A Study of Consumer Prices, Part 2

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SECTION 4. A STUDY OF CONSUMER PRICES. PART 2

Note. *Part 1 of this Study (Quarterly Economic Commentary, Section 4, March 1971) described movements in the consumer price index since 1958, and suggested adjustments to the published series to render them more suitable for use in regression analysis. One part of the discussion concerned the effects of the change in the base of the index from 1953 to 1968. In fact, this part of the discussion was based on an error in the interpretation of the weighting system used in the indices. Accordingly, §4.3 and §4.6 of Part One of the Study should be ignored, as should Tables 3 and 6, Charts 2 and 3, and items 3 and 4 of the conclusions.*

The error in no way affects the main discussion of indirect tax influences contained in §4.5 of Part 1, and Part 2 is aimed at analysing short-term movements in the "net of tax" index set out in Table 4 of Part 1.

§4.1 *Introduction*

The purpose of this Part of the Study of Consumer Prices is to provide analysis of short-term movements in the consumer price index, with a view to obtaining one or more models of use in short-term forecasting. The actual selection of equations for use as forecasting tools must await further testing. This requires a rather longer period than is yet available since the last of the observations from which the regressions are calculated. Such prediction testing, as well as tests of the stability over time of the coefficients of selected equations, will be the subject of Part 3 of this Study in a future issue of the Quarterly Economic Commentary.

As was discussed in Part 1, changes in rates of indirect taxes have a major effect on quarter to quarter changes in the index. As these tax changes are not very amenable to regression analysis, even if fundamentally the tax changes may be caused by the same cost factors as changes in other prices, the problem has been tackled by eliminating from the index as far as possible the impact of changes in indirect tax rates since 1958. Thus, throughout this Part of the Study, references to the consumer price index in fact refer to the "net of tax" indices set out in Table 4 of Part 1. In a forecasting situation, of course, anticipated changes in rates of indirect taxation would have to be added to any predicted change in the "net of tax" index, to arrive at a forecast for the published consumer price index as a whole.

§4.2 *The Form of The Models*

As with other studies which have appeared in the Quarterly Economic Commentary, all the equations shown in the Tables have been estimated using single-equation least squares (OLS). However, this method has been adopted with more than usual trepidation, given the high degree of interaction between consumer prices and other macro-economic variables. When analysing exports or imports, it is reasonable to assume that there is little feedback from the dependent variables to the independent. But this is a far more restrictive assumption in the present case, given that consumer prices have an important influence on the timing and size of wage increases, as well as being affected by them in turn.

On a priori grounds therefore, we can presume that some bias will be introduced into our equations if we study consumer prices in isolation, and ignore the complex of interrelationships in which they are imbedded. Whether this bias is quantitatively significant could only be ascertained by specifying a simultaneous equations model. The only evidence we have on this point comes from O'Herlihy, [1] who found that taking account of simultaneous influences made a considerable difference to the coefficients of his price equation. Even this is not directly relevant, since O'Herlihy was using annual data, and the fact that they were jointly determined need not imply that the same must hold of quarterly data.

The quesion of the suitability or otherwise of single-equation regression techniques remains an open one, therefore; we make exclusive use of them in the remainder of this paper more because of their simplicity, and because of our orientation towards forecasting as opposed to studying structural relations, rather than from any conviction that they are superior to alternative techniques. Since our analysis uses quarterly data throughout, we are therefore making the not unreasonable assumption that any influence of prices on earnings occurs with at least a three month lag. The resultant absence of simultaneous interdependence makes ordinary least squares applicable. Thus the equations which follow may be looked on either as independent relations, or as one of a number of reduced form equations derived from a recursive simultaneous model.

§4.3 *Absolute Values, Regression Analysis*

Having decided on the single equation OLS form, it remains to be decided whether to work in absolute values or first differences. Absolute values are still quite widely used in short-term econometric model building. However, the example of "A Study of Imports" (Q.E.C. 1969-1970 passim) suggests strongly that they are inappropriate to this type of short-term time series analysis. Therefore, only a brief examination of absolute values is made here, to see whether the problems which arose in the "Study of Imports" are repeated.

Detailed discussion of the variables which may influence consumer prices is contained in §4.4. For the analysis of absolute values only the most obvious "explanatory" variable, the index of average weekly earnings in manufacturing industry, has been tested. A time trend, the lagged value of the dependent variable and seasonal dummies complete the set of variables.

Some results of this regression analysis are shown in Table 4.1. By some standard statistical criteria (adjusted R^2 and F-value), these equations appear highly satisfactory. However, closer inspection reveals that this appearance is illusory. Each equation "explains" the dependent variable so well that it barely matters which independent variable or combination of variables is used.

The problem is brought home by the first equation shown, the simple regression of the dependent variable on time. With an adjusted R^2 of .945, it implies that 95% of the variation in the consumer price index can be explained by an hypothesis of constant linear growth over time. A log-linear relationship (implying constant proportional growth) provides an even closer fit viz.:

$$\text{Log } P_c = 2.041 + .004t \quad \bar{R}^2 = .964^{1}$$

The extremely low values of DW in both equations, indicating very strong positive residual autocorrelation, suggest that there have been lengthy sub-periods when prices were rising faster or slower than the general price trend over the period as a whole.

[1] Following Pratschke [2], this may be adjusted to make it comparable with the R squared from the linear regression (equation A_1), yielding a value of .963.

