

**An Analysis of Industrial Exports**

Terence J. Baker

Special Article

in

**QUARTERLY  
ECONOMIC  
COMMENTARY**

January 1969

**TERENCE J. BAKER**



4.1 *Introduction*

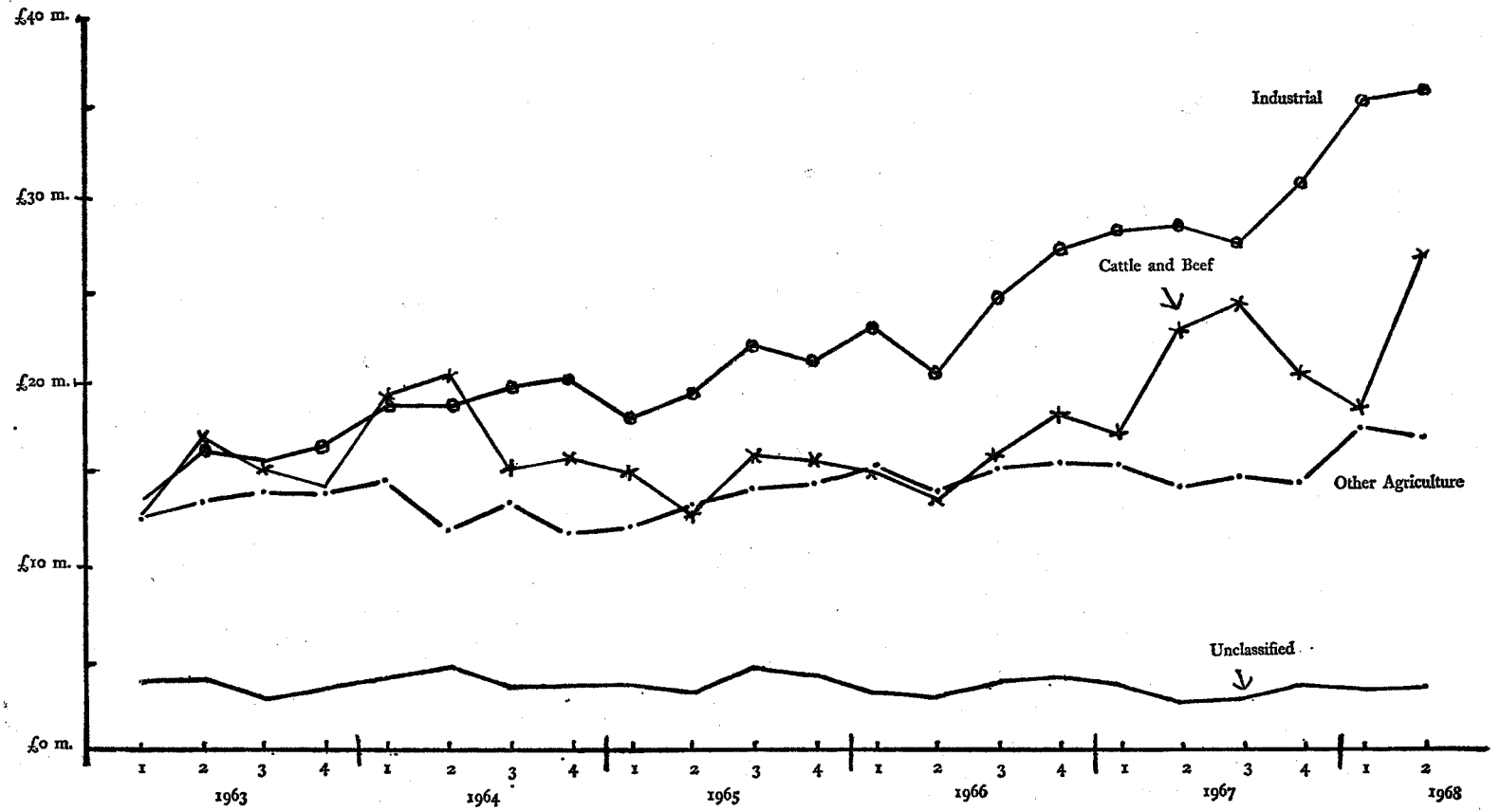
There is no need to justify any attempt to obtain a greater understanding of the factors influencing the level of Irish exports. The importance of exports to the economy, the extent to which their rate of growth has varied from year to year, and the fact that a forecast of their level is fundamental to any econometric prediction of National Accounts are all too obvious to need stressing. Yet it is a curious fact that very little serious analysis of exports has been published, and export forecasts, by the staff of the Institute as well as by other forecasters, have been based almost exclusively on intuitive reasoning and direct inquiry.

TABLE 4.1: IRISH DOMESTIC EXPORTS BY TYPE 1963-1968, SEASONALLY CORRECTED, CURRENT PRICES (£ million)

Year	Quarter	Cattle and beef	Other Agricultural	Industrial	Unclassified	Total
1963	I	13.0	13.0	13.3	4.1	43.4
	II	17.0	13.4	16.4	4.1	50.9
	III	15.6	14.2	15.9	3.4	49.1
	IV	14.4	14.1	16.5	3.7	48.7
1964	I	19.2	14.7	18.7	4.1	56.7
	II	20.4	12.5	18.7	4.5	56.1
	III	15.4	13.9	19.6	3.7	52.6
	IV	16.1	12.3	20.2	3.8	52.4
1965	I	15.3	12.9	18.0	3.8	50.0
	II	13.1	13.4	19.4	3.6	49.5
	III	16.4	14.4	22.3	4.8	57.9
	IV	16.2	14.7	21.5	4.2	56.6
1966	I	15.5	15.6	23.4	3.5	58.0
	II	13.6	14.1	20.8	3.4	51.9
	III	16.3	15.3	24.7	3.9	60.2
	IV	18.5	15.7	27.1	4.1	65.4
1967	I	17.6	15.4	28.2	3.8	65.0
	II	23.9	14.6	28.4	3.3	70.2
	III	24.5	15.0	27.5	3.4	70.4
	IV	20.9	14.8	30.9	3.7	70.3
1968	I	18.8	17.6	35.4	3.6	75.4
	II	27.0	17.1	35.7	3.7	83.5

Sources: C.S.O. Trade Statistics of Ireland. Review of External Trade. Seasonal Correction by ratio to moving average.

