frac{PBAVG}{PWAVG}, TREND\right) \qquad (6)$$

where

QUK = U. K. imports of the good wheat (1000 m.t.),

PUK = import price index of the good wheat (£/m.t.),

PBAR = the current selling price of barley including government subsidies (£/m.t.),

PCR = the cif import price of U. S. #3 yellow corn (£/m.t.),

Y = gross domestic product (billions £),

PBC = live beef prices (£/112 lb.),

PB_{-1} = live beef prices lagged one year,

PBAVG = 5 year average of barley producer prices,

PWAVG = 5 year average of wheat producer prices, and

TREND = 1960 I-VI = 1, 1960 VII-XII = 2, etc. (semiannual data are used)

The second stage develops allocation equations to determine the sources of the import demand. The possible sources considered are Canada, Australia, the U. S., the European Community (excluding new members), and the rest of the world. Because of the potentially serious threat of multicollinearity, cross-quantities are used in place of cross-prices.[2] This can be justified assuming linear demands in terms of the prices. Taking the Canadian allocation equation as typical, it is formulated as:

$$QCAN = QCAN(\frac{PCAN}{PROW}, QUK, QAUS, QEC\text{-}6, QUSA) \qquad (7)$$

where

Q_{---} = wheat imports from Canada (CAN), Australia (AUS), the EC (EC-6) and the U. S. (USA) (1000 m.t.), and

P_{---} = price of imported wheat (£/m.t.).

An allocation equation is presented for each exporter except the rest of the world (ROW). ROW is allocated the residual.

The entire estimation model including the closing identity is:

$$QUK = QUK(\frac{PBAR}{PUK}, \frac{PCR}{PUK}, \frac{Y}{PUK}, \frac{PBC}{PUK}, \frac{PB_{-1}}{PUK}, \frac{PBAVG}{PWAVG}, TREND), \qquad (8)$$

$$QCAN = QCAN\ (\frac{PCAN}{PROW}, QUK, QAUS, QEC\text{-}6, QUSA),$$

$$QAUS = QAUS(\frac{PAUS}{PROW}, QUK, QCAN, QEC\text{-}6, QUSA),$$

$$QUSA = QUSA(\frac{PUSA}{PROW}, QUK, QCAN, QEC\text{-}6, QAUS),$$

$$QEC = QEC(\frac{PEC\text{-}6}{PROW}, QUK, QCAN, QUSA, QAUS), \text{ and}$$

$$QROW \equiv QUK - QCAN - QAUS - QEC - QUSA.$$

Equation system 8 was estimated using three stage least squares for the period 1960-1973 I-VI. The three stage procedure is used in order to: (1) obtain consistent parameter estimates in light of the simultaneous nature of the model, and (2) take account of any contemporaneous

correlation of the error terms. If the errors are contemporaneously correlated, the three stage procedure will result in a gain in asymptotic efficiency. Since the U. K. wheat market is a small part of an interconnected world market, it is quite conceivable that the error components for the allocation equations would be contemporaneously correlated due to fluctuations in the world market.[3, 4] Tables 1 and 2 present the results of two and three stage estimation of equation system 8, respectively.[5]

The expected signs and magnitudes of the quantity coefficients can be postulated and compared to the estimated values. First, the coefficients of the cross-quantities should be negative and greater than negative one. That is, as a cross-quantity increases (total imports fixed), the sum of imports of other wheat have to be decreased by the same magnitude as the initial increase. Second, there is an expected direct relation of magnitude less than one between total imports and imports from any particular supplier. Table 2 indicates that three estimated coefficients do not conform to these expectations. These are: (1) the coefficient on the total import variable in the EEC equation which is greater than 1.0, (2) the U. S. coefficient in the Australian allocation equation which is greater than zero and (3) the Australian coefficient in the U. S. allocation equation which is also greater than zero. None of these were significantly different from either one in the first case or zero in the remaining two cases. Adjustments for these coefficients will be made in one of the simulations conducted in a later section of this paper.