TABLE 4.1: CONSUMER PRICE INDEX, ALL ITEMS, NET OF TAX, ABSOLUTE VALUES

A. *Variables*

Dependent Y = consumer price index, all items, net of tax. 1958 IV–1970 IV.
Independent X1 = average weekly earnings in manufacturing industry. 1958 IV–1970 IV.
X2 = time
X3 = Y_{t-1}
X4,5,6 = seasonal dummies.

B. *Significance and Fit*

Equation No.	Variables Significant at			Not Significant at 25%	$\bar{R}^2$	F	S.E.E.	DW
	1%	5%	25%					
A1	2				.945	818	3.94	0.12
A2	1				.988	4,064	1.86	0.72
A3	1	4,5		6	.989	1,101	1.74	0.53
A4	3				.995	9,717	1.17	1.79
A5	1,3				.996	6,786	1.02	1.87
A6	1,3,4,5			6	.998	3,935	0.83	1.89

Notes. $\bar{R}^2$ is the multiple correlation coefficient adjusted for loss of degrees of freedom. The standard error of estimate (S.E.E.) should be evaluated by comparison with the standard deviation of Y; 16.73. DW is the Durbin-Watson statistic.

C. *Regression Coefficients*

Equation No.	X1	X2	X3	X4	X5	X6	Intercept
A1		1.139					107.56
A2	.301						77.43
A3	.304			1.796	1.463	.489	75.82
A4			1.046				−5.05
A5	.081		.767				16.86
A6	.091		.737	1.180	1.141	−.123	18.30

While these two equations may seem of little practical use, they do provide a standard for judging other methods. There is little point in expending the much greater work required to develop a more sophisticated model, if it fails to show improvement over such simple extrapolative methods. Turning, therefore, to equations with more substantive economic content, it can be seen from the table that some improvement is in fact made. The dependent variable is explained extremely well by industrial earnings; either alone (equation A2) or with seasonal dummies (A3).

However, both these equations have major limitations. The first of these is the size of the standard error of estimate. Though small in relation to the total variation of the index over the period, it is very large relative to the average points change from quarter to quarter (i.e. 1.186). The forecasting power of these equations is therefore extremely limited. A second major defect is the high level of positive autocorrelation, as shown by the Durbin-Watson statistic.

The last three equations in Table 4.1 are included in order to illustrate a technique frequently employed in econometrics, when the independent variables are assumed to influence the dependent with a lag which is spread, or "distributed", over time. By a simple Koyck transformation this influence of all past values of the explanatory variables is subsumed under a single lagged value of the dependent variable, thus making the regression much more manageable.

The disadvantages of this procedure are not always appreciated, however. First, unless the values of all those variables which influence the dependent variable are included, the coefficient of the lagged dependent variable will be biased upwards. This is almost certainly the case with equations A5 and A6, where the coefficient of Y_{t-1} is quite unreasonably high. By substituting the estimated coefficients of equation A6 into the standard Koyck formula, it can be shown that the repercussions of a change in the independent variables only become negligible after 30 time periods, implying a lag in adjustment of over 7 years!

A second major defect of the distributed lags method is that, if successive observations of the dependent variable are highly correlated, the remaining independent variables may appear to add little or nothing to the fit of the equation, and to have a very small effect on the value of the dependent variable. This is obviously the case with equations A5 and A6. These equations are not appreciably more satisfactory than A4, the simple regression of the consumer price index on its own lagged value, which, as it stands, has no economic justification whatsoever. In other words, if we are interested solely in prediction, a first-order autoregressive structure is as good a method as any of those so far considered. But this tells us nothing about the economic determinants of the consumer price index, and is only useful for forecasting in the sense of mechanically extrapolating a time series.[2]

Finally, all the variables are growing together over time, making it virtually impossible to distinguish between the contributions to the fit provided by the different independent variables. This may be seen from the matrix of correlation coefficients between the variables included in equation A5.

	Y	X1	X3
Y	1.000		
X1	.995	1.000	
X3	.998	.998	1.000

Needless to say, all these values are highly significant.[3] While multicollinearity is not necessarily a problem if our sole concern is with prediction, it is hardly justifiable to make no attempt whatsoever to investigate structural relations.

This discussion suggests that there is little point in using regressions on absolute values of the variables to study movements in consumer prices. In the remainder of this article, therefore, all variables are cast in the form of percentage first differences, which provides a much more stringent test of the underlying economic relations.

§4.4 *The Independent Variables*

In any analysis of this nature, there are two stages in the problem of selecting independent variables. In the first place the factors which seem theoretically likely to influence the behaviour of the dependent variable must be determined. In the second place, suitable numerical series representing these factors must be either discovered or constructed.

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[2] A third defect of the distributed lags method which is worth mentioning, is that the apparent absence of autocorrelation in equations A4 to A6 is illusory. It can be shown that, when lagged values of the dependent variables are included, the Durbin-Watson statistic is biased towards 2 (its value when the residuals are serially independent). Consequently, it cannot be relied upon to detect the presence of serial correlation.

[3] In technical terms, the determinant of the X'X matrix is .00021: if no multicollinearity were present, this determinant would equal unity. For a discussion of this and other measures of multicollinearity, see Farrar and Glauber [3].