CHART 4.1: IRISH DOMESTIC EXPORTS BY TYPE 1963-1968. CURRENT PRICES



There are several reasons for this. The most important is that if either exports of goods and services, or merchandise exports are taken as a single entity, there are no obvious explanatory variables with which to relate them. On the other hand a really detailed micro approach, such as that adopted by Kavanagh in his unpublished study, is useful as a basis for long term policy decisions, but is far too complex for forecasting purposes.

So far as any answer to this intractable problem is possible, it seems likely to be found through the process of selective disaggregation. A start to this process was made in the *Quarterly Economic Commentary* of September 1968, when seasonally corrected quarterly series at current prices were published for domestic exports of "cattle and beef", "other agricultural", "industrial", and "unclassified" products. These are shown in Table 4.1 and Chart 4.1. By thus identifying the very different trends over the past five years in these broad categories of exports, it became possible to project each category with rather more confidence and with a greater reference to relevant facts than was possible for merchandise exports as an undifferentiated whole. However the actual projections remained almost entirely intuitive, as no formal relationships between any of these series and any outside variable were established.

#### 4.2 The pattern of industrial exports

The aim of the present exercise is to take the largest of these categories, namely domestic industrial exports (excluding exports from the Shannon Free Airport), and by further disaggregation to attempt to relate subcategories within it to external variables. The actual subdivisions made owe very little to economic theory and a great deal to statistical availability and common sense.

The first and most obvious division is by destination. Given the desire to keep the number of divisions as small as possible, and the size of each as large as possible, the only geographical division made is between the UK and the rest of the world. The second major division is into those industrial exports which fall into S.I.T.C. Sections 5 to 8 and those which do not. The reason for this division is that only exports in Sections 5 to 8 can be readily compared with other countries' imports, these being the Sections which are internationally regarded as manufactured goods. In the remainder of the paper Sections 5 to 8 are referred to as "manufactured" exports and the remainder of industrial exports as "other".

TABLE 4.2: IRISH INDUSTRIAL EXPORTS BY CATEGORY 1963-68, CURRENT PRICES

Year	To UK		To Rest of World	
	Manufactured	Other	Manufactured	Other
	£ million			
1963	29.6	16.7	11.8	4.1
1964	37.6	18.1	16.7	4.8
1965	37.5	17.8	19.8	6.4
1966	43.1	18.6	24.4	9.9
1967	52.2	23.9	26.2	12.6
	% of total			
1963	47.6	26.8	19.0	6.6
1964	48.7	23.4	21.6	6.2
1965	46.0	21.8	24.3	7.9
1966	44.9	19.4	25.4	10.3
1967	45.4	20.8	22.8	11.0

Given this two-way breakdown of industrial exports, the period studied chooses itself, as the Irish Trade Statistics follow the S.I.T.C. classifications only from 1963 onwards, and in a short study such as this it would be impracticable to convert earlier data to this form. In any case the period of 5½ years permits 22 quarterly observations, and with the rapid change in the composition of industrial exports a longer period would not necessarily permit either more accurate seasonal corrections or the establishment of more meaningful relationships with other variables.

Table 4.2 shows the breakdown of the annual industrial exports into the four divisions outlined. This table shows how the UK market for industrial exports, while remaining dominant and growing absolutely, has nevertheless declined in relative importance over the period studied. The UK took 74% of Irish industrial exports in 1963, a proportion which declined steadily to 64% in 1966 and recovered to 66% in 1967. With regard to manufactured goods the relative fall was quite modest, from 48% to 45%. Viewed the other way round, as a proportion of UK manufactured imports, Irish manufactured exports to the UK grew from 1.74% in 1963 to 1.84% in 1967. This is comparing Irish exports f.o.b. with UK imports c.i.f., which of course understates the true proportion in each case. A N.I.E.S.R. study\* suggests that, after making certain adjustments to the figures to ensure comparability, the Irish share of UK manufactured imports on a c.i.f. basis was about 2.8% in 1966. Other industrial exports to the UK grew much more slowly than the other three categories of exports, and their share of the total thus declined sharply from 27% to 21% over the period. The fastest growth was in other industrial exports to the rest of the world, which more than trebled during the five years studied, thus nearly doubling their share of the total.

There is not a great deal to be gained from studying quarterly figures for these divisions unless they are seasonally corrected. A complication arises here, as some of the four categories contain components which seriously disrupt the seasonal pattern. At the same time these disruptive components can be regarded as supply rather than demand determined, and thus from the point of view of analysis, as well as the narrower viewpoint of seasonal correction, there is a strong argument in favour of isolating them from the rest of the figures. The items in question are petroleum products to the UK, ships and planes to the rest of the world, and metal ores to the rest of the world.

Manufactured exports to the UK remain unchanged, but each of the other categories is subdivided once more. Of the separated items, petroleum exports to the UK can themselves be seasonally corrected, but neither ships and planes, which appear to be random, nor metal ores, which have been exported only since the beginning of 1966, can.

The seasonally corrected series are shown in Table 4.3. The method adopted in each case was the ratio to moving annual average. For purposes of analysis of a past period this method would appear to be as suitable as Leser's quasi linear method used in our regular seasonal corrections, as well as being much simpler to apply.

In the case of exports to the rest of the world the ratio to moving averages was applied simply to the raw data. In the case of exports to the UK however the period was characterised by several events, random in their timing, which seriously affected the seasonal pattern in most years. These were dealt with by adjusting the raw data to allow for the effects of these events before calculating the ratios. The actual adjustments made were more or less arbitrary, but by inspection appear to be of the right order of magnitude. The adjustments and their causes are set out below.

While the seasonal correction factors are calculated on the basis of the adjusted figures, the series in Table 3 are of course the actual figures divided by the seasonal correction factors thus derived.

\*UK Imports of Manufactures from Developing and New Industrial Countries, 1954-1966. Ann Morgan, National Institute Economic Review, May 1968.