Table 1. Two Stage Least Squares Estimation Results 1960-1973I)

$$QUK = \underset{}{1857.79} + \underset{(738.40)}{969.08}\frac{PBAR}{PUK} + \underset{(703.89)*}{1344.54}\frac{PCR}{PUK} - \underset{(876.44)}{1095.06}\frac{Y}{PUK} - \underset{(86.31)}{108.49}\frac{PBC}{PUK} + \underset{(109.93)}{115.33}\frac{PB_{-1}}{PUK} - \underset{(1806.22)}{1248.54}\frac{PBAVG}{PWAVG} + \underset{(18.46)}{21.69}\,TREND$$

$$QCAN = \underset{}{414.55} - \underset{(210.76)}{9.62}\frac{PCAN}{PROW} - \underset{(.381)}{.454}\,QAUS - \underset{(.151)***}{.787}\,QEC - \underset{(.307)}{.434}\,QUSA - \underset{(.353)}{.483}\,QUK$$

$$QEC = \underset{}{-114.96} - \underset{(233.76)}{149.55}\frac{PEC}{PROW} - \underset{(.173)***}{.861}QCAN - \underset{(.371)**}{.793}\,QAUS - \underset{(.338)}{.441}QUSA + \underset{(.327)**}{.835}QUK$$

$$QAUS = \underset{}{-708.93} - \underset{(170.88)}{74.29}\frac{PAUS}{PROW} - \underset{(.192)}{.214}\,QCAN - \underset{(.164)**}{.348}\,QEC + \underset{(.237)}{.147}\,QUSA + \underset{(.189)***}{.666}\,QUK$$

$$QUSA = \underset{}{51.19} - \underset{(216.18)}{131.01}\frac{PUSA}{PROW} - \underset{(.275)}{.281}\,QCAN - \underset{(.264)}{.283}\,QEC + \underset{(.422)}{.300}\,QAUS + \underset{(.411)}{.270}\,QUK$$

* Significantly different from zero at the 10 percent level.

** Significantly different from zero at the 5 percent level.

*** Significantly different from zero at the 1 percent level.

(Two tailed t tests are used) Standard errors are in parentheses.

Table 2. Three Stage Least Squares Estimation Results (1960-1973I)

$$QUK = \underset{}{1833.17} + \underset{(520.46)}{876.28}\frac{PBAR}{PROW} + \underset{(521.12)^{**}}{1205.07}\frac{PCR}{PROW} - \underset{(623.48)}{458.58}\frac{Y}{PUK} - \underset{(61.66)}{77.01}\frac{PBC}{PUK} + \underset{(78.38)}{26.37}\frac{PB_{-1}}{PUK} - \underset{(1274.23)}{978.10}\frac{PBAVG}{PWAVG} + \underset{(13.21)}{13.81}\,TREND$$

$$QCAN = \underset{}{-102.46} - \underset{(131.37)}{5.19}\frac{PCAN}{PROW} - \underset{(.304)^{*}}{.535}\,QAUS - \underset{(.096)^{***}}{.911}\,QEC - \underset{(.232)^{***}}{.759}\,QUSA + \underset{(.276)^{***}}{.796}\,QUK$$

$$QEC = \underset{}{-447.890} - \underset{(132.36)}{70.836}\frac{PEC}{PROW} - \underset{(.109)^{***}}{.988}\,QCAN - \underset{(.284)^{***}}{.846}\,QAUS - \underset{(.241)^{***}}{.688}\,QUSA + \underset{(.256)^{***}}{1.047}\,QUK$$

$$QAUS = \underset{}{-718.38} - \underset{(138.57)}{71.44}\frac{PAUS}{PROW} - \underset{(.158)}{.201}\,QCAN - \underset{(.129)^{**}}{.337}\,QEC + \underset{(.193)}{.246}\,QUSA + \underset{(.160)^{***}}{.651}\,QUK$$

$$QUSA = \underset{}{115.79} - \underset{(151.30)}{101.12}\frac{PUSA}{PROW} - \underset{(.198)^{**}}{.501}\,QCAN - \underset{(.182)^{**}}{.448}\,QEC + \underset{(.302)}{.294}\,QAUS + \underset{(.305)}{.346}\,QUK$$

See Table 1 for notes.

SIMULATIONS OF 1980 U. K. WHEAT IMPORT PATTERNS

Three basic simulations will be presented using the estimated coefficients in Table 2. The first two of these, Simulations I and II, are concerned with U. K. entrance into the EC. The third, Simulation III, assumes the U. K. had not entered the EC and that she maintained trade relations with Australia.[6] The first half of 1980 will be the period for which these simulations will be conducted.