Were the object of the exercise to attempt prediction of the value of the dependent variable for a single quarter on the basis of actual values of the explanatory variables, a further condition would be necessary. The actual values of the explanatory variables, allowing for any lags discovered in the relationships, would have to be available earlier than the actual value of the dependent variable. In the case of the consumer price index, which is published very soon after the date to which it refers, this condition would be unlikely to be met. However, the forecasting use to which it is hoped to put the results of the exercise is to forecast the value of the consumer price index for up to a year or eighteen months ahead, on the basis of projections of the independent variables. In this case the necessary condition for the explanatory variables is that they should be more amenable to direct forecasting than the consumer price index itself.

The most obvious factor influencing movements in the consumer price index is the general level of earnings. Not only are wages and salaries an important element of cost, but also increases in earnings provide a degree of buoyancy in money demand, thus enabling higher prices to be charged without necessarily reducing the volume of sales. As discussed briefly in §4.2, the interrelationship between earnings and prices is complex, with movements in each influencing movements in the other. For the purpose of this study, we have made the simplifying assumption that current prices do not affect earnings within a three month period. Thus we can regard the change in earnings in any quarter as exogenous to our system, even if the change is in part determined by earlier changes in the consumer price index. In other words we are postulating an iterative process of adjustment between prices and wages, with a lag of at least 3 months on the price-wage leg, rather than a simultaneous relationship.

When it comes to specifying actual series to represent earnings, we are in some difficulty. The most relevant series would be an index of earnings of all employees throughout the economy, or at least in all commercial non-agricultural sectors. In the absence of such series on a quarterly basis, we must fall back on the available series for industrial earnings. The series actually chosen is the index for average weekly earnings of all industrial workers in manufacturing industry. The assumptions implicit in using this index to represent all employee remuneration are that there is little divergence between changes in earnings in manufacturing industry and those in the rest of the economy with regard to size or timing, or alternatively that any such divergences are constant.

One further complication in the use of this series as a variable in the regression analysis is that the figures for each quarter relate to a week in the middle of the last month of each quarter. The consumer price index on the other hand relates to a day in the middle of the central month of the quarter. Thus to use current terms for each index would imply the assumption that any rise in earnings between the end of one quarter and the end of the next would accurately reflect either the rise between the middles of the quarters, or between the average earnings over each quarter as a whole. In fact the problem is best overcome by normally using the earnings variable in lagged form, especially as on theoretical grounds a lag would be expected between increases in earnings and any consequential increase in prices. It should be borne in mind however that in the circumstances a lag of "one quarter" in fact represents a lag of only about 8 weeks, and of "two quarters" an actual lag of about 21 weeks.

The impact that a given increase in earnings can be expected to have on prices, on the assumption of "cost-plus" pricing policies, is influenced by changes in labour productivity. Clearly an improvement in output per head can go some way to offset any increase in average earnings.

The series chosen to represent labour productivity is output per head in manufacturing industry. As it is average weekly earnings in manufacturing industry which has been chosen as an index of earnings, this seems to be an appropriate matching index of productivity. Unfortunately, the assumption that manufacturing industry can be used as a reasonable proxy for the economy as a whole is less tenable for productivity than for earnings, but in the absence of alternatives it has to be made. Some experiments have been made in fusing the two series together into a series of average labour cost per unit of output, by either dividing the earnings index by the productivity index, or by subtracting changes in the productivity index from those in earnings. By and large, however, better results are obtained by treating the two indices as separate variables, with earnings exerting a positive, and productivity a negative, influence on the level of consumer prices.

One reason why treating the two series separately works better could be that changes in earnings are generally known immediately by management and are thus liable to be passed on quite rapidly. Changes in productivity on the other hand are generally not known until after the event, and in any one quarter may be due to temporary, reversible, factors. Probably it is a cumulative trend in productivity, rather than simple quarter-to-quarter changes, which can be expected to influence pricing decisions. In recognition of this, the productivity index is used throughout on a smoothed, or moving-average basis. In some formulations a three quarter moving average of the actual values of the index is used; in others a five quarter moving average of the index after correction for seasonality. In general the latter gives better results.

The next obvious influence on the consumer price index is the level of wholesale prices. It has been decided that little would be gained from attempting to establish relationships between consumer prices and wholesale prices in general. The underlying factors of earnings, productivity etc. should determine both, and any short-run relationship between them would be of superficial interest.[4] Thus domestic wholesale prices are regarded as merely an intermediate step in the process of determining consumer prices and accordingly are ignored.

However, the elimination of intermediate prices from consideration does not mean that all price indices are irrelevant. Import prices, the level of which is determined by factors separate and distinct from those which govern domestic price levels, clearly should have their own impact on the consumer price index. Agricultural prices also are governed by different forces from other domestic prices and therefore justify their inclusion as a potential explanatory variable.

With regard to import prices, there appear to be two ways in which they may affect the consumer price index. Prices of imported consumer goods ready for use could be expected to have a direct effect on the consumer price index. Prices of other imports, such as basic materials or goods for further production could be expected to influence Irish costs of production, and thus, ultimately, prices. Even imports of capital goods should eventually be expected to work through to the general price level.