TABLE 4.3: IRISH INDUSTRIAL EXPORTS 1963-68. SEASONALLY CORRECTED, CURRENT PRICES  
(£ million)

Year	Quarter	To UK			To Rest of World				Total (8)
		Manufactured (1)	Other (excluding Petrol) (2)	Petrol (3)	Manufactured (excluding Ships and Planes) (4)	Other (excluding mining) (5)	Ships and Planes (not corrected) (6)	Mining (not corrected) (7)	
1963	I	6.6	3.3	0.4	2.2	1.0	—	—	13.5
	II	7.3	3.5	0.4	2.6	1.0	1.5	—	16.3
	III	7.5	3.7	0.7	2.6	1.0	—	—	15.5
	IV	8.2	3.9	0.6	2.9	1.0	—	—	16.6
1964	I	8.9	4.0	0.5	2.8	0.8	1.5	—	18.5
	II	9.6	4.3	0.3	3.1	1.4	—	—	18.7
	III	9.7	4.1	0.4	3.0	1.3	1.1	—	19.6
	IV	9.4	3.9	0.5	3.6	1.4	1.5	—	20.3
1965	I	8.2	3.8	0.6	3.9	1.5	—	—	18.0
	II	9.0	4.0	0.8	4.2	1.7	0.2	—	19.9
	III	9.8	3.9	0.6	5.1	1.4	1.6	—	22.4
	IV	10.5	3.6	0.6	4.6	1.9	0.2	—	21.4
1966	I	10.5	4.3	0.3	4.8	1.4	0.9	0.8	23.0
	II	9.5	3.7	0.1	4.9	1.5	0.3	0.7	20.7
	III	11.7	4.8	0.3	5.4	1.8	—	0.8	24.8
	IV	11.4	4.8	0.2	6.2	1.7	1.7	1.2	27.2
1967	I	12.5	4.7	0.8	6.4	2.5	—	1.1	28.0
	II	13.0	4.7	1.6	6.4	1.7	0.2	1.3	28.9
	III	12.3	4.6	0.9	6.4	2.1	—	1.0	27.3
	IV	14.3	5.6	1.4	6.7	2.0	0.1	1.0	31.1
1968	I	16.2	4.9	0.5	8.5	2.5	—	2.1	34.7
	II	16.5	4.7	0.7	9.9	2.5	0.1	1.3	35.7

Event	Date	Quarter	Adjustments	
			Manufactured Exports	Other Industrial Exports
			£ million	£ million
UK Import Levy .. ..	November 1964	1965 I	+ .8	
UK Seamen's Strike ..	May 1966	1966 II	+1.2	+ .5
		1966 III	- .6	- .4
		1966 IV	- .6	- .1
End of Levy .. ..	November 1966	1966 IV	+ .4	
		1967 I	- .2	
		1967 II	- .2	
Liverpool Dock Strike ..	September 1967	1967 III	+ .8	+ .2
		1967 IV	- .4	- .2
		1968 I	- .4	
Devaluation .. ..	November 1967	1968 I	- .4	
		1968 II	- .4	

#### 4.3 Analysis of Export Categories

Table 4.3 shows quarterly industrial exports since 1963 broken down into seven categories, five of which are seasonally corrected. Thus disaggregation in itself is a considerable aid to understanding the growth of industrial exports in the past five years and to forecasting by intuitive methods their future growth. However, the table opens the way to further analytical and predictive steps.

In the case of the three minor categories (cols. 3, 6 and 7), prediction should be relatively simple by means of direct inquiry. In each case only a very small number of enterprises is involved, and by asking these companies directly it should be possible to obtain a reasonably accurate forecast of exports in these categories for the coming year.

The four major categories present a more difficult problem, but one which is in some of the cases amenable to analysis. In this study a fairly detailed statistical analysis has been made of "manufactured" exports to the UK. This is because this is still by far the largest of the categories, and also because it is the one most amenable to such analysis. The other categories have received much more perfunctory treatment, but sufficient, it is felt, for certain broad conclusions to be drawn.

#### 4.4 Exports of Manufactured Goods to UK

Inspection of both annual and quarterly data suggests that there is a close relationship between total UK imports of manufactured goods and Irish exports of these products to the UK, both valued at current prices. This is illustrated in Chart 4.2. However it can be seen that the fit, although close, is by no means perfect. Accordingly the hypothesis has been adopted that the level of Irish exports of manufactured goods to the UK depends on the level of total UK imports of manufactured goods, and on various other factors. The full list of possible explanatory variables tested is as follows:

$X_1$  = Total UK imports of manufactured goods (seasonally corrected).

$X_2$  =  $X_1$ , leading by one quarter.

$X_3$  =  $X_1$ , lagging by one quarter.

$X_4$  = Index of Irish unit labour costs 1961 = 100, difference of quarter from trend.

$X_5$  = two-year smoothed increase in volume of production index, manufacturing industry.

$X_6$  = Dummy variable for seamen's strike.

$X_7$  = Dummy variable for Liverpool dock strike.

$X_8$  = Dummy variable for Free Trade Agreement.

$X_9$  = Time trend.

CHART 4.2: IRISH MANUFACTURED EXPORTS TO UNITED KINGDOM Cf.  
UNITED KINGDOM MANUFACTURED IMPORTS

Irish Manufactured Exports to United Kingdom X—  
Total Manufactured Imports to United Kingdom X—|—|—|—X.  
Index Mean=100

