Irish Agriculture and Associated Industries 1964: Effects of Various Cereal Policies

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GIVEN the 1964 structure of Irish Agriculture and associated industries, as published in Paper Number 44* of the Economic and Social Research Institute, the exercises described below investigate the effects on the economy of changes in the 1964 pattern of home-grown cereals:

(*a*) the effects on the economy of substituting home-grown grains for some imported grains,

(*b*) The effects of the converse situation, where most of the required grains are imported.

MORE HOME-GROWN GRAIN, WITH LESS IMPORTS

The native grains in question are wheat, oats and feeding barley. Exercises (1) and (2), which investigate this situation, assumed that a minimum amount of hard wheat, namely one-quarter of the flour-milling requirement (amounting to 91,150 tons for 1964) would have to be imported. We made the further assumption that if the extra growing of wheat, oats and barley was to take place, the income arising in these three sectors would have to be increased substantially, per unit of output, in order to entice farmers to substitute grain-growing for other farming enterprises. An extra £0·2 per £1 of output at original 1964 prices was considered an adequate incentive. Although we think this extra 0·2 per unit to be realistic, others might choose a different level of incentive.

The area of land in usage for all farming activity was held constant, by means of total Land Annuities and annuity coefficients for the various crops; thus if grain growing increased, some other sectors would necessarily be reduced.

*R. O'Connor, with M. Breslin: *An Input-Output Analysis of the Agricultural Sector of the Irish Economy in* 1964, Dublin: Economic and Social Research Institute. Paper No. 44.

We realize that for Exercises (1) and (2) there will be price increases, due to native grains having a higher unit cost than imported ones and also due to the extra profit margins on the home-grown cereals. At these prices we assume that products produced from native grain could not be exported unless a subsidy were applied to keep export prices at their original 1964 levels; the subsidy possibly being an acreage payment.

Substitution Rates

For imported wheat replaced by native wheat we used a 1:1 tonnage substitution rate. For feed grains, however, we used the standard substitution rates as published in the Department of Agriculture Leaflet Number 2 "Foods for Livestock"

i.e. when	Barley	=	10 Milo = 9·5
	Wheat	=	10 Oats = 12·0
	Maize	=	9·5 Wheat Offals = 13·0.

LESS HOME-GROWN GRAINS, WITH MORE IMPORTS

Exercises (3) and (4), which investigate this situation have all grains imported, except (i) oats grown and consumed on farms without process of sale and (ii) malting barley. If this situation were to come about there would be more land available for other farming activities. Also the extra imported grains might bring about some reductions in product price levels.

A summary of quantities and values for production, imports and disposal of grains in 1964 is given in Table 1 following.

METHODOLOGY

In the 1964 Agricultural Input-Output Transactions Table, as published, the flows along some of the rows contained both domestic products and imports of similar commodities. It was first of all necessary, before attempting any cereal substitutions, to separate out the domestic and import content of each non-zero entry in all such rows. Eight cereal items were considered wholly or partly replaceable by domestic items namely, wheat, oats, barley, maize, milo, wheaten flour, bran/pollard, maize meal. All the imports included in any of the rows of the original 1964 Table were brought down to the Primary Input section, leaving purely domestic flows along the inter-industry rows.

The 8 cereal items were preserved in 8 separate rows of the Primary Inputs while the other competitive imports (not under review here) were aggregated into a single row. There were two further rows for non-competitive imports, i.e. one for the estimated import content of fertilizers and one for the estimated import content of other expenses.

TABLE 1: *Production. Imports and Disposal of Certain Cereals in 1964 on a dried grain basis*

Cereal	Home Production	Imports	Total Supply	Disposal: Human Consumption	Disposal: Animal Feed: Unsold	Disposal: Animal Feed: Sold (as such)	Disposal: Animal Feed: Compound Feed	Disposal: Seed	Disposal: Changes in Stocks and Exports
				Quantity (000 tons)					
Wheat	240·6	168·4	409·0	358·2	21·4	nil	55·6	17·2	−43·4
Oats	292·7	13·6	306·3	18·9	216·9	26·9	19·5	23·2	0·9
Barley (Feeding and Malting)	487·9	0·4	488·3	111·2	122·0	47·0	223·6	27·2	−42·7
Maize and Milo	nil	193·0	193·0	3·2	nil	43·7	125·7	nil	20·4
Wheat Offals	106·3	106·6	212·9	nil	nil	62·0	140·9	nil	10·0
TOTAL	1,127·5	482·0	1,609·5	491·5	360·3	179·6	565·3	67·6	−54·8
				Value (£000)					
Wheat	7,280	4,450	11,730	10,836	258	nil	1,463	562	−1,389
Oats	2,901	381	3,282	254	1,460	608	520	421	19
Barley	10,181	13	10,194	2,919	1,272	1,295	5,031	639	−962
Maize and Milo	nil	4,320	4,320	72	nil	1,006	2,799	nil	443
Wheat Offals	2,237	2,099	4,336	nil	nil	1,354	2,778	nil	204
TOTAL	22,599	11,263	33,862	14,081	2,990	4,263	12,591	1,622	−1,685

Having arranged the Transactions table as indicated, the Direct Input Coefficients (also called Technical Coefficients) were calculated, by dividing the Total Input cost of each column into each entry in that column, these technical coefficients adding to unity in each column.

EXERCISE (1)

Substitution of home-grown for imported grain, with varying exports of beef, milk products, mutton and lamb

General Assumptions: Replace wholly or partially as indicated above the 8 cereal import items by domestic equivalents; increase the income arising coefficient in wheat, barley and oats columns by 0·2. In the replacement, soft wheat imports were replaced by native wheat, oats by oats and barley by barley. Also imported flour was replaced by native flour; maize, milo, bran/pollard and maize meal were all replaced by native barley, the latter first being milled or compounded, except for a few, smallish bran/pollard import amounts going directly to animals. The latter were replaced by unmilled native barley. The appendix illustrates numerically, via a 7-sector model, the different stages of reaching the final solution to the problem of type Exercise (1).

Adjustment of Technical Coefficients

The Department of Agriculture substitution rates referred to above, together with prices per ton for domestic and import items (in original 1964 Table) were used to adjust the technical coefficients of the domestic substitutes. The following scheme illustrates the transformations required where actual numbers relate to the row or column numbers in the 1964 Table.

Column No. (j)	*Technical coefficients before substitution of domestic for imports*		*Technical coefficients after substitution of domestic for imports*	
	Inter-industry		*Inter-industry*	
9	Native wheat	a_{9j}	Native wheat	$a_{9j}+\lambda_w w_j$
10	Native oats	a_{10j}	Native oats	a_{10j}
11	Native barley	a_{11j}	Native barley	$a_{11j}+\lambda_b b_j+\lambda_m m_j$
	*Primary**		*Primary**	
	Imported wheat	w_j	Imported wheat	*nil*
	Imported barley	b_j	Imported barley	*nil*
	Imported milo	m_j	Imported milo	*nil*
			Adjustment coefficient	c_j
	Total input	1·0	Total input	1·0

*For convenience of exposition the five other grain import items have been omitted.