In order to conduct the simulations, the exogenous variables have to be projected to 1980 for each situation. These exogenous variables are $\frac{PBAR}{PUK}$, $\frac{PCR}{PUK}$, $\frac{Y}{PUK}$, $\frac{PBC}{PUK}$, $\frac{PB\text{-}1}{PUK}$, $\frac{PBAVG}{PWAVG}$, TREND, $\frac{PCAN}{PROW}$, $\frac{PAUS}{PROW}$, $\frac{PUSA}{PROW}$, and $\frac{PEC\text{-}6}{PROW}$. The first two situations dealing with U. K. entrance into the EC allow taking advantage of a feature of the CAP system. Levies and subsidies are applied as agricultural products cross member countries' borders which ensure that relative prices are the same throughout the EC and that these relative prices equal relative prices measured in unit of account prices. Therefore, unit of account prices were trended to 1980 using a first order autoregressive system for all relative prices except the beef prices.[7] The unit of account beef prices misrepresent the actual selling situation because of a lack of market unity (Hudson, p. 14). Other EC beef price series were not helpful because they did not conform to the live beef prices used to estimate equation system 8. As a result, the average relative beef prices over the period 1960-1973 I-VI were used as a proxy of the 1980 values. For consumer prices the trend values of EC target prices were used, and for producer prices the trend values of EC intervention prices were used. These projections directly allow for Simulation I, U. K. entrance in the EC while maintaining U. K.-Australian trade relations. Two adjustments

are made to compensate for Simulation II, termination of U. K.-Australian trade agreement. First, the coefficients with incorrect sign or magnitude were restricted to zero if incorrect sign or one if incorrect magnitude. Second, a tax was calculated which reduced U. K. imports from Australia to the same average share of the market as imported by Germany for the period 1960 to 1964. This time span was chosen because the German adoption of the CAP in subsequent years distorted the import pattern of Germany. During the period 1960 to 1964, however, both Germany and the U. K. were net consumers of wheat. Also, both have similar climates, sizes and are geographically close. Germany imported an average 7.76 percent of her wheat imports from Australia during 1960 to 1964 while the U. K. imported an average 15.88 percent. A tax of 22.68 percent was estimated to be necessary to reduce U. K. imports of Australian wheat to 7.76 percent. This tax was added to the $\frac{PAUS}{PROW}$ to adjust for termination of U. K.-Australian trade agreements.[8]

Simulation III assumed the U. K. had not entered the EC and had maintained trade relations with Australia. In this situation, 1960-1973 I-VI values of the exogenous variables were trended to 1980 using a first order autoregressive process. The resulting percentage flows of Simulations I through III and the total estimated imports for each are presented in Table 3. The 1968-69 through 1971-72 average values are also provided as a point of reference.

Moving from Simulation III to Simulation I to Simulation II can be viewed as steps ranging from non-entrance into the EC to full entrance. Certain trends immediately appear. The percent of the total that Australia and Canada hold of the U. K. import market steadily declines. This is

Table 3. Trade Flows and Total Imports - Simulations I-III and 1968/1969 through 1971/1972

	Simulation I	Simulation II	Simulation III	
	U. K. Entrance with maintenance of U. K.-Australian trade agreements	U. K. Entrance with termination of U. K.-Australian trade agreements	U. K. not entering EC	1968/1969[a] through 1971/1972 average
			--Percent--	
QAUS	20.26	9.99	17.27	22.9
QEC	30.16	52.34	22.56	14.7
QCAN	25.64	17.62	35.64	33.5
QUSA	14.64	6.35	12.13	12.9
QROW	9.30	13.69	12.39	16.0
Total Imports	2,388,730 m.t.	2,316,360 m.t.	2,194,670 m.t.	2,263,400 m.t.

[a] IWC, World Wheat Statistics.

to be expected with the incentive to buy EC-produced wheat created by the CAP. The U. S. shows an expected net decline but experiences a modest increase when moving from Simulation III to Simulation I. The rest of the world is predicted to have an unexpected net increased share of the U. K. market. This increase amounts to 43,821 metric tons, or almost 2 percent of the average U. K. predicted total imports.