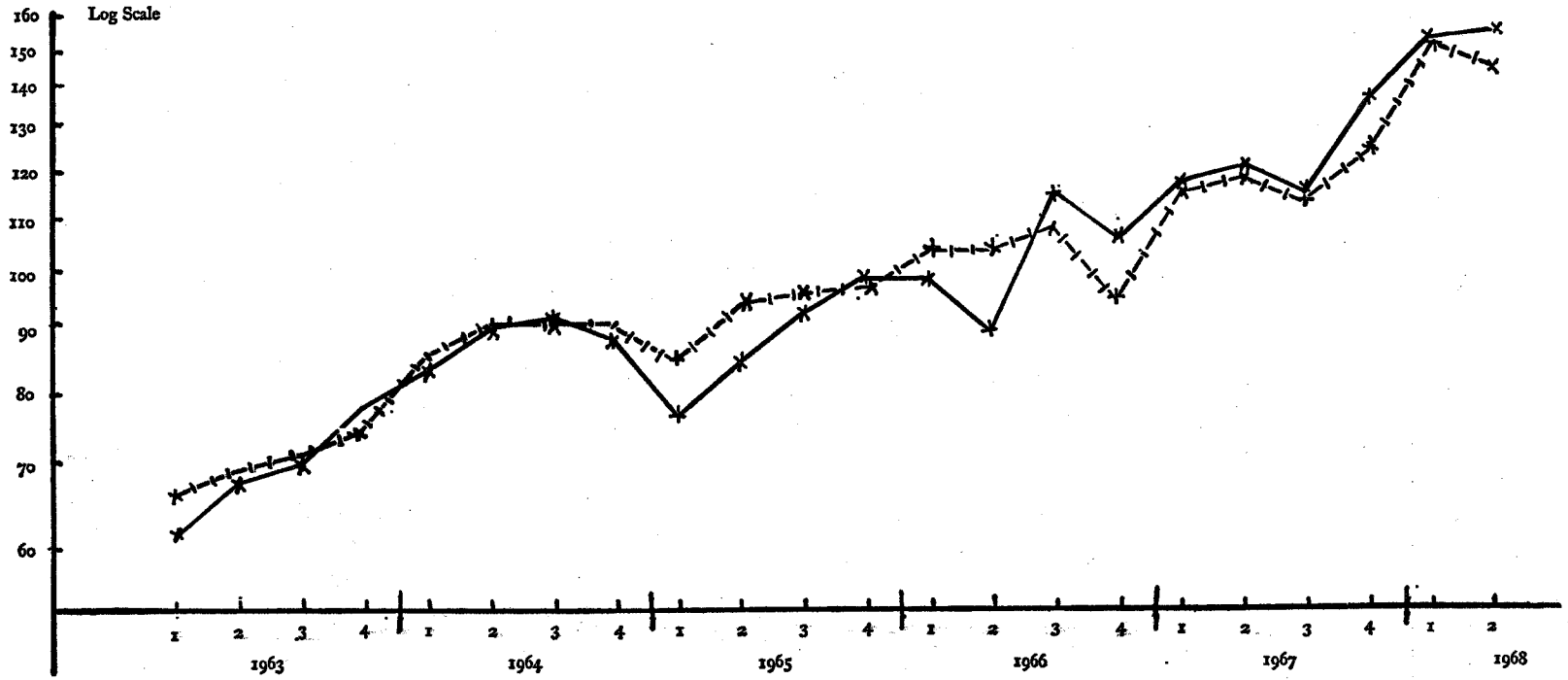


TABLE 4.4: IRISH MANUFACTURED EXPORTS TO UK VARIABLES



TABLE 4.4: IRISH MANUFACTURED EXPORTS TO UK VARIABLES

	Y	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub> variation from trend × 100	X <sub>5</sub> % increase × 100	X <sub>6</sub>	X <sub>7</sub>	X <sub>8</sub>	X <sub>9</sub>	
	£'000	£ million	£ million	£ million							
1963	I	6,572	402	409	419	-21	1,155	0	0	0	1
	II	7,261	419	402	429	-5	958	0	0	0	2
	III	7,459	429	419	453	-32	1,149	0	0	0	3
	IV	8,249	453	429	519	-55	1,309	0	0	0	4
1964	I	8,864	519	453	548	15	1,444	0	0	0	5
	II	9,583	548	519	550	57	1,428	0	0	0	6
	III	9,720	550	548	546	31	1,387	0	0	0	7
	IV	9,422	546	550	513	-2	1,378	0	0	0	8
1965	I	8,175	513	546	571	8	1,454	0	0	0	9
	II	8,990	571	513	579	11	1,459	0	0	0	10
	III	9,812	579	571	586	-8	1,286	0	0	0	11
	IV	10,529	586	579	624	-35	948	0	0	0	12
1966	I	10,535	624	586	627	-9	649	0	0	0	13
	II	9,502	627	624	642	5	643	-2	0	0	14
	III	11,704	642	627	573	18	728	1	0	1	15
	IV	11,363	573	642	696	30	946	1	0	1	16
1967	I	12,523	696	573	714	4	956	0	0	1	17
	II	13,021	714	696	687	-35	978	0	0	1	18
	III	12,308	687	714	749	-7	1,066	0	-1	1	19
	IV	14,347	749	687	915	-2	1,314	0	1	1	20
1968	I	16,226	915	749	887	-8	1,714	0	0	1	21
	II	16,488	887	915	887	0	1,759	0	0	1	22

Note: For description of variables, see text.

Some explanation is necessary for some of these variables.  $X_1$ ,  $X_2$ , and  $X_3$  are valued c.i.f., although the dependent variable  $Y$  is valued f.o.b. It is therefore implicitly assumed that the relationship between f.o.b. exports and freight charges remains unchanged throughout the period.  $X_4$  is included as a test of the effect of unit labour costs, that is, average weekly earnings in manufacturing industry after allowing for changes in productivity, on manufactured exports. As the main explanatory variable is total UK imports it is felt that a comparison of Irish with UK labour costs would not be appropriate, as any change in UK labour costs relative to the rest of the world would be reflected in the level of total UK manufactured imports. The correct comparison would appear to be with unit labour costs in the other countries supplying the UK market. Such a comparison however would have been quite impracticable in a short study, and so the rather heroic assumption has been made that, on balance, average unit labour costs in the rest of the world have followed a steady trend. On this assumption, any deviation of Irish labour costs from their trend during this period should be reflected in their having a short-term effect on Irish exports, when taken in conjunction with total UK imports as the other explanatory variable.

$X_5$  is included as a test of whether Irish manufactured exports have been held back by shortage of capacity in times of boom conditions. No reliable measures of capacity utilisation exist for the period, and so the assumption has been made that the greater the increase in industrial production over the preceding two-year period (taking three-quarterly moving averages to eliminate random fluctuations) the greater the likelihood that capacity constraints are being felt.