Unfortunately, it is not easy to break down import prices into the two categories of consumer goods and others. Although a wholesale price index for imported consumer goods does exist (and has accordingly been taken as one variable), weighting problems render the construction of a composite wholesale price index for other imports a complicated task. Rather than delay the entire exercise by undertaking such a task, it has been decided simply to use the import price (unit value) index for all items instead. The simplicity of this procedure seems sufficient to outweigh its two principal disadvantages: firstly that its inclusion of consumer goods (with a weight of about 22%) means that the two indices cannot justifiably be used together in the

[4] For a full discussion of the longer-term relationship, and of the inferences which can be drawn from it, see Geary and Pratschke [4].

same equations as representing separate factors influencing the consumer price index in different ways; and secondly that the unit value index of import prices does not indicate changes in tariff rates which, theoretically at least, should influence the final price level.

In fact, as will be seen, neither index works particularly well in spite of attempts at further refinement. In the light of failure of previous econometric work in Ireland to establish realistic and significant relationships between import price indices and other variables to which theoretically import prices must be related, it must be doubted whether any experimentation based on existing indices of import prices is likely to produce acceptable results.

Agricultural prices are represented in most cases by the agricultural price index, and a few cases by the more volatile index for livestock alone. The two are obviously highly correlated, and should be used as alternatives to each other. In a few cases, however, they are used together in an attempt to see whether livestock prices, which by and large are determined outside the Irish economic system, have a different effect from other agricultural prices, most of which are determined within the system.

The next potential factor to be considered is the level of interest rates. This is not commonly included in empirical work on price levels. On a theoretical plane, high interest rates are regarded as likely to depress, or at least restrain, prices, through acting to reduce the general level of economic activity, thus encouraging price cutting in the short-term and moderating the rise in incomes in the longer term. Indeed, raising interest rates is, of course, a frequently used anti-inflationary device in practical demand management. It is not expected that any long-term depressive effect of high interest rates on the consumer price index would show up in the type of regression analysis being undertaken in this study. However, it is felt that short-term effects would show up, but that these are unlikely to be depressive. It is frequently overlooked that interest charges are an important cost of production in many industries and services. If it be true that a large proportion of pricing decisions are taken on a cost-plus basis, then high interest rates could be expected to lead to increased prices in the short run. This seems a more plausible assumption than that high interest rates would lead to a significant volume of price cutting in an attempt to clear stocks of products which have become expensive to hold.

In Ireland it is fair to assume that interest rates, as distinct from other aspects of credit policy, are primarily determined externally. Thus problems of simultaneity do not arise, and interest rates can legitimately be used in a single equation model.

The series chosen to represent the interest rate factor as a variable in the regression analysis is the ordinary overdraft rate of the Associated Banks. This seems the most appropriate single rate of interest affecting business decisions. Because it is felt that the general level of the interest rate is more important than small changes in it, this variable is treated in absolute terms, rather than in terms of percentage changes. As should be clear from the preceding discussion, there is some uncertainty as to whether this variable should be expected to have a positive or a negative coefficient. The authors feel that a positive coefficient—implying that in the short run businessmen tend to pass on high interest rates in increased prices—is the more likely.

With the exception of the earnings variable, which, as discussed, has a dual cost and demand aspect, all the factors discussed so far have been related to a cost-plus theory of pricing. However, while according this theory of price determination a dominant role, the authors would not wish to deny that market demand considerations do also have some influence on pricing behaviour. In particular, it is felt that conditions where demand tends to outstrip capacity are indeed conducive to a rapid rise in prices, over and above any which takes place through the mechanism of higher earnings. In an attempt to take this factor into account, some equations include as a potential explanatory variable the dummy form of the indusrial capacity utilisation index, as used in "A Study of Imports, Part 4" (Q.E.C. March 1970). This is constructed by considering the level of industrial output in any quarter in relation to the long term trend of industrial output. Where the value for a quarter is high in relation to the trend a value of 1 is ascribed to that quarter, where it is near the trend a value of 0 is given, and where it is low in relation to the trend a value of —1 is given.

Thus the factors to be considered in the regression analysis are changes in earnings, productivity, import and agricultural prices, and levels of interest rates and capacity utilisation. The series chosen as variables to represent these factors are in most cases far from ideal, but they appear to be the best readily available, and should suffice to demonstrate the effect of the various factors on the consumer price index. As will be seen in the analysis, the variables are tested with differing time-lags, on the assumption that changes in costs or market conditions may take some time to work through to the consumer price index but that the length of this lag cannot be specified in advance on a priori grounds.

The regressions are run in terms of both simple percentage changes from quarter to quarter and in terms of percentage changes in the three quarter moving averages of the variables. This latter technique is designed to minimise the effect of any purely random movements in one or more of the variables and to bring out the underlying relationships which might be obscured by such random movements.

With the exception of one formulation of the productivity variable, the series have not been seasonally corrected. Apart from some items in the food group, the "net of tax" consumer price index does not exhibit any significant degree of purely seasonal variation. In these circumstances it has been thought preferable, as well as computationally simpler, to use seasonal dummy variables in the regressions, instead of seasonally correcting all the series.

§4.5 *Regression Analysis, Percentage Changes*

Table 4.2 sets out the results of the regression analysis in terms of simple percentage changes from quarter-to-quarter. Many more equations have been calculated than are reported in the table, mainly to test differing lag structures for the variables, and to test alternative formulations of some of the variables. The results shown in the table embody those formulations and lags of each variable which appear to perform most satisfactorily in terms of significance and consistency of regression coefficients and improvement in the fit of equations. Because of the importance of X1, it is shown lagged both one and two periods, although the second lag does not yield very good results.