The parameters λ_w, λ_b and λ_m combine the feed equivalent tonnage substitution rates with the original price-per-ton ratios, for wheat, barley and milo respectively, e.g. for barley replacing milo

$$\lambda_m = \frac{\text{Substitution rate for barley}}{\text{Substitution rate for milo}} \times \frac{\text{Price per ton home grown barley}}{\text{Price per ton of milo}}$$

and similarly for the other λ's.

The "Adjustment coefficient" c_j is put in to make the column sum still unity. With c_j included, all prices are still at their original 1964 levels and we can work within the old price system and find the total adjustment necessary to keep prices stable. If, however, the adjustment coefficient be omitted, the quantity results will still be the same, but now price levels will change since the column sums are no longer unity; these changes in price levels can be calculated, and are given by the row vector:

$$[p_1, p_2 \ldots p_n] = [\pi_1, \pi_2 \ldots \pi_n][I - A]^{-1} \text{ where}$$

$[\pi_1\ \pi_2 \ldots \pi_n]$ are the sums of the Primary inputs for each column excluding Adjustment coefficient row but including any extra profit margin (such as 0·2 on grains); and A is the matrix of technical coefficients, after the substitution at original prices of native for imported grains.

In the Input-Output scheme, any vector of domestic outputs X required for a specified Final Demand Y is given by

$$X = (I - A)^{-1}\, Y \text{ where;}$$

A is the inter-industry matrix of Technical coefficients (here after domestic substitution for imports).

I is the Unit Matrix, and

$(I - A)^{-1}$ is the inverse of $(I - A)$. Each column j of the inverse gives the total amounts of all sectors' outputs required for one unit of Final Demand for domestic commodity j.

Assumptions concerning land use and final demands

The extra use of land for grain growing requires necessary reductions in land available for livestock. The Land Annuity coefficients were used to measure the amount of land per unit of production of relevant items. It was decided also to keep Other Industries, Personal Consumption and Stock Changes identical with original values (at original prices) apart from minor adjustments due to replacement of imported cereals by domestic equivalents. It was furthermore decided to keep at original levels and prices the exports of live cattle, live sheep, live horses and the small amount of exports of whole and skim milk.

Thus the three exports being the only parts of Final Demand to be changed were

(1) Mutton/Lamb and a small amount of Horse Meat (L),
(2) Beef (B),
(3) Milk Processing (M).

These were denoted L, B and M respectively.

The total final demand vector for Exercise (1) was therefore subdivided into

(*a*) a vector of *known values* which included Domestic Consumption and Stock Changes for all sectors; and exports for all sectors except cattle slaughter, sheep/horse slaughter and milk processing, and

(*b*) a second vector having zero elements in all rows except in those for cattle slaughter, sheep/horse slaughter and milk processing, where the three letters L, B and M were entered respectively. These letters represented the exports of the latter three sectors which are unknown.

If these were known the resultant total domestic output $\underset{\sim}{X}$ would be given by:

$$X = [I - A]^{-1} \begin{bmatrix} \text{Column} \\ \text{Vector} \\ \text{of known} \\ \text{Values} \end{bmatrix} + B \begin{bmatrix} \text{Cattle} \\ \text{Slaughter} \\ \text{Column} \\ \text{of Inverse} \end{bmatrix} + L \begin{bmatrix} \text{Sheep,} \\ \text{Horse} \\ \text{Slaughter} \\ \text{Column} \\ \text{of Inverse} \end{bmatrix} + M \begin{bmatrix} \text{Milk} \\ \text{Processing} \\ \text{Column} \\ \text{of Inverse} \end{bmatrix}$$

In fact:

(A) X_1 (cattle raising) new output is given by cattle output required by known final demands

+ B (element 1 of Cattle Slaughter column of Inverse)
+ L (element 1 of Sheep, Horse Slaughter column of Inverse)
+ M (element 1 of Milk Processing column of Inverse)

Similarly for X_2 (dairying) and so on.

For each column j of the $(I - A)$ Inverse we can also find a "Total" requirement coefficient for any Primary Input such as Land Annuities. This coefficient gives the complete direct and indirect amounts of the Primary Input required by one unit of Final Demand for domestic output j; it is given by the scalar product of column j of the Inverse and the row of Direct Input coefficients for the Primary in question. (See text preceding Table A.7 of the Appendix). Such total requirement coefficients were calculated for Annuities and certain other primary Inputs.

Determination of unknowns, B, L and M

To determine values for the three unknowns, B, L and M, three equations are required. For Exercise 1 the three equations were based on the following assumptions:—

(1) Cattle (Sector 1) and Dairying (Sector 2) outputs to be in the same proportions as for 1964 originals, i.e. 88, 109: 88, 754.
(2) Dairying (Sector 2) and Milk Processing (Sector 24) to be in proportion of 1964 original outputs, i.e. 88, 754: 43, 451.
(3) Land Annuity: total specified to be unchanged.
This implies constant area of land in use.

On the basis of these assumptions the three equations were derived as follows:
From (A) above

(*a*) $72{,}615{\cdot}2 + 0{\cdot}704542\, B + 0{\cdot}000067\, L + 0{\cdot}189982\, M = X_1$

where:

72,615·2 is the output of cattle required by the known final demands obtained by pre-multiplying the vector of known final demands by the inverse matrix.
0·704542 is element 1 of cattle slaughter column of inverse
0·000067 is element 1 of sheep/horse slaughter column of inverse
0·189882 is element 1 of milk processing column of inverse and X_1 is the new derived output of the cattle sector

similarly:

(*b*) $63{,}570{\cdot}6 + 0{\cdot}000901\, B + 0{\cdot}000219\, L + 1{\cdot}208733\, M = X_2$

where:

63,570·6 is the output of dairying required by the known final demands obtained in the same way as output of cattle at (*a*) above
0·000901 is element 2 of cattle slaughter column of inverse
0·000219 is element 2 of sheep/horse slaughter column of inverse
1·208733 is element 2 of milk processing column of inverse and
X_2 is the new derived output of the dairying sector.

Now from assumption (1) above

$$\frac{X_1}{X_2} = \frac{88{,}109}{88{,}754}$$

hence our first equation is

$$88754 \times [72{,}615{\cdot}2 + 0{\cdot}704542\, B + 0{\cdot}000067\, L + 0{\cdot}189982\, M] =$$
$$88109 \times [63{,}570{\cdot}6 + 0{\cdot}000901\, B + 0{\cdot}000219\, L + 1{\cdot}208733\, M] \text{ that is}$$
$$0{\cdot}708799\, B - 0{\cdot}000152\, L - 1{\cdot}017360\, M = -9{,}576{\cdot}2 \ldots \qquad (1)$$

The second equation was derived using equation (*b*) above and the following equation (*c*) for milk processing.