The dummy variables  $X_6$  and  $X_7$  for the major strikes in the period are self cancelling and used purely as distributors in time. The dummy  $X_8$ , on the other hand, representing the Free Trade Agreement is regarded as having a continuous effect, being entered as zero until the middle of 1966 and as one for each quarter thereafter. The time variable  $X_9$  is used in the normal way in an attempt to show whether serious problems of collinearity exist and if so to partly eliminate them.

Multiple regressions were run by computer with Irish manufactured exports to the UK as the dependent variable and all the above variables together, and various combinations of them, always including  $X_1$ , as explanatory. The simple linear regression of  $Y$  on  $X_1$  was also calculated. The results are set out in Table 4.5.

The most striking feature of the table is the overriding importance of  $X_1$ , total UK manufactured imports, as an explanatory variable. As well as being consistently significant at the 1% level, the value of its coefficient remains fairly constant, varying only from 13 when its lagged and leading forms are included to 19½ when used on its own or with the strike dummies. In the simple regression there is an  $R$  of .974, and consequently there is not a great deal of room for the other variables to improve the fit. Nevertheless it is worth studying how far the other variables prove significant and improve the fit compared to the simple regression. The best fit is obtained when all the variables are used together, and it is interesting that in this case only two of them, labour costs and the Liverpool dock strike, are not significant at the 10% level.

However it is most instructive to look at the performance of each variable separately.

The lagged and leading terms  $X_2$  and  $X_3$ , when used with  $X_1$ , or with  $X_1$  and the dummy variables, in equations 2 to 5, do not greatly improve the fit obtained.  $X_2$  does not in these equations achieve significance at the 10% level, while  $X_3$  achieves it only at the 10% level. Despite the fact that in the full equation 1 both these variables are significant at the 5% level, they do not therefore appear to be very valuable. It is interesting that  $X_3$  shows up rather better than  $X_2$ , suggesting that the response of Irish manufactured exports to events is faster rather than slower than UK manufactured imports as a whole. This presumably reflects both the short distances involved and the composition of the exports in which few products with a long period of gestation are included.

TABLE 4.5: IRISH MANUFACTURED EXPORTS TO UK MULTIPLE REGRESSIONS,

Equation Number	Variables Included	Variables Significant At			Variables Not Significant at 10%	R	DW Value
		1%	5%	10%			
1	1, 2, 3, 4, 5, 6, 7, 8, 9,	1, 6	2, 3, 8, 9,	5	4, 7	.9961	1.56
2	1, 2, 3, 6, 7, 8,	1	6	8	2, 3, 7,	.9930	Not Calculated
3	1, 2, 3,	1	—	3	2	.9793	"
4	1, 2	1	—	—	2	.9754	"
5	1, 3,	1	—	3	—	.9786	"
6	1, 4, 5, 6, 7, 8	1	6, 8,	—	4, 5, 6,	.9919	"
7	1, 4, 5,	1	—	—	4, 5,	.9740	1.66
8	1, 6, 7, 8, 9,	1	6, 8,	—	7*, 9	.9914	Not Calculated
9	1, 6, 7, 8,	1	6, 8	—	7*	.9913	1.64
10	1, 6, 9,	1, 6,	—	—	9	.9873	Not Calculated
11	1, 6, 7,	1, 6,	—	—	7	.9873	"
12	1, 6,	1, 6,	—	—	—	.9867	1.84
13	1, 9	1,	—	—	9	.9757	Not Calculated
14	1,	1,	—	—	—	.9739	1.66

\*Almost significant at 10%

$$\text{Equation 1. } Y_c = -3,037 + 15.93X_1 + 4.75X_2 + 6.43X_3 - 3.32X_4 - 0.71X_5 + 668.73X_6 + 247.35X_7 + 820.32X_8 - 190.52X_{10}$$

(1.98)    (1.88)    (2.21)    (2.85)    (0.40)    (182.54)    (265.84)  
 (327.14)    (68.71)

$$\text{Equation 9. } Y_c = -42 + 17.14X_1 + 505.38X_6 + 488.05X_7 + 849.65X_8$$

(1.12)    (198.77)    (282.15)    (328.83)

$$\text{Equation 12. } Y_c = -1,200 + 19.58X_1 + 804.45X_6$$

(0.75)    (188.65)

$$\text{Equation 14. } Y_c = -1,151 + 19.50X_1$$

(1.02)

The next pair of variables  $X_4$  and  $X_5$ , representing unit labour costs and a capacity proxy, perform surprisingly badly. The capacity proxy is significant at the 10% level in the full equation and neither is significant in any of the other combinations in which they are included, although the sign of  $X_4$  is consistently in the expected direction. When taken together with  $X_1$ , they succeed in raising the R by only .0001. This almost complete lack of effectiveness does not of course mean that neither labour costs nor capacity constraints has any effect on manufactured exports, merely that the series chosen for these variables are ineffective in the equations formulated. This could be because the series used are poor measures of these factors. It could be that they operate with a time lag that was not tested. The most likely explanation is that the relationship between these factors and the level of manufactured exports to the UK is far more complex than the simple and direct link assumed in the formulation of the equations.

In the case of capacity constraints, it would perhaps be more reasonable to expect them to operate only when capacity is practically fully utilised. Until that level is reached, higher utilisation would be a result of a high level of exports, only beyond that level would capacity constraints result in exports being lower than would be expected from a consideration of demand factors. Very skilful formulation, based on much better data than are available, would be needed to test this hypothesis.

With regard to  $X_4$ , unit labour costs compared with the trend over the period, the position is more tantalising. This series, although far from perfect, is logically constructed and does clearly show the effect on labour costs of the ninth and tenth wage rounds. Thus, if the assertion which is sometimes made, that increased wage costs have an immediate deleterious effect on exports, were true, then  $X_4$  should have a significant impact on the equations in which it is included. However, even on theoretical grounds this simplistic assertion is dubious, as it rests on the assumptions that wage costs are immediately reflected in export prices, and that export markets are price elastic.

The true relationship is likely to be far more complex. Unit wage costs (after allowing for productivity changes) can affect profit margins as well as prices. Sometimes one will be affected during one period and the other in another period, depending on the state of the market and the nature of contractual obligations. Thus, the effects of a relative increase in labour costs, as a result say of a wage-round, will be a mixture of price effects and of profit effects (such as decisions to delay or cancel expansion projects or to cut back on overseas marketing activity) each operating with varying time lags.