The most striking feature of the table is the consistently good performance of $X1_{-1}$, that is, average industrial earnings lagged by approximately 8 weeks as compared to the consumer price index. Not only is it significant at the 1% level in all equations, but also its regression coefficient is reasonably stable between the equations. When used on its own (with the seasonal dummies) in equation B1 it produces a result with a significant F-value and an adjusted R^2 of .445. In first difference analysis this is quite a reasonable result. Rather surprisingly $X1_{-2}$ the double-lagged form of the earnings index, implying a lag of about 21 weeks, performs very badly. On its own (with the dummies) it produces a barely significant equation (B.12), while in combination with other variables in equations B2 and B11 its coefficient is significant only at the 25% level and it does little to improve the fit of the equations. Longer lags had even less effectiveness. It thus appears as if the effect of changes in industrial earnings on the consumer price index is both significant and rapid. Such a finding is in agreement with common-sense expectations. Moreover the size of the coefficient,

TABLE 4.2: CONSUMER PRICE INDEX, ALL ITEMS, NET OF TAX SIMPLE PERCENTAGE CHANGES

A. *Variables*

Dependent	Y	= consumer price index, all items, net of tax.
Independent	X1	= average weekly earnings in manufacturing industry.
	X2	= output per head in manufacturing industry (five quarter moving average of seasonally corrected data).
	X3	= wholesale price index, imports for personal consumption.
	X4	= unit value index, all imports.
	X5	= agricultural price index.
	X6	= ordinary overdraft rate of associated banks.
	X7,8,9	= seasonal dummy variables.

Notes. The period of observation for Y is from 4th quarter 1958 to 4th quarter 1970.
All variables except X6,7,8,9, are expressed in %. 1st differences.
The subscript $_{-1}$ after a variable denotes a lag of one quarter, $_{-2}$ two quarters. The seasonal dummies are included in all equations, but for ease of presentation their significance and coefficients are omitted.

B. *Significance and Fit*

Equation No.	Variables Significant at 1%	5%	10%	25%	Not Significant at 25%	$\bar{R}^2$	F	S.E.E.	DW
B1	1_{-1}					.445	10.61	.723	1.75
B2	1_{-1}			1_{-2}		.459	9.16	.713	1.74
B3	1_{-1}				2_{-1}	.436	8.41	.729	1.75
B4	1_{-1}		3_{-1}			.475	9.68	.703	1.82
B5	1_{-1},4					.555	12.95	.647	1.67
B6	1_{-1},5_{-1}					.543	12.40	.656	2.20
B7	1_{-1}	5_{-1}			2_{-1}	.535	10.22	.661	2.18
B8	1_{-1},5_{-1}	6_{-1}				.593	12.63	.619	2.39
B9	1_{-1},4,5_{-1}					.610	13.54	.605	1.95
B10	1_{-1},5_{-1}	4	6_{-1}			.629	11.41	.587	2.17
B11	1_{-1},5_{-1}		3_{-1}	1_{-2}, 6_{-1}	2_{-1}	.614	9.48	.603	2.36
B12		1_{-2}				.228	4.54	.852	1.56

Notes. See Table 4.1, Section B.
The standard deviation of Y is 0.970.

C. *Regression Coefficients*

Equation No.	$X1_{-1}$	$X1_{-2}$	$X2_{-1}$	$X3_{-1}$	X4	$X5_{-1}$	$X6_{-1}$	Intercept
B1	.310							−.105
B2	.281	.101						−.383
B3	.313		.106					−.213
B4	.301			.183				−.257
B5	.312				.226			−.203
B6	.260					.171		.524
B7	.262		.098			.170		.422
B8	.216					.159	.199	−.841
B9	.272				.184	.135		.311
B10	.239				.148	.134	.141	−.615
B11	.201	.072	.090	.167		.167	.141	−.846
B12		.194						−.091

D. *Selected Equations*

B5 $Y_c = -0.203 + .312X1_{-1} + .226X4 + .412X7 + 1.504X8 - .725X9$

B10 $Y_c = -0.615 + .239X1_{-1} + .148X4 + .134X5_{-1} + .141X6_{-1} - .257X7 + .517X8 - 1.070X9$

at around 0.3 in most equations implies that a 10 per cent increase in earnings, if all other factors remained constant, would lead to an increase of about 3 per cent in the consumer price index. This result is not far from what would be expected in the light of previous work.

None of the other variables behaves quite as well as $X1_{-1}$. The performance of the productivity variable, X2, is particularly disappointing. This variable has been tested in various formulations. Treated as a separate variable, it has been tried as a simple percentage change, as a three quarter moving average of the raw data, and as a five quarter moving average of seasonally corrected data, as shown in the table. It has also been combined with X1 to form a series of unit labour cost. Needless to say, different lags have been tried with each formulation. The form shown in Table 4.2, poor as its results are, gives slightly better results than its alternatives in terms of the fit of the equations which include it. However, its coefficient fails to achieve any degree of significance in any equation, it worsens the fit of those equations which include it (e.g. compare B6 with B7), and, worst of all, its coefficients consistently have the wrong sign, being positive where a negative relation must be expected. Thus, in this particular section of the analysis, there is no option but to disregard productivity as an explanatory variable.