(*c*) $22{,}581{\cdot}0 + 0{\cdot}000746\, B + 0{\cdot}000181\, L + 1{\cdot}001704\, M = X_{24}$
where:

22,581·0 is the output of milk processing required by the known final demand, obtained in the same way as the output of cattle at (*a*) above
0·000746 is element 24 of cattle slaughter column of inverse
0·000181 is element 24 of sheep/horse slaughter column of inverse
1·001704 is element 24 of milk processing column of inverse and
X_{24} is the new derived output of the milk processing sector.
Now from assumption (2) above

$$\frac{X_2}{X_{24}} = \frac{88{,}754}{43{,}451}$$

hence the second equation is

$$88{,}754\,[22{,}581{\cdot}0 + 0{\cdot}000746\, B + 0{\cdot}000181\, L + 1{\cdot}001704\, M] =$$
$$43{,}451\,[63{,}570{\cdot}6 + 0{\cdot}000901\, B + 0{\cdot}000219\, L + 1{\cdot}208733\, M] \text{ that is,}$$
$$0{\cdot}000063\, B + 0{\cdot}000151\, L + 0{\cdot}837370\, M = 17{,}446{\cdot}1 \ldots \qquad (2)$$

The third equation which is based on the land annuity restriction is as follows:—

$$2{,}547{\cdot}1 + 0{\cdot}011993\, B + 0{\cdot}028146\, L + 0{\cdot}014589\, M = 3{,}045{\cdot}1 \ldots \qquad (3)$$

where:

2,547·1 = the value of annuities associated with all the unchanged sectors of the model while

(0·011993) (0·028146) and (0·014589) are the annuity total requirement coefficients of cattle slaughter, sheep slaughter and milk processing respectively derived as explained above.

3,045·1 = the land annuity total for the state in the original table which is left unchanged.

Solving these equations, the values of B, L and M were found to be (in £000) 16,382, – 91 and 20,844 respectively, compared with the original exports from these sectors of 16,377, 4,097 and 20,826. The figure of – 91 indicates an import of mutton and lamb which was considered so small as to be negligible and was therefore omitted from the further calculations. The next step was to calculate the outputs, primary inputs and c_j adjustment appropriate to B and M by the procedure shown in Table A.9 of the Appendix. These values were then added to the corresponding figures derived from the known final demands to give the required results.

Results of Exercise (1)

Milk processing and cattle exports remained at approximately their original 1964 levels with mutton and lamb exports reduced to zero levels. The monetary effects of the substitutions which are shown in Table 2 were as follows:—

As a result of substituting home-grown for imported cereals, total imports were reduced by £7·7 m. Total exports as a result of the reduction in mutton and lamb were reduced by £4·2 m. giving an increase in net exports of £3·5 m.

Income arising in the grain growing sectors increased by £12·4 m. but as a result of the reduction in sheep production, income arising, in all the farming sectors combined, increased by only £8·6 m. There was also a slight net reduction in non-farming industries so that the total income increase in all sectors in the model before application of the c_j adjustment was £8·2 m.

The above results however, are unrealistic since in the absence of subsidies they require substantial price increases throughout the system. The realistic result is obtained when the (c_j) adjustment is made which has the effect of keeping prices constant at their original 1964 levels. As can be seen the (c_j) adjustment which is in fact a subsidy works out at £6·8 m. giving an increase (after allowing for rates and other subsidies) of £1·1 m. net product in all sectors in the model. If, however, we were to allow prices to rise on the home market but were to keep export prices constant, the amount of subsidy required for the latter purpose would be £1·8 million. The increase in net product in this case would be £6·2 m. and food prices on the home market would rise by 2·65 per cent.

Reason for these results

It is of some interest to understand how Exercise (1) gives the original 1964 levels of B and M, with L changing. An examination of the three derived equations which are rewritten below for convenience shows that in (1) and (2) the coefficients of L are very small, so small in fact that they can be omitted, to give a system of two equations for the two unknowns B and M. When the latter are solved the values of B and M obtained are found to be approximately at their original 1964 levels and when these values are substituted into equation (3), L emerges with a very low value. Hence grain growing replaces sheep in Exercise (1).

TABLE 2: *Substitution of home-grown for imported grains: Results of Exercises (1) and (2.) compared with 1964 originals*

Items	*1964 Original*	*Exercise 1*		*Exercise 2*	
		Actual	*Change from original*	*Actual*	*Change from original*
			£000		
Imports					
Fertilisers	8,574	9,079	+505	9,071	497
Cereals	12,564	2,390	−10,174	2,390	−10,174
Other	41,514	43,513	+1,999	40,923	−591
Total imports	62,652	54,982	−7,670	52,384	−10,268
Total exports	137,206	133,041	−4,165	128,206	−9,000
Exports less imports	74,554	78,059	3,505	75,822	1,268
(A) Income arising (before the (c_j) adjustment)	207,941	216,135	8,194	214,170	6,229
of which (in all farming sectors)	(161,159)	(169,724)	(8,565)	(168,299)	(7,140)
(in grain growing sectors)	(10,321)	(22,684)*	(12,363)	(22,558)+	(12,237)
(B) Adjustment (c_j)	nil	−6,844	−6,844	−6,810	−6,810
(C) Income arising (after (c_j) adjustment)	207,941	209,291	+1,350	207,360	−581
(D) Rates	7,188	7,184	−4	7,148	−40
(E) Subsidies	−19,876	−20,097	−221	−18,718	1,158
(F) Net Product (after (c_j) adjustment) [(C)+(D)+(E)]	195,253	196,378	+1,125	195,790	537
(G) If adjustment not applied, extra subsidy or tax to keep export prices at original 1964 level	nil	−1,768	−1,768	−1,733	−1,733
(H) Net product arising if adjustment not applied to home market [(A)+(D)+(E)+(G)]	195,253	201,454	6,201	200,867	5,614
Price changes if no adjustment made to productive sectors			%		%
Personal consumption	—	—	+2·65	—	+2·65
Exports	—	—	+1·33	—	+1·33

*6,350 being due to profit incentive.
+6,315 being due to profit incentive.

The three equations for Exercise (1) are

$$(1)\ 0{\cdot}708799\,B - 0{\cdot}000152\,L - 1{\cdot}017360\,M = -\,9{,}576{\cdot}2,$$
$$(2)\ 0{\cdot}000063\,B + 0{\cdot}000151\,L + 0{\cdot}837370\,M = 17{,}446{\cdot}1,$$
$$(3)\ 0{\cdot}011993\,B + 0{\cdot}028146\,L + 0{\cdot}014589\,M = 498{\cdot}0.$$

EXERCISE (2)

Substitution of home-grown for imported grain with exports of mutton and lamb held constant.

For Exercise (2), we did precisely as for Exercise (1) except that Mutton/Lamb Exports were held at their original 1964 levels, with B and M to be determined *via* equations (1) and (3) above. This resulted in exports of Beef and Milk Products of 11,075 and 17,128 respectively compared with the original 16,377 and 20,826 (values in £000). The full results are given in Table 2 and show that in all cases the results are somewhat inferior to those from Exercise (1).

EXERCISE (3)

Substitution of imported for home-grown grain with varying exports of beef, milk products, mutton and lamb.