Another interesting comparison can be made. Simulations II and III can be compared in order to get an idea of the adjustments wheat exporters to the U. K. must make as a result of entrance (that is, changes in export patterns). Table 4 presents quantity flows given full U. K. entrance into the EC (Simulation II) and non-entrance into the EC. The difference between the two is presented in column 3. Assuming the U. K. was a small country in terms of wheat imports, these differences are absorbed by each exporter without impact on the world prices of wheat. The analysis presented in this paper does not, however, suggest where reductions or additions are made. As can be seen, the predicted adjustment exporters must make as a result of U. K. entrance into the EC falls most heavily on the EC-6 with increased exports to the U. K. and Canada with decreased exports to the U. K. Lesser quantity adjustments are required for the U. S. and Australia, and very little adjustment is predicted for the rest of the world. The percentage changes are also provided in column 4. These indicate that Australia, Canada, and the U. S. lose substantial portions of their U. K. market. The EC on the other hand, experiences an approximately 145 percent increase in their market.

Summary and Conclusions

Three stage least squares are applied to international trade data to analyze the impact on the wheat import pattern of the United Kingdom resulting from entry into the EC. Projections are made to 1980. The model used is designed to differentiate wheat by place of origin. This allows consideration of quality differences.

Several conclusions can be drawn from the predicted flows and total imports in Table 3. First, the predicted total imports are very stable regardless of the simulation conducted. For Simulations I-III, total wheat imports range from 2,194,670 to 2,388,730 m.t. This compares to an average in recent years of 2,263,400 m.t.[9]

Secondly, the termination of U. K.-Australian trade agreements yields a tremendous impact on U. K. imports of Australian wheat. The Australian share of the U. K. market falls from an estimated 17.27 percent of the U. K. market given the U. K. had not entered the EC to 9.99 percent. Third, EC countries can be expected to be called upon to make the largest adjustment resulting from U. K. entrance with an approximately 145 percent increase in shipments to the U. K. Much of this would most probably come from stocks that would otherwise accumulate as a result of the Common Agricultural Policy. The model also predicts that Australia, Canada, and the U. S. will either be competing for new outlets of their wheat or be forced to cut back exports.

The most general conclusion of this study is the trend of the flows from historical flow levels to predicted flows with the U. K. fully integrated into the EC. The EC-6's share of the U. K. wheat market steadily increases as the simulations progress from the historical level to full entrance, and as noted earlier, the non-EC exporters, other than ROW, experience a loss in their market share.

FOOTNOTES

1. This follows the terminology used by Armington (1969).

2. This is a non-traditional formulation which is intended to solve a potentially serious problem, multicollinearity. The simple correlation coefficients for the wheat prices used in this study are all above .9. Had this problem not existed, price information would be the more realistic information to include. The present formulation lessens the economic content of the allocation equations. See Ferguson and Gould, (p. 375) (1975) for a similar application.

3. For a discussion of three state least squares, see Johnston (pp. 395-400) or Theil (pp. 508-515).

4. Even though equation system 8 was estimated using a simultaneous equation technique, it should be noted that the import demand equation contains no jointly determined variables as dependent variables. Thus, the two-stage and ordinary least squares estimates are the same and are unbiased. This aspect was used to try alternative formulations of the import demand equation and to investigate the error structure. The Shapiro-Wilk (1965) test did not indicate a possible divergence from normality.

5. A test for complete independence of the error structure resulted in rejecting the null hypothesis of independence. For the test used, see Morrison, p. 113.

6. The U. K., prior to entrance into the EC, had maintained a trade agreement with Australia which tended to give preference to Australia produced wheat. The U. K. agreed to purchase 760,000 m.t. per year from Australia (Australian Wheat Board).

7. The 1976/77 relative EC prices were also tried. There was very little difference in the simulation results between these and the trended results.

8. Using EC prices which have a variable levy already applied and adding the 22.68 percent tax on the price of Australian produced wheat necessitates assuming that the response by U. K. consumers is the same for a like change in the price or tax. It is also assumed that the U. K. is a small country in terms of wheat imports. These assumptions allow for the avoidance of explicit supply functions of the exporters since price increases do not alter offers by world suppliers. A tentative estimate of the U.K.'s impact on the world wheat market supports the small country assumption.

9. Preliminary results of work by B. H. Davey (1973) suggest that the U. K. supply of wheat should increase by a modest amount due mainly to increased yields by 1978. A 1972 USDA report, Compound Feeds in the United Kingdom, further predicts a reduced use of grains in compound feeds by 1980 in the U. K. These two results tend to suggest reduced import demand by the U. K. The analysis is far from conclusive, but recent production and import trends tend to bear this out. Thus, the above total import predictions may be an overstatement.

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