Turning to the price variables, the results are rather more satisfactory. The least successful of the price variables is X3, the wholesale price index for imports of consumer goods. Although barely significant in the equations in which it appears, at least the coefficient of $X3_{-1}$ has the expected positive sign, and the addition of the variable to an equation does marginally improve the fit, as can be seen from a comparison of B1 and B4. Experiments with a more sophisticated form of the index, weighted by the share of imported consumer goods in total consumption, failed to improve the results.

Much more successful is X4, the unit value index for all imports. This has the expected sign, considerably improves the fit of the equations in which it appears, and is itself significant at at least the 5% level. However it is worrying that it is the current term of this index, rather than any of its lagged terms, which performs so well. A priori, one would expect some time to elapse before the effect of an increase in import prices of raw materials or semi-manufactures worked through to the consumer price index. Thus this result must be treated with some caution unless confirmed by further analysis.

The results for X5, the agricultural price index, seem much more straightforward. One would expect a positive, significant relationship between agricultural and consumer prices, with a fairly short time lag. This is precisely the result obtained, with $X5_{-1}$ being significant at the 1% level in most equations, and considerably improving the fit. As in the case of earnings, the size of the coefficient (at about .15) is towards the lower end of the range that might be expected on common-sense grounds.

The behaviour of the final variable tested is interesting. X6 represents the level of the interest rate on overdrafts, and as explained in §4.4, it is possible to argue on theoretical grounds that its coefficient could be either positive or negative. In fact, in all the equations in which it is included, not only those reported in Table 4.2, its coefficient is consistently positive. However, in this set of equations it is not consistently significant. Although it does tend to improve the fit of any equation which includes it (compare B6 and B8), and can be included legitimately in a forecasting model, the evidence is thus not sufficiently conclusive to reach an opinion yet as to the structural relationship between interest rates and consumer prices.

Viewing Table 4.2 as a source of possible forecasting equations, the results can be regarded as encouraging. The best adjusted R^2 (equation B10) of .629 is reasonably good for an equation in first difference terms with 7 independent variables (including the dummies). Also, the build-up towards this "best" equation, as extra variables are added, is logical, suggesting that the best result is not a mere accident. For most of the equations there do not appear to be any serious problems of autocorrelation, and the standard errors of estimate, while quite high in relation to the standard deviation of the dependent variable, are by no means unreasonably so for a first-difference analysis.

The behaviour of the seasonal dummies, not shown in the table, is acceptable, with the coefficients quite small and fairly stable. Thus it seems justifiable to select two equations from the table for further testing as to their suitability as forecasting tools. Those selected are B10, because it has the highest $\bar{R}^2$ and the lowest S.E.E., and B5, as the best of the equations containing only two explanatory variables.

Nevertheless, the results as a whole do leave considerable room for improvement, both in obtaining potential forecasting tools and in establishing relationships between individual variables and the consumer price index. In an attempt to effect some such improvement, we turn now to an analysis of the moving averages of the variables.

§4.6 *Regression Analysis, Moving Averages*

The purpose of taking moving averages of series is to reduce the effect of purely random changes in one or more of them, which might be obscuring underlying relationships between them. In this part of the exercise, the analysis is in terms of percentage changes between three quarter centred moving averages of each variable. The results are set out in Table 4.3.

As in the case of Table 4.2, the variable $X1_{-1}$ is consistently significant at the 1% level. In this case its coefficient is rather less stable, varying from 0.15 to almost 0.4 according to which other variables, if any, are also included in the equation. However, in most equations the value of the coefficient is not dissimilar to those obtained in Table 4.2, and is reasonably in line with priori expectations. As in the previous analysis, $X1_{-2}$ has little significance, implying again that the effect of increased earnings on consumer prices is a rapid one, with a lag of only about eight weeks.

The smoothing of the variables has a marked effect on the performance of the productivity variables. In either three or five quarter moving average terms (X2 or X3) the productivity variable (lagged by eight weeks) is consistently significant at at least the 5% level, and in all cases has the expected negative sign. Moreover, the negative coefficients are very stable at about —0.2 for $X3_{-1}$ and —0.1 for $X2_{-1}$ Of the two formulations, the five quarter average (X3) performs slightly the better, as can be seen from a comparison of equations C2 and C6. It is, however, necessary to include X2 in the presentation because some of the combinations with other variables illustrated in the later equations of Table 4.3 are not available for X3.

Unfortunately the smoothing of the variables, which has such a beneficial effect for the productivity variables has the opposite effect on the import price variables. The wholesale price index for consumer imports has been tested but in no case achieved significance or added to the fit of any equation. It has accordingly been left out of the analysis presented in Table 4.3. The unit value index for all imports is presented, but as can be seen its performance is poor. It is felt better to include it, as structurally there should be an import price variable in the analysis, and in some cases its presence does contribute a little to the fit of the equations. It is interesting that in this analysis of the smoothed variables the import price index performs best when lagged by two quarters. This is inherently a more plausible result than the current relationship observed in Table 4.2, despite the much greater statistical

TABLE 4.3: CONSUMER PRICE INDEX, ALL ITEMS, NET OF TAX. PERCENTAGE CHANGES OF THREE QUARTER MOVING AVERAGES

A. *Variables*

Dependent Y = consumer price index, all items, net of tax.
Independent X1 = average weekly earnings in manufacturing industry.
X2 = output per head in manufacturing industry.
X3 = output per head (five quarter moving average, seasonally corrected).
X4 = unit value index, all imports.
X5 = agricultural price index.
X6 = ordinary overdraft rate of associated banks.
X7 = capacity utilisation dummy variable.
X8,9,10 = seasonal dummy variables.