General Assumptions

To import all of the cereals home-grown in the original 1964 economy, except malting barley and native oats fed to livestock without process of sale. Replace native barley by imported (and cheaper) milo. Irish wheat is not grown; it is replaced by imported wheat. Irish oats (as specified) is replaced by imported oats. There is no restriction on imports of cereals.

Procedure

The native grains' coefficients were taken down in to the Primary Input rows and adjusted along the lines explained above for Exercise (1) and (2), except that in this case the λ's used were the reciprocals of those used in Exercises (1) and (2).

There was again a Primary row of Adjustment coefficients; the new $(I - A)$ inverse was obtained and applied to the known final demands, to give part of the solution.

As in the case of Exercises (1) and (2) the following assumptions were made in order to determine the magnitudes of B, L and M, these symbols having the same meaning as in the other exercises.

(1) Cattle and Dairying outputs to be in the same proportions as for 1964 Original outputs.
(2) Dairying output to be in the same ratio to Milk Processing as for the Original 1964 output.
(3) The total land usage, as measured by the Annuity coefficient, to be unchanged.

On the basis of these assumptions and using the same procedure as described for Exercise (1) the following three equations were developed:

$$(4) \quad -0{\cdot}708801B + 0{\cdot}000151L + 1{\cdot}017354M = 9{,}579{\cdot}7$$
$$(5) \quad 0{\cdot}000290B + 0{\cdot}000070L + 0{\cdot}391488M = 8{,}158{\cdot}1$$
$$(6) \quad 0{\cdot}011805B + 0{\cdot}028058L + 0{\cdot}014191M = 776{\cdot}8.$$

Solving these equations, gave B and M about the same as the original 1964 amounts. L the exports of mutton and lamb were 10,265 compared with 1964 original of 4,097 (units in £000). Thus sheep used the extra land available, in contrast to Exercise (1) where sheep production was replaced by grain growing. As in the case of Exercise (1), this result is due to the very low coefficients for L in equations 4 and 5.

The results which are given in Table 3 show that in this case the increase in mutton exports was not sufficient to balance the increase in grain imports so that net exports are reduced by £3·6 million. Income arising in the grain growing sectors is reduced by £8·4 m. This is offset somewhat by increases in the other farming sectors but despite this, the income arising in all farming sectors is reduced by £2·8 m. and in all sectors in the model by £2·2 m. After the application of the c_j adjustment of £1·7 m. (which in this case is a surplus) and allowing for rates and subsidies, net product arising in all sectors is down by £0·1 m. No attempt was made to calculate the multiplier effects, of the surplus or reduction of net product, upon the outputs of sectors, imports, etc. The results shown give the differences arising from the changes described in the exercise, with Personal Consumption, Other Industries, Stock Changes and all Exports, except those mentioned in the exercises, held constant at their original levels.

EXERCISE (4)

Substitution of imported for home-grown grain with exports of mutton and lamb held constant.

For Exercise 4, we did precisely as for Exercise (3), except that Mutton/Lamb exports were held at their original 1964 levels, with B and M to be determined *via* equations (4) and (6) above. This resulted in exports of Beef and Milk Products of 24,352 and 26,382 respectively compared with the original 16,377 and 20,826. The full results are given in Table (3) and show that in all cases the results are better for the economy than those of Exercise 3, e.g., a loss of Foreign Exchange of

TABLE 3: *Substitution of imported for home grown grains: Results of Exercises (3) and (4) compared with 1964 originals*

Items	1964 Original	Exercise (3) Actual	Exercise (3) Change from original	Exercise (4) Actual	Exercise (4) Change from original
	£000	£000	£000	£000	£000
Imports					
Fertiliser	8,574	7,878	−696	7,874	−700
Cereals	12,564	24,690	12,126	24,948	12,384
Other	41,514	43,142	1,628	44,760	3,246
Total Imports	62,652	75,710	13,058	77,582	14,930
Total Exports	137,206	146,675	9,469	151,822	14,616
Exports less Imports	74,554	70,965	−3,589	74,240	−314
(A) Income arising before the (c_j) adjustment	207,941	205,740	−2,201	208,592	651
of which					
(in all farming sectors)	(161,159)	(158,386)	(−2,773)	(160,274)	(−885)
(in grain growing sectors)	(10,321)	(1,922)	(−8,399)	(1,915)	(−8,406)
(B) Adjustment (c_j)	nil	+1,679	+1,679	+1,694	+1,694
(C) Income arising (after (c_j) adjustment)	207,941	207,419	−522	210,286	2,345
(D) Rates	7,188	7,194	6	7,247	59
(E) Subsidies	−19,876	−19,466	410	−21,528	1,652
(F) Net Product (after (c_j) adjustment) (C) + (D) + (E)	195,253	195,147	−106	196,005	752
(G) If adjustment not applied extra subsidy or tax to keep export prices at original 1964 levels	nil	333	333	349	349
(H) Net product if adjustment not applied to home market (A) + (D) + (E) + (G)	195,253	193,801	−1,452	194,660	593
Price changes if not adjustment made to productive sectors:—			%		%
Personal consumption	—	—	−0·6	—	−0·6
Exports	—	—	−0·2	—	−0·2

£0·3 m., compared with a corresponding loss of £3·6 m. for Exercise (3) and an increase of £0·7 m. in Income Arising as against the Exercise (3) reduction of £2·2 m.

One point should be kept in mind however when interpreting the figures from Exercise (4), which show fairly substantial increases in beef and milk product exports. The model assumes that these extra products could be exported for a price reduction of 0·2 per cent. In view of experience in subsequent years this is not a realistic assumption particularly for milk products. An increase in milk product exports of this magnitude would no doubt lead to a sharp drop in prices, so that the export subsidies required would be much greater than those contained in the overall £21·5 m. shown here. It is doubtful therefore if the results of Exercise (4) are very realistic under present world market conditions.

SUMMARY AND CONCLUSIONS

The results of the above exercises would seem to indicate that for the economy as a whole arguments in favour of substituting cheap imported for home-grown grain are not as well founded as is often thought. If such substitution were to take place there would be either a fall, or an insignificant rise in income arising in agriculture, while the gain to the remainder of the economy from lower pieces would likewise be marginal.

If on the other hand home-grown grain were substituted for imported, without any price changes, there would be a gain of £1·1 m. in the net product of the sectors considered in the model.* However, if in 1964, prices were allowed to rise on the home market, but prices on export markets were kept at original levels by the application of a subsidy the equivalent gain would be about £6 m. This situation would of course involve fairly substantial income redistribution as between different classes of farmers and between farmers and other workers. Incomes of grain growers would increase by about £12 m. but those of other farmers would be reduced by £4–5 m. giving a net increase in Agricultural incomes of about £7–8 m. Food prices on the home market would increase by about 2·7 per cent and direct farm subsidies by about £1–2 m. As the major part of the last two expenses would be paid by the non-farming sectors, these increases would represent an income redistribution as between farmers and non-farm workers.

Unfortunately, the 1964 input output table cannot be used to show how the substitution if carried out would affect incomes of farmers in different regions. There is no doubt that such policies would benefit farmers in the grain growing regions of the country and work to the detriment of those on the poorer soil in the North and West, but in order to quantify the magnitudes of the benefits or penalties, regional input output tables would be needed.