There is scope in this field for much further research which might yield very fruitful results. However, these results are likely to be of importance to the long term planner concerned with the secular trend of exports. For the short term forecaster concerned with the factors underlying the quarter by quarter fluctuations around this trend, it would appear from this analysis that marginal changes in unit wage costs are an unimportant factor compared with changes in the level of UK manufactured imports.

Returning to the equations in Table 4.5, the dummy variables for specific events work reasonably well. In particular,  $X_6$ , representing the greater effect of the seamen's strike on Irish exports than on total UK imports of manufactured goods, is highly significant in every equation in which it appears. On its own with  $X_1$  it raises the R from .974 to .987, and thus appears the most valuable of the subsidiary explanatory variables.  $X_7$ , which postulated a similar skewed effect for the Liverpool dock strike is not very significant and does little to improve the fit. On the other hand  $X_8$ , which postulates a permanent boost to exports from the Free Trade Agreement is significant at the 5% level in every equation in which it appears, and improves the fit in conjunction with  $X_1$ ,  $X_6$  and  $X_7$  from .988 to .991.

An encouraging feature of the regressions is the unimportance of  $X_9$ , the time variable. The only time it is significant, is in equation 1, and there its sign is negative. When taken alone with  $X_1$  it fails to be significant at the 10% level and improves the fit only from .974 to .976, although here at least its sign is positive. When the dummies are included, especially  $X_8$ , its contribution to the fit is negligible.

These results suggest that the relationships observed between the other variables are genuine, and not merely the result of all of them moving together through time.

Taken together, this regression analysis seems to establish beyond reasonable doubt, that the most important factor determining the level of Irish manufactured exports to the UK is the level of total UK manufactured imports. Specific events, such as the seamen's strike and the introduction of the Free Trade Agreement have had a measurable impact, but no other continuous series spanning the whole period appears significant.

Study of the residuals suggests that a further dummy variable representing the early period of the UK import surcharge would have been significant. A series of negative residuals in 1965 is probably responsible for the fact that the D.W. tests, although satisfactory, are consistently below 2. Another impression gained from visual impression of the residuals is that some part of the remaining error may be due to the vagaries of the seasonal correction process. In almost all the equations the residuals for the first quarter of each year tend to be strongly negative. This could well be due to the fact that the first quarter has been treated more severely in the Irish seasonal correction than in the British. Such problems are inseparable from the use of quarterly time series.

Equations 1, 9, and 12, can be regarded as satisfactory analytical tools for explaining the recent course of manufactured exports. As predictive tools they are less satisfactory, although nevertheless of some use. This arises partly from the nature of the problem, in that the errors, although small in relation to the absolute figures used, can be large in relation to the quarter to quarter changes in the dependent variable. To some extent this difficulty is lessened if the quarterly equations are used for predicting four quarters at a time, in order to obtain annual forecasts. As the errors are reasonably random it is likely that the aggregate error from four quarters will be considerably less than four times the probable error for a single quarter. This is a further advantage of quarterly over annual models for prediction purposes, as this cancelling out of random errors is not possible in predicting a single year on an annual model.

A second drawback is that the relationship between the two main variables is itself so close that the significance and effect of the other variables tends to become obscured. An approach to dealing with this second problem might be to conduct the exercise in two stages, using the minor independent variables to explain the residuals of the simple regression between Y and  $X_1$ . This has not been attempted here but is probably well worth doing if a reliable predictive model is to be refined from this rather crude first stage analysis.

With regard to the other problem mentioned, the obvious answer is to attempt an analysis in terms of first differences. Again for reasons of time, no sophisticated analysis of first differences has yet been made. However, without recourse to a computer, two fairly simple tests have been made.

A simple linear regression of percentage first differences between manufactured exports to the UK and UK manufactured imports yields the following result:

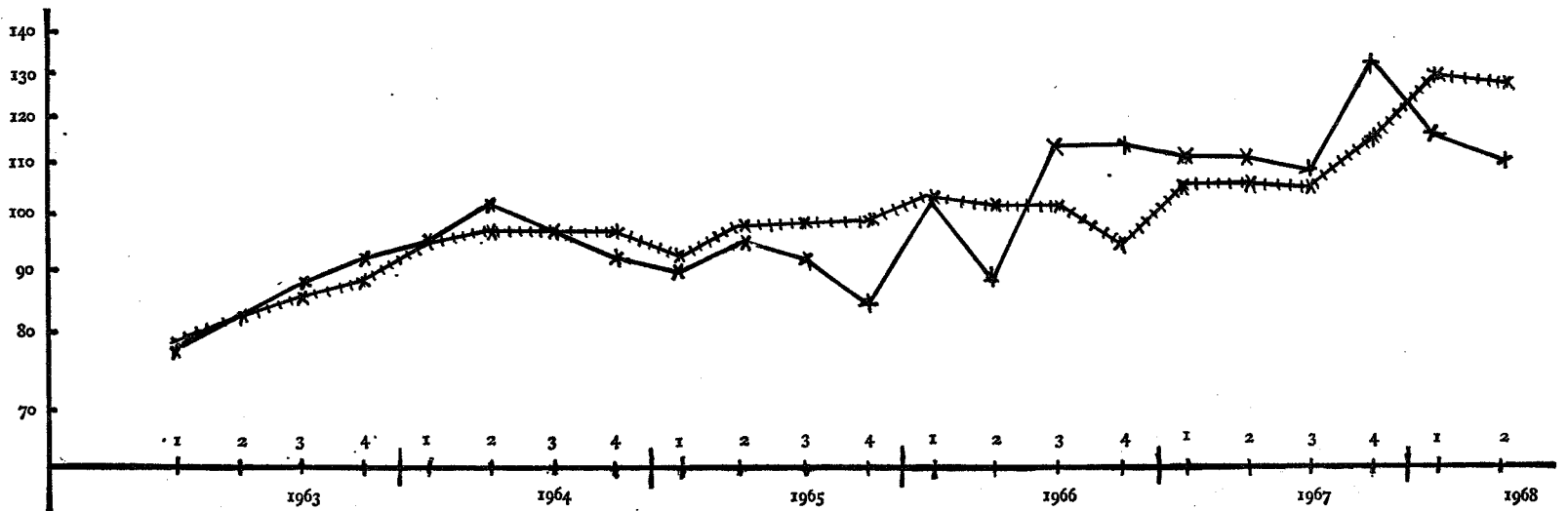
$$Y_c = 1.81 + .731X_1 \quad R = .630 \quad T = 3.54 \\ (.206)$$