Notes. The period of observation for Y is from 4th quarter 1958 to 3rd quarter 1970. Variables Y, X1, X2, X4, X5 are expressed as % 1st differences of 3 quarter moving averages, X3 as % 1st difference of 5 quarter moving average, X6 is expressed in absolute terms, and X7,8,9,10 are dummy variables.
The subscript $_{-1}$ after a variable denotes a lag of one quarter, $_{-2}$ two quarters.
The seasonal dummies are included in all equations, but for ease of presentation their significance and coefficients are omitted.

B. *Significance and Fit*

Equation No.	Variables Significant at				Not Significant at 25%	$\bar{R}^2$	F	S.E.E.	DW
	1%	5%	10%	25%					
C1	1_{-1}					.446	10.4	.482	0.54
C2	$1_{-1},3_{-1},5_{-1}$					.781	28.9	.303	1.21
C3	$1_{-1},3_{-1},5_{-1},6_{-1}$					.826	32.9	.270	1.45
C4	$1_{-1},3_{-1},5_{-1},6_{-1}$	7_{-1}			4_{-2}	.848	30.2	.252	1.54
C5	$1_{-1},3_{-1},5,6_{-1}$	$5_{-1},7_{-1}$			$1_{-2},4_{-2}$	.876	31.1	.228	1.44
C6	$1_{-1},5_{-1}$	2_{-1}				.731	22.3	.336	1.27
C7	$1_{-1},6_{-1}$	$2_{-1},5,5_{-1}$		1_{-2}		.808	22.9	.284	1.36
C8	$1_{-1},2_{-1},4_{-2}$	5	5_{-1}	1_{-2}		.807	22.8	.285	1.18
C9	$1_{-1},2_{-1}$	$5,5_{-1}$	$4_{-2},6_{-1}$	1_{-2}		.820	22.5	.275	1.32
C10	$1_{-1},5,6_{-1}$	$2_{-1},5_{-1},7_{-1}$			$1_{-2},4_{-2}$	.840	23.5	.259	1.58

Notes. See Table 4.1, Section B.
The standard deviation of Y is 0.648.

C. *Regression Coefficients*

Equation No.	$X1_{-1}$	$X1_{-2}$	$X2_{-1}$	$X3_{-1}$	$X4_{-2}$	X5	$X5_{-1}$	$X6_{-1}$	$X7_{-1}$	Intercept
C1	.393									−.381
C2	.287			−.224			.258			.097
C3	.234			−.197			.245	.131		−.707
C4	.203			−.198	.039		.237	.142	.111	−.746
C5	.173	.012		−.194	.047	.150	.116	.143	.124	−.842
C6	.289		−.114				.257			.241
C7	.168	.080	−.094			.131	.132	.141		−.741
C8	.160	.090	−.136		.184	.146	.110			.300
C9	.149	.082	−.116		.118	.141	.113	.092		−.335
C10	.149	.045	−.106		.045	.151	.110	.155	.133	−.769

D. *Selected Equations*

$$C3\ Y_c = -0.707 + .234X1_{-1} - .197X3_{-1} + .245X5_{-1} + .131X6_{-1} + .423X8 - .045X9 + .292X10$$

$$C5\ Y_c = -0.842 + .173X1_{-1} + .012X1_{-2} - .194X3_{-1} + .047X4_{-2} + .150X5 + .116X5_{-1} + .143X6_{-1} + .124X7_{-1} + .302X8 + .331X9 + .398X10.$$

significance of that relationship. The present result thus adds to the suspicion that the results obtained for the import price variable (X4) in Table 4.2 may have been fortuitous. Nevertheless it cannot be denied that the failure of any form of import price index to exhibit a consistently significant relationship with the consumer price index in this section of the analysis is disappointing. Import prices obviously do influence consumer prices, and the explanation of the failure of this analysis clearly to demonstrate the link could lie in the field of lag structures varying through time or according to the composition of import price changes. Alternatively it could indicate imperfections in the import price indices themselves.

In contrast to import prices, the agricultural price index maintains its significance in this smoothed form of the analysis. The current term, as well as the single lag, is generally significant at the 5% level or better. The coefficients are reasonable stable if X5 and $X5_{-1}$ are considered together. As was explained in §4.5 a current relation or one with only a short lag would be expected with this variable, while the actual value of the coefficients is in line with expectations.

The interest variable, X6, lagged by one quarter, again has a fairly stable, positive, coefficient. In this case the significance levels achieved by $X6_{-1}$ tend to be rather better than in Table 4.2, and its contribution to fit is considerable, as can be seen from equations C2 and C3.

An additional variable tested in this section of the analysis is a dummy for the extent of capacity utilisation. This variable is significant at the 5% level where it is included, and does help to improve the fit of the equations. Its coefficient is fairly stable, and positive, implying that shortage of industrial capacity does tend to be associated with periods of rapidly rising consumer prices, while surplus capacity is associated with smaller than average price increases.