*The model under review is a partial model and does not cover all sectors of the economy. This should be kept in mind in interpreting the results.

APPENDIX

Solution of Exercise (1) by using a 7-sector model.

The Transactions Matrix:

Suppose we have the simple economy illustrated by the 7-sector transaction table following. There are four Agricultural sectors, namely, Cattle, Dairying, Grain Growing and Pasture; and there are only three further sectors in the inter-industry complex, namely, Grain Milling/Animal Feed, Cattle Slaughter, Milk Products. Final demand consists of Exports and Other.

The Primary Input rows are Imports of Grain, Imports Other, and Income Arising. (We ignore Rates, Subsidies and Depreciation.) All Transactions are shown in £000.

Following the Total Input row are two other rows; the first giving the Land usage (arbitrary units) per £1 of output of the sectors directly using land, namely Grain Growing and Pasture; the second row gives the total land used by the system, the aggregate of the latter row (19·0 units) being the total available supply of land. Note that Cattle and Dairying in the economy here considered, do not directly use land; their indirect use will appear below in the outcome of the matrix inversion etc. (See Table A. 1, page 374).

The direct input, or technical coefficients to the seven productive sectors are as follows:

TABLE A. 2: *Technical coefficients based on Table A. 1*

Sector Type	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1. Cattle	—	0·16	—	—	—	0·650	—
2. Dairying	0·35	—	—	—	—	—	0·80
3. Grain Growing	0·01	0·01	0·10	—	0·350	—	—
4. Pasture	0·15	0·10	—	—	—	—	—
5. Grain Milling	0·02	0·02	—	—	—	—	—
6. Cattle Sl.	—	—	—	—	—	0·125	—
7. Milk Products	—	—	—	—	—	—	—
Primary Inputs							
8. Imports of Grain	—	—	—	—	0·250	—	—
9. Other Imports	0·01	0·02	0·15	0·32	0·125	0·175	0·04
10. Income Arising	0·46	0·69	0·75	0·68	0·275	0·050	0·16
Total Input	1·00	1·00	1·00	1·00	1·000	1·000	1·000
Land usage	—	—	0·2	0·6	—	—	—

These coefficients are obtained in the usual way by dividing the entries in each column of Table A. 1 by the column totals. Thus every entry in column 1 is divided by 100, every entry in column 4 is divided by 25 and so on for the other columns.

Adjustment of the Technical Coefficients

To replace imported by home-grown grain, the following assumptions are made:—

(1) 11 tons of home-grown grain are equivalent to 10 tons of imports.

TABLE A. 1: *7-Sector Transactions Table (£000)*

Sectors	*Inter-industry*								*Final Demand*			*Total Output*
	1 Cattle	*2 Dairying*	*3 Grain Growing*	*4 Pasture*	*5 Grain Milling*	*6 Cattle Slaughter*	*7 Milk Processing*	*Total Inter*	*Exports*	*Other Final*	*Total Final*	
1. Cattle	—	16	—	—	—	26	—	42	50	8	58	100
2. Dairying	35	—	—	—	—	—	40	75	—	25	25	100
3. Grain Growing	1	1	2	—	14	—	—	18	—	2	2	20
4. Pasture	15	10	—	—	—	—	—	25	—	—	—	25
5. Grain Milling	2	2	—	—	—	—	—	4	—	36	36	40
6. Cattle Slaughter	—	—	—	—	—	5	—	5	20	15	35	40
7. Milk Processing	—	—	—	—	—	—	—	—	20	30	50	50
Total Inter	53	29	2	—	14	31	40	169	90	116	206	375
Primary Inputs												
Imports of Grain	—	—	—	—	10	—	—	10	—	—	—	10
Imports, Other	1	2	3	8	5	7	2	28	—	—	—	28
Income arising	46	69	15	17	11	2	8	168	—	—	—	168
Total Primary	47	71	18	25	26	9	10	206	—	—	—	206
Total Input	100	100	20	25	40	40	50	375	90	116	206	581
Land Usage												
Per £1 of output	—	—	0·2	0·6	—	—	—	—	—	—	—	—
Total	—	—	4	15	—	—	—	19	—	—	—	19

(2) In the initial situation when there is both imported and home grown grain on the market, the price of the home-grown produce is 20 per cent higher than that of the imports.

(3) Grain growers are given an extra £0·1 per £1 output at original prices to entice them to increase production of home-grown grains.

(4) Home Consumption of the products of all sectors, and exports of live cattle are to remain unchanged, but exports of cattle slaughter and milk products are allowed to vary. This implies that the columns of "other final" demands and the exports of sector 1 as given in Table A. 1 are left unchanged.

The first three of these assumptions involve adjusting the technical coefficients in Table A. 2. These adjustments are made as follows:—(See Table A. 3).

The import coefficient of 0·250 in row 8 of column 5 is first increased by ratio 11/10 (assumption (1) above) and then by 6/5 (assumption (2) above) so that it becomes 0·330 (i.e. 0·250 x 11/10 x 6/5=0·330). This adjusted coefficient is then removed from row 8 and added on to 0·350 in row (3) of column 5 to give a coefficient of 0·680 for native grain sold to milling. The latter coefficient is greater by 0·080 than the sum of the two former coefficients which it replaces i.e. 0·680−(0·250+0·350)=0·080 hence an adjustment of −0·080 is necessary in column 5 to keep the column sum unity.

Similarly for column 3. From assumption (3) above grain growers are given an extra £0·1 per £1 output at original prices, therefore it is necessary to increase the coefficient of 0·75 for income arising in this column by 0·1 to give a coefficient of 0·85 for this item. Following from this, an adjustment of −0·10 is necessary in column 3 to keep the column sum unity. This is the c_j adjustment mentioned in the main text. The adjusted matrix of Technical Coefficients is given in Table A. 3.

TABLE A. 3: *Adjusted Technical Coefficients*

	1	*2*	*3*	*4*	*5*	*6*	*7*
1. Cattle	—	0·16	—	—	—	0·650	—
2. Dairying	0·35	—	—	—	—	—	0·80
3. Grain Growing	0·01	0·01	0·10	—	0·680	—	—
4. Pasture	0·15	0·10	—	—	—	—	—
5. Grain Milling	0·02	0·02	—	—	—	—	—
6. Cattle Slaughter	—	—	—	—	—	0·125	—
7. Milk Process	—	—	—	—	—	—	—
Primary Inputs							
8. Other Imports	0·01	0·02	0·15	0·32	0·125	0·175	0·04
9. Income Arising	0·46	0·69	0·85	0·68	0·275	0·050	0·16
10. Total Primary	0·47	0·71	1·00	1·00	0·400	0·225	0·20
11. Adjustment			−0·10		−0·080		
Total Input	1·00	1·00	1·00	1·00	1·000	1·000	1·00
Land Usage	—	—	0·2	0·6	—	—	—

(1—A) matrix and its inverse $(1-A)^{-1}$ matrix

The (1—A) matrix derived from the first seven rows and columns of Table A. 3 is given in Table A. 4. The entries in this table are derived in the usual way by subtracting each diagonal entry in Table A. 3 from 1·0 and applying minus signs to all the other entries.