The fit of this is not good enough to be much use for prediction. However, from the set of equations on the absolute data, it appears that both the seamen's strike and the Free Trade Agreement had significant effects on exports. Thus a simple dummy variable to represent these two events, with a value of  $-1$  for the second quarter and  $+2$  for the third quarter of 1966 has been added to the equation. The result now becomes:

$$Y_c = 1.32 + .729X_1 + 10.34X_2 \quad R = .863 \\ (.138) \quad (2.09)$$

CHART 4.3: OTHER INDUSTRIAL EXPORTS TO UNITED KINGDOM OF  
UNITED KINGDOM TOTAL IMPORTS

Other industrial exports to United Kingdom X—X  
Total imports to United Kingdom X+++++X  
Index Mean=100  
Log scale



This is much better, and strongly suggests that a properly formulated multiple regression, including lagged terms, can be found that would yield a very high degree of fit in terms of percentage first differences, and which would accordingly be of great value for prediction. From inspection it appears highly likely that the introduction of further variables, and in particular of lagged versions of  $X_1$ , would reduce the constant term considerably.

The implications of this analysis, either in absolute or difference terms, seem to be that although the Irish share of UK imports of manufactured goods is growing slowly over time, this secular movement is greatly outweighed by the importance of fluctuations in the growth of total UK manufactured imports. In absolute terms, each change of £1 million in UK imports tends to lead to a change of about £17,000 to £20,000 in Irish exports, which is sufficient to increase slowly the Irish share of the market. In terms of percentage changes it appears that Irish manufactured exports to the UK tend to increase by about 1.3% per quarter plus .73 of whatever percentage change there is in UK manufactured imports. In times of expanding trade there is not much difference between the results obtained by the two methods, but if trade is static or declining the results diverge considerably, with the first difference approach giving probably too favourable a result from the point of view of Irish exports.

More work is necessary to resolve this conflict and to develop a prediction model which can be used with confidence, although even at this stage the equations available are a valuable reinforcement for intuitive projection. However good the model devised (unless it is formulated entirely in lagged terms) the accuracy of any prediction based on it is limited by the quality and the assumptions made concerning the future values of the independent variables. In the case considered here, the important factor is clearly the accuracy of forecasts of UK manufactured imports. The National Institute of Economic and Social Research in London publishes each quarter forecasts of total UK imports for the following 12 to 18 months. On the whole the relationship between total and manufactured imports is fairly close, but any conversions which may have to be made between them can be checked periodically against direct forecasts of manufactured imports which N.I.E.S.R. are prepared to make available at irregular intervals. Of course one cannot assume that the N.I.E.S.R., forecasts will always be accurate—they were in fact seriously wrong in the early part of 1968—but most of the time they should provide a reasonably reliable external basis for our calculations.

#### 4.5 *Other Industrial Exports to UK*

There is no obvious UK series with which to compare the miscellaneous other industrial exports to the UK. This category includes some food products, beer and spirits, and various raw materials in different stages of transformation. Comparison with internal UK National Accounts' components such as G.N.P. or Personal Consumption are vitiated both by the frequent revisions to which these series are subject and by the great importance of such import affecting factors as changing tariff and quota regulations. It has been decided that the most sensible standard of comparison for these exports, although they themselves fall into S.I.T.C. sections 0-4, is total UK imports of all Sections (excluding U.S. military planes). The relationship is shown graphically in Chart 4.3.

It appears from this that there is indeed some relationship between UK imports and Irish other industrial exports to the UK when allowance is made for the other special factors which are suggested on the chart. No computer time has been spent on the problem, which rules out complicated analysis. The following simple test has been made.

The dependent variable (exports) is smoothed by eliminating the, unexplained, kink in the final quarter of 1965 and the first quarter of 1966, and the extra effects of the seamen's strike in the second, third and fourth quarters of 1966. This adjusted dependent variable is then regressed on total UK imports ( $X_1$ ) and a dummy of 1 from the third quarter of 1966 onwards for the Free Trade Agreement ( $X_2$ ). The result of this equation is

$$Y_c = 2.34 + 1.105X_1 + .667X_2 \quad R = .9039$$

(0.395)    (.146)

$X_2$  is significant at the 1% and  $X_1$  at the 2% level.

As it stands this equation is not at all suitable for prediction purposes and can only be regarded as a first test to see whether any relationship appears to exist. However, the chart suggests that were other variables included, especially one for the UK import levy which appears to have had a disproportionate effect on this category of exports, a reasonable fit might be obtained. The divergence in the final three quarters of the period is puzzling. It could be accounted for partly by vagaries of timing, pushing into the final quarter of 1967 some of the exports which could normally have been expected in the first half of 1968, and partly by the effect of devaluation in raising the prices and consequently the value of total imports while leaving the prices of other industrial exports from Ireland unchanged.

Observation of a few more quarters is needed to resolve this problem. In the meantime there does appear to be sufficient evidence of linkage between the level of UK imports and Irish "other" industrial exports for the former to be taken into account when intuitively projecting the latter. As this category does not usually fluctuate greatly, such an approach should be reasonably satisfactory for forecasting purposes.

#### 4.6 *Manufactured Exports to the Rest of the World*

As was stated previously, ships and planes, quarterly exports of which are determined by delivery schedules of the Verolme yard and the disposal policies of Aer Lingus and the Irish shipping companies rather than by external demand for their products, have been excluded from this category.

Table 4.6 shows the annual amount and the percentage changes in the category, compared with an index of the manufactured imports (S.I.T.C. Sections 5-8) of the eight most important foreign customers for Irish manufactured exports. These are crudely weighted according to the proportion of identifiable manufactured Irish exports that they take.