TABLE A. 4: (1—A) *Matrix derived from Table A. 3 with a further column for known final demands*

	1	*2*	*3*	*4*	*5*	*6*	*7*	*Known Final Demand**
								£000
1.	1·00	—0·16	—	—	—	—0·650	—	58
2.	—0·35	1·00	—	—	—	—	—0·80	25
3.	—0·01	—0·01	0·90	—	—0·68	—	—	2
4.	—0·15	—0·10	—	1·00	—	—	—	—
5.	—0·02	—0·02	—	—	1·00	—	—	36
6.	—	—	—	—	—	0·875	—	15
7.	—	—	—	—	—	—	1·00	30

*For explanation of known final demand entries see assumption (4) above.

The inverse of the (1—A) matrix in Table A. 4 is given in the first seven rows and columns of Table A. 5.

TABLE A. 5: *Inverse of (I—A) matrix in Table A. 4 together with sector outputs required directly and indirectly by known final demands*

	Inverse matrix $(I-A)^{-1}$							*Derived Sector Outputs*
	1	*2*	*3*	*4*	*5*	*6*	*7*	*£000*
1.	1·059321	0·169491	0·0	0·0	0·0	0·786925	0·135593	81·5
2.	0·370763	1·059321	0·0	0·0	0·0	0·275424	0·847457	77·5
3.	0·037500	0·032222	1·111111	0·0	0·755556	0·027857	0·025778	33·6
4.	0·195974	0·131356	0·0	1·0	0·0	0·145581	0·105085	20·0
5.	0·028602	0·024576	0·0	0·0	1·0	0·021247	0·019661	39·2
6.	0·0	0·0	0·0	0·0	0·0	1·142857	0·0	17·1
7.	0·0	0·0	0·0	0·0	0·0	0·0	1·0	30·0

The column of outputs in Table A. 5 is obtained by multiplying in turn the entries in each row of the inverse matrix by the entries in the column of known final demands in Table A. 4 and summing the results. The output of 81·5 given in the first row of Table A. 5 is obtained as follows:

$(58\times1{\cdot}059321)+(25\times0{\cdot}169491)+(2\times0{\cdot}0)+(0\times0{\cdot}0)+(36\times0{\cdot}0)+$ $+(15\times0{\cdot}786925)+(30\times0{\cdot}135593)=81{\cdot}5$ (correct to one decimal place). Similarly the output of 77·5 in the second row of the table is obtained by multiplying the second row of the inverse matrix by the same column of final demands and so on for the other output entries.

By applying the technical coefficients from Table A. 3 to the column of derived outputs in Table A. 5 we can obtain the Transactions table relevant to the adjusted system. The primary inputs from this Transactions table are given in Table A. 6 with Land usage requirements derived by applying the land usage coefficients from either Table A. 2 or A. 3 to the derived outputs.

TABLE A. 6: *Primary inputs £1000 and land usage requirements for derived outputs*

Type of Primary	*Derived outputs*							*Total primary inputs*
	81·5	*77·5*	*33·6*	*20·0*	*39·2*	*17·1*	*30·0*	
			Primary Inputs					
Other Imports	0·8	1·6	5·0	6·4	4·9	3·0	1·2	22·9
Income arising	37·5	53·5	28·6	13·6	10·8	0·9	4·8	149·6
Adjustments	0·0	0·0	−3·4	0·0	−3·1	0·0	0·0	−6·5
Land Usage	0·0	0·0	6·7	12·0	0·0	0·0	0·0	18·7

The information given in Table A. 6 is not sufficient for the solution of our problem. We also need to know the primary input requirements per unit of the various kinds of final demands. These requirements are given in Table A. 7. They are obtained by multiplying in turn each column of the inverse matrix by a row of the primary input technical coefficients in Table A. 3 and summing the results. Thus the "other imports" requirements of unit of final demand for the output of sector 1 is:—

$(0{\cdot}01 \times 1{\cdot}059321) + (0{\cdot}02 \times 0{\cdot}370763) + (0{\cdot}15 \times 0{\cdot}037500) + (0{\cdot}32 \times 0{\cdot}195974) + (0{\cdot}125 \times 0{\cdot}028602) + (0{\cdot}175 \times 0{\cdot}0) + (0{\cdot}04 \times 0{\cdot}0) = 0{\cdot}089920$ (see Table A. 7). Similarly the "other import" requirements of one unit of final demand for the output of sector 2 is obtained by multiplying the row of "other import" technical coefficients by the *second* column of the inverse matrix: i.e. $(0{\cdot}01 \times 0{\cdot}169491) + (0{\cdot}02 \times 1{\cdot}059321) \ldots\ldots + (0{\cdot}04 \times 0{\cdot}0) = 0{\cdot}072821$ and so on for the "other import" requirements of the other sectors. The "income arising" for a unit of final demand for the output of sector 1 is:— $(0{\cdot}46 \times 1{\cdot}059321) + (0{\cdot}69 \times 0{\cdot}370763) \ldots\ldots + (0{\cdot}16 \times 0{\cdot}0) = 0{\cdot}916117$. The adjustment requirement for a unit of final demand for the output of sector 3 is—:

$$(0{\cdot}0 \times 0{\cdot}0) + (0{\cdot}0 \times 0{\cdot}0) - (0{\cdot}10 \times 1{\cdot}111111) + (0{\cdot}0 \times 0{\cdot}0) - (0{\cdot}080 \times 0{\cdot}0) + (0{\cdot}0 \times 0{\cdot}0) + (0{\cdot}0 \times 0{\cdot}0) = -0{\cdot}111111$$

TABLE A. 7: *Primary Inputs and land usage requirements per unit of the various kinds of final demands*

Type of Primary	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Aggregate £000*
Other Imports	0·089920	0·072821	0·166667	0·320000	0·238333	0·266798	0·098256	22·9
Income Arising	0·916117	0·932367	0·944444	0·680000	0·917222	0·737687	0·905894	149·6
Adjustment	−0·006038	−0·005188	−0·111111	0·0	−0·155555	−0·004485	−0·004151	−6·5 (units)
Land Usage	0·125085	0·085258	0·222222	0·600000	0·151111	0·092920	0·068206	18·7

The aggregate figures in this table (which are exactly the same as the total primary inputs in Table A. 6) are obtained by multiplying each row entry in Table A. 7 by the known final demand in Table A. 4 corresponding to that row. Thus the figure of 22·9 in the first row is obtained as follows:

$(58 \times 0{\cdot}089920)+(25 \times 0{\cdot}072821)+(2 \times 0{\cdot}166667)+(0 \times 0{\cdot}320000)+(36 \times 0{\cdot}238333)+(15 \times 0{\cdot}266798)+(30 \times 0{\cdot}098256)=22{\cdot}9$. Similarly for the other aggregate figures in Table A. 7.

The advantage of Table A. 7 for the purpose under review is that it shows indirect as well as direct requirements for the various primary inputs whereas the technical coefficients in Table A. 3 which are based on sector outputs show only the direct input requirements. It should be noted that because of indirect effects the land usage and the adjustment are spread over practically all of the sectors in Table A. 7 compared with Table A. 6 where these inputs occur only in the sectors where they are directly required.

Solution of Problem

The problem to be solved is that of finding the levels of sector outputs, income arising, exports etc. under conditions where native grain replaces imported grain. Grain growers get an extra £0·1 per £1·0 of output at original prices as an incentive with the following constraints.

(1) Total land area to remain at 19 units as originally

(2) Cattle and dairying to have their outputs in the same proportions i.e. 1:1 as before.

These two constraints imply two unknowns which must be determined. Let these be B and M, the exports of beef and milk products respectively. These unknowns are the additional final demands for the outputs of sectors 6 and 7 respectively so that the new final demands are:—

Final demands (£000)

Sector	*known*	*additional*	*Total (new)*
1	58	—	58
2	25	—	25
3	2	—	2
4	—	—	—
5	36	—	36
6	15	B	15+B
7	30	M	30+M

By multiplying the new column of final demands by the inverse matrix we can obtain the outputs relevant to these final demands. Thus the total output required from sector 1 (cattle) is that required by the known final demands given in Table A. 5 (81·5) plus B times element 1 of column 6 of inverse matrix plus M times element 1 of column 7 of inverse i.e.

(*a*) $81{\cdot}5496+0{\cdot}786925B+0{\cdot}135593M$.

Similarly the output of sector 2 (dairying) is:—

(*b*) $77{\cdot}5423+0{\cdot}275424B+0{\cdot}847457M$.

Since we have specified that cattle and dairying must be in proportion of 1:1 these two outputs must be equal and so our first equation is

(1) $81{\cdot}5496+0{\cdot}786925B+0{\cdot}135593M=77{\cdot}5423+0{\cdot}275424B+0{\cdot}847457M$

In order to find unique values for B and M a second equation is needed. This is derived from the land use specification which states that total land is to remain at 19 units as originally. As for equation (1) total land usage is made up of usage based on known final demands as given in Table A. 7 (18·7 units) plus B and M multiplied by their respective total land requirements per unit from Columns 6 and 7 of Table A. 7 also i.e.

(2) $19{\cdot}0=18{\cdot}7108+0{\cdot}092920B+0{\cdot}068206M$.

Solving equations (1) and (2)
we obtain $B=-0{\cdot}6676$
$M=5{\cdot}1496$

As B and M are total exports of Beef and Milk respectively which were 20·0 and 20·0 in Table A. 1 the negative value for B means that a small amount of beef has to be imported. The original and new final demands are shown in Table A. 8.

TABLE A. 8: *Original and new final demands (£000)*

Sector	*Original*			*New*			*Difference*		
	Exports (1)	*Other* (2)	*Total* (3)	*Exports* (4)	*Other* (5)	*Total* (6)	*Exports* (7)	*Other* (8)	*Total* (9)
1. Cattle	50	8	58	50	8	58	—	—	—
2. Dairying	—	25	25	—	25	25	—	—	—
3. Grain growing	—	2	2	—	2	2	—	—	—
4. Pasture	—	—	—	—	—	—	—	—	—
5. Grain milling	—	36	36	—	36	36	—	—	—
6. Cattle Slaughter	20	15	35	−0·67 (B)	15	14·33	−20·67	—	−20·67
7. Milk products	20	30	50	5·15 (M)	30	35·15	−14·85	—	−14·85
Total	90	116	206	54·48	116	170·48	−35·52	—	−35·52

New Values for sector outputs, and primary inputs

Once B and M have been determined the outputs and primary inputs for the new situation are obtained by applying B and M to columns 6 and 7 of the inverse matrix (Table A. 5) and to the corresponding primary input requirement per unit of final demand as given in Table A. 7. The results of this exercise are then added to the outputs and primary inputs generated by the known final demands which are given in Tables A. 5 and A. 6 respectively to obtain the overall results as shown in Table A. 9.

It should be noted from Table A. 9 that outputs of cattle and dairying are equal as required by equation (1) and that the total area of land used is unchanged at 19 units. The land used could also be obtained by applying the technical coefficients for land use

TABLE A.9: *New Values for sector outputs and primary inputs*

Sectors	*Col. 6 of Inverse*	*Col. 7 of Inverse*	*B(−0·6676) ×(1)*	*M(5·1496) ×(2)*	*Output required for known final demands*	*New Outputs (3)+(4)+(5)*	*Original outputs*	*Difference (6) less (7)*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
					£000	£000	£000	£000
1. Cattle	0·786925	0·135593	−0·53	0·70	81·55	81·72	100·00	−18·3
2. Dairying	0·275424	0·847457	−0·18	4·36	77·54	81·72	100·00	−18·3
3. Grain growing	0·027857	0·025778	−0·02	0·13	33·60	33·71	20	13·7
4. Pasture	0·145581	0·105085	−0·10	0·54	20·00	20·44	25	− 4·6
5. Grain Milling	0·021247	0·019661	−0·01	0·10	39·20	39·29	40	− 0·7
6. Cattle Slaughter	1·142857	0·0	−0·76	0·00	17·10	16·34	40	−23·7
7. Milk Processing	0·0	1·00000	−0·00	5·15	30·00	35·15	50	−14·8
Primary Inputs	*Input Multipliers Table A.7 (Col. 6)*	*(Col. 7)*			*Inputs for known finals*	*New Inputs*	*Original Inputs*	
Grain Imports	—	—	—	—	—	—	10	−10·0
Other Imports	0·266798	0·098256	−0·18	0·51	22·90	23·23*	28	− 4·8
Income arising	0·737687	0·905894	−0·49	4·66	149·60	153·77	168	−14·2
Adjustment	−0·004485	−0·004151	+0·00	−0·02	−6·50	−6·52	—	− 6·5
Land usage	0·092920	0·068206	−0·06	0·35	18·71	19·00	19	Nil

*Excludes negative export of beef which is netted out of total final demand for beef.

from either Tables A. 2 or A. 3 to the new total outputs of grain growing and pasture in Table A. 9.

(i.e. $0{\cdot}2\times33{\cdot}71+0{\cdot}6\times20{\cdot}44=19{\cdot}0$).

As expected the output of grain growing is up from 20 in the original table to 33·7 here. Total imports are down by 14·8 (i.e. $10+28-0-23{\cdot}2=14{\cdot}8$), but if we look at Table A. 8 we see that total exports are down by 35·52 hence there is a decrease in exports less imports. As there is also a decrease in income arising, the economy would lose by changing over completely to home grain growing.

The adjustment can be regarded as a necessary subsidy paid by the government to keep prices stable. It is paid to producers as a negative production cost and if there were no adjustment, prices would have to rise in order to cover the increased income postulated for grain growers. These price effects are discussed in the following section, but in order to understand how they are calculated it is convenient to have the complete Transactions table for the new situation. This table is prepared by applying the technical coefficients (including the adjustment and land usage coefficients) from Table A. 3 to the new total inputs (i.e. the new outputs in column 6 of Table A. 9). Table A. 10 is the new Transactions table at original prices.