As the top part of the table shows there is no close correspondence between the annual percentage increases in this index (column 2) and in manufactured exports to countries other than the UK (column 4) beyond the fact that both tend to grow very rapidly. This lack of correspondence is no doubt partly due to the imperfections of the index as a standard of comparison. More important probably is the fact that manufactured exports to the rest of the world are far more narrowly based, with regard to range of products, than are manufactured exports to the UK. Thus on the one hand there is less reason why the narrow range of Irish exports should move in conjunction with the broad spectrum of these countries' manufactured imports. On the other hand the narrow base means that major developments in one or two industries in Ireland can have an overwhelming impact on total exports in this category. This is brought out in columns 5 and 6, which show that over half of the total increase in manufactured exports to the rest of the world since 1963 is due to the development of the chemical and scientific goods industries as major exporters. Even if these items are excluded, as in column 8, the fit with the "world index" in terms of annual percentage changes is not very good.

For prediction purposes the choice for this category therefore appears to lie between simple extrapolation at a high rate of growth, on the assumption that some new products will be introduced each year to maintain this growth, and obtaining direct information on new developments while assuming that the base of old products will move roughly in line with world trade. Some combination of these approaches should provide tolerably useful forecasts.

#### 4.7 *Other Industrial Exports to the Rest of the World*

With mining removed for prediction by inquiry, a small category is left, which however is growing rapidly, having doubled between 1963 and 1967. No study has been made to try to relate this category to any external indicator. In spite of the fact that its growth has not been smooth, 1966 having shown no increase over 1964, the absolute errors involved in applying a simple extrapolation are likely to be small in comparison with total Irish exports, and for the present at least prediction can be left safely to this method.



TABLE 4.6: IRISH MANUFACTURED EXPORTS TO THE REST OF THE WORLD

Manufactured Imports, Rest of World				
Year	Weighted average US, W. Germany, France, Netherlands, Canada, Japan, Italy and Belgium			
	Index 1962=100		% Increase	
	1		2	
1963	111.3		11.3	
1964	128.8		15.8	
1965	147.0		14.1	
1966	174.5		18.7	
1967	190.3		9.0	
Irish Manufactured Exports (excluding ships and planes)				
	£ million		% Increase	
	3		4	
	1963	10.24		
1964	12.55		22.6	
1965	17.85		42.2	
1966	21.43		20.1	
1967	25.92		20.9	
Irish Manufactured Exports				
	Chemicals	Scientific Goods	Other	
	£ million	£ million	£ million	% increase
	5	6	7	8
	1963	.61	.18	9.43
1964	.96	.06	11.54	22.3
1965	3.54	.46	13.85	20.1
1966	4.96	.98	15.49	11.8
1967	6.32	2.82	16.78	8.3

#### 4.8 Summary

The disaggregation of Industrial exports carried out in this study, and the examination of some of the major categories isolated, should help both in the understanding of the pattern of export growth and in the short-term prediction of future exports.

With regard to structure the most interesting findings appear to be those set out below.

(i) Manufactured (S.I.T.C. Sections 5-8) exports to the UK accounted for 45% of total industrial exports in 1967 and for £22.6 million of the total increase of £60.1 million between 1963 and 1967. They are highly dependent on the behaviour of total UK imports of manufactured goods. It seems probable that the Free Trade Agreement led to a slight increase in these exports, over and above what would have been expected from the behaviour of other factors. In general however all other influences are marginal in the short run compared with that of the level of UK imports.

(ii) Other industrial exports to the UK are the most slowly growing category of industrial exports, accounting for only £7.2 million of the total £60.1 million increase over the period. These also appear to be related, although less closely, to the level of total UK imports. On this category the Free Trade Agreement appears to have had a marked favourable effect, perhaps of the order of £2½ million per year.

(iii) Industrial Exports to the rest of the world grew more rapidly than those to the UK during the period, accounting for £22.9 (38%) of the total increase. £12.8 million, or over half, of this increase came from three important new items, metal ores, chemicals and scientific goods, all of which were negligible or non-existent in 1963. Even excluding these items (as well as the rather peculiar ships and planes item), industrial exports to the rest of the world increased faster than those to the UK between 1963 and 1967, the respective increases being 85% and 64%.

This faster increase may reflect the slightly greater rise in world than in UK imports over the period, but is more likely to be due to the composition of the export mix, with modern products with a high rate of growth having a greater weight in exports to the rest of the world than to the UK.

So far as prediction is concerned the position reached can be summarised as follows:

(i) The largest category, Manufactured Exports to UK at £52 million in 1967, appears amenable to statistical forecasting methods. Given the time, the present equations can be improved on, but even as they stand they provide a moderately useful guide, so long as reliance can be placed on the N.I.E.S.R. predictions of UK imports.

(ii) Three important items, petroleum products to UK, ships and planes and metal ores to the rest of the world, totalling £9 million in 1967, can be approached by means of direct inquiry to the relevant sources.

(iii) Other Industrial Exports to UK (£19.5 million) can be related to total UK imports. The relationship is rather crude at present but can no doubt be refined. In any case this category does not fluctuate very much, apart from the stimulus it appears to have gained from the Free Trade Agreement.

(iv) Manufactured Exports to the rest of the world (£26 million) can at present be approached in two ways. One is by means of more or less naive extrapolation, the other by means of direct enquiry for its most dynamic components and statistical relationship (admittedly slightly shaky) for the remainder. Use of both methods is probably advisable.

(v) Other Industrial Exports to the rest of the world (£8.2 million) can at present only be approached through naive extrapolation, unless of course relevant direct information becomes available. Given the size of this category it probably does not much matter if mistaken predictions are made.

In all, it is hoped that this disaggregated approach, with statistical methods being used when possible and appropriate, will lead to more accurate prediction for industrial exports than would be possible taking the category as an integral whole. Further work should clearly improve some parts of the prediction process, and this will be carried out as time permits. Similarly the apparent initial success of the disaggregation approach or quarterly data in this field suggests that its use should be extended to other areas, such as the other categories of exports, imports and industrial production. This also will be attempted as time permits.