Price Changes in the Absence of Adjustment

The sector of total primary inputs (row 10 of Table A. 3) when post-multiplied by the inverse matrix gives the changes in price levels arising from the price incentive to grain Growers, and substitution of the more expensive native grain for imported grain. When this operation is carried out the resulting price changes are:

Row	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Price Change	1·006038	1·005188	1·111111	1·0	1·155555	1·004485	1·004151

It is of interest to note that these price ratios exceed unity by amounts exactly equal to, and of opposite sign to the adjustment coefficients per unit of final demand given in Table A. 7.

As can be seen the actual numerical price ratios for the seven sectors are found to be hardly different from unity except for grain growing (3) and grain milling (5) where the price changes are 11 and 16 per cent respectively. Of the 11 per cent, 10 per cent is due to the grain growing incentive; while of the 16 per cent, 8 per cent is due to the substitution of native for imported grain at original prices, and a further 7 per cent is due to the increased prices which come about as a result of the grain growing incentive. Thus the direct observable first order causes explain most of the computed price change, while the residue of each change (positive or negative) is due to second, third and higher order effects.

Transactions table at new prices

If the adjustment row of the new Transactions Table (Table A. 10) is deleted and the primary input rows including "income arising" are left unchanged we can obtain

TABLE A. 10: *Transactions table for new situation at original prices (£000)*

Sectors	Inter-Industry								Final Demand			
	(1) Cattle	(2) Dairying	(3) Grain Growing	(4) Pasture	(5) Grain Milling	(6) Cattle Slaughter	(7) Milk Processing	Total Inter.	Exports	Other Final	Total Final	Total Output
1. Cattle	—	13·09	—	—	—	10·63	—	23·72	50	8	58	81·72
2. Dairying	28·60	—	—	—	—	—	28·12	56·72	—	25	25	81·72
3. Grain growing	0·82	0·82	3·37	—	26·70	—	—	31·71	—	2	2	33·71
4. Pasture	12·26	8·17	—	—	—	—	—	20·43	—	—	—	20·44
5. Grain milling	1·64	1·64	—	—	—	—	—	3·28	—	36	36	39·29
6. Cattle Slaughter	—	—	—	—	—	2·01	—	2·01	−0·67	15	14·33	16·34
7. Milk Processing	—	—	—	—	—	—	—	—	5·15	30	35·15	35·15
Total Inter	43·32	23·72	3·37	—	26·70	12·64	28·12	137·87	54·48	116	170·48	308·37
8. Other Imports	0·81	1·63	5·06	6·54	4·92	2·87	1·40	23·23	—	—	—	23·23
9. Income arising	37·59	56·37	28·65	13·90	10·81	0·83	5·62	153·77	—	—	—	153·77
10. Adjustment	—	—	−3·37	—	−3·14	—	—	−6·51	—	—	—	−6·51
11. Total Inputs	81·72	81·72	33·71	20·44	39·29	16·34	35·15	308·37	54·48	116	170·48	478·86
12. Land Usage			6·74	12·26				19·00				19

Note: Due to rounding errors the additions of the various entries do not always give the correct total outputs or inputs.

TABLE A. 11: *Transactions table for new situation at new prices (£000)*

Sectors	Inter-Industry (1) Cattle	(2) Dairying	(3) Grain Growing	(4) Pasture	(5) Grain Milling	(6) Cattle Slaughter	(7) Milk Processing	Total Inter.	Final Demand Exports	Other Final	Total Final	Total Outputs
1. Cattle	—	13·17	—	—	—	10·69	—	23·86	50·30	8·05	58·35	82·21
2. Dairying	28·75	—	—	—	—	—	28·27	57·02	—	25·13	25·13	82·15
3. Grain growing	0·91	0·91	3·74	—	29·66	—	—	35·22	—	2·22	2·22	37·44
4. Pasture	12·26	8·17	—	—	—	—	—	20·43	—	—	—	20·44
5. Grain Milling	1·90	1·90	—	—	—	—	—	3·80	—	41·60	41·60	45·40
6. Cattle Slaughter	—	—	—	—	—	2·02	—	2·02	−0·67	15·07*	14·40	16·42
7. Milk processing	—	—	—	—	—	—	—	—	5·17	30·12	35·29	35·29
Total Inter.	43·82	24·15	3·74	—	29·66	12·71	28·27	142·35	54·80	122·19	176·99	319·35
Other Imports	0·81	1·63	5·06	6·54	4·92	2·87	1·40	23·23	—	—	—	23·23
Income Arising	37·59	56·37	28·65	13·90	10·81	0·83	5·62	153·77	—	—	—	153·77
Total Inputs	82·21	82·15	37·44	20·44	45·40	16·42	35·29	319·35	54·80	122·19	176·99	496·35

**Note:* Due to rounding errors the additions of the various entries do not always give the correct total outputs or inputs.

a Transactions table at new prices by multiplying the entries in each production *row* of Table A. 10 by the corresponding price change shown above. Thus the entries in the first *row* of Table A. 10 are multiplied by 1.006038, those in the second by 1·005188 and so on for the others. Table A. 11 which has been derived in this way from Table A. 10 shows that though aggregate income arising remains the same in the two tables both internal and export values are higher in the former than in the latter as a result of the price increases. The same physical flows of products as in Table A. 10 still apply, but now there is no Primary input row of Adjustment amounts to absorb the grain growers incentive and the extra expense of native grain. Consequently the extra cost per physical unit must be absorbed by price increases. In a situation such as this, increased export prices could have serious repercussions on demand and so it may be deemed necessary to subsidise certain exports so as to keep their prices constant, while at the same time allowing the higher prices on the home market. The amount of subsidy required for this purpose is obtained simply by deducting the export value of each sector at original prices from the corresponding value at the new prices and summing the results. For our present example the sectoral subsidies required to keep export prices constant are as follows:—

£000

Sector	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Total*
Subsidy	0·30						0·02	0·32

These figures are obtained by deducting the entries in the export column of Table A. 10 from the corresponding entries in the export column of Table A. 11.

It is worth observing that the 6·51 increase in income arising, absorbed by the Adjustment row of Table A. 10 is exactly passed on to Final Demand in Table A. 11. Final Demands in the latter table pay 176·99 for the same physical flows of goods as cost them 170·48 in Table A. 10, the increase in cost in aggregate being exactly 6·51. This property of Input-Output Tables in general can be readily explained by reference to Table A. 11. The aggregate Total Input of productive sectors 1 to 7 (319·35) is by definition equal to the Total Output of these same 7 productive sectors (319·35). If we net out of both schemes the aggregate total inter-industry (or Intermediate) absorption of the flows (142·35), this leaves aggregate flow to Final Demand equal to aggregate Primary Input, both amounts being 177·00. Thus, in general, any change in Primary Inputs to Productive Sectors will produce an equal change in Final demands of these sectors.