Taken as a whole, the results shown in Table 4.3 can be regarded as satisfactory. Several of the equations have an adjusted R^2 of well over .8, which is high for an analysis of first differences even in a smoothed form. The overall significance of the equations as measured by the F-value is considerably better than in Table 4.2, and, with the large number of variables (including seasonal dummies) included in most equations, about as high as could reasonably be expected. The standard errors of estimate are also much better than in Table 4.2, even making allowance for the lower standard deviation of the dependent variable. The only serious flaw in the results is the evidence of positive serial autocorrelation of the residuals in all the equations, as demonstrated by the Durbin-Watson statistic in the last column of part B of the table. The Geary tau test also indicates the presence of positive residual autocorrelation.

Despite this, it appears quite justifiable to select two of the better equations, C3 and C5, for further testing in Part 3 of this Study with a view to their adoption as forecasting tools.

§4.7 *Disaggregated Indices*

It might be thought that little is to be gained in terms of greater forecasting ability by estimating still more equations in the light of the reasonably satisfactory results set out in the last section. However, the large number of variables in the best equations suggests that different components of the consumer price index may be affected by different influences. To distinguish between the forces which affect the various components would greatly improve our understanding of the underlying relations involved.

Fortunately, it has not been found necessary to estimate a great many new equations at this point. A study of the matrix of correlation coefficients between a number of independent variables, and some different components of the price index is a guide to many of the relationships. A portion of this matrix is reproduced in Table 4.4, where the correlations between the independent variables and the all items index are also given for comparison.

The table gives ample support for our a priori conjecture that the various components of the all items index are correlated with different independent variables. In interpreting the correlation coefficients shown, it should be kept in mind that they do not provide a stringent test of association, far less permit inferences about causation to be drawn. For example, two variables subject to a common seasonal variation may appear to be correlated by such a test, even if they are not directly related in an economically meaningful way.

TABLE 4.4: CORRELATION COEFFICIENTS

Components of the consumer price index and selected independent variables. Percentage first differences, 1958 IV to 1970 IV

Variables	Components of Consumer Price Index (all net of tax)				
	All Items	Food	All Manufactures	Non Food Manufactures	All Non-Food
A. Independent:					
Industrial Earnings$_{-1}$	.213	−.116	.023	.432**	.593**
Output per Head$_{-1}$ (Smoothed)	−.001	.068	.032	−.096	−.126
Wholesale Price Index (Consumer Imports)	.158	.217	.222	.095	−.009
Unit Value Index:					
(All Imports)	.345*	.310*	.303*	.093	.194
(All Imports)$_{-2}$	.259	.049	.149	.364**	.420**
Agricultural Price Index (Total)	.384**	.426**	.377**	−.074	.066
Agricultural Price Index (Livestock)	.422**	.604**	.537**	−.084	−.136
Overdraft Rate$_{-1}$ (Absolute Value)	.414**	.180	.290*	.426**	.517**
B. Components of CPI:					
All Items	1.000	.855**	.951**	.558**	.579**
Food		1.000	.957**	.119	.077
All Manufactures			1.000	.400**	.328*
Non-Food Manufactures ...				1.000	.886**
All Non-Food					1.000

* Significant at 5% ** Significant at 1%.
Subscripts $_{-1}$, $_{-2}$ denote lags of one or two quarters. Other variables are current.

Despite these reservations, however, the consistency of the results shown seems to justify fairly definite conclusions. The most striking feature of the table is the complete lack of correspondence between the food and total non-food components. Thus of the four independent variables which were significant in the equations in Tables 4.2 and 4.3, two (industrial earnings and the bank overdraft rate), seem to be closely associated with the non-food components, and not at all with the food index. The situation is precisely the opposite in the case of the agricultural price index. The unit value index for all imports completely reverses its position when its value lagged two periods is considered instead of its current value.[5]

[5] When lagged one period only, this index is not significantly related with any of the components of the consumer price index.

Most of these results merely confirm common-sense expectations, though some of them are mildly surprising. The earnings variable and the two agricultural price indices shown are in the former category. Given the low proportion of value added in the food industry (21% in 1968, compared with 34% for all manufacturing industries)[6], and the fact that many items of food are consumed at relatively low levels of fabrication, we would not expect food prices to be greatly affected by industrial earnings. Similarly there is no reason why agricultural prices should have any short-term effect on non-food consumer prices.

The bank overdraft rate is an interesting case, suggesting as it does that bank credit is relatively less important in price formation in agriculture and the food industry than in the non-food manufacturing industries. (It is worth noting in this context that the partial correlation between the bank overdraft rate and the agricultural price index is only .083). This result provides some tentative support for the rationale underlying our use of the money interest rate as an independent variable, in that cost-plus pricing policies demonstrably do not apply to the agricultural sector of the economy.

The behaviour of the unit-value index for all imports is the most unusual aspect of the table: taken at face value it could suggest that import prices of food affect the consumer price index immediately, while import prices of other goods are reflected in the consumer price index after a lag of two quarters. Since the latter category consists more of imports of raw materials and capital goods than of non-food consumer goods, this result in fact supports common-sense expectations. The wholesale price index for consumer imports is not significantly correlated to any of the components of the consumer price index, but the fact that its coefficient of correlation with the food index is higher than that with the non-food, tends to confirm the results obtained for the unit value index.

The dichotomy between movements in the food and total non-food components is clearly brought home in the lower half of the table, which shows that, while both are related to the all items index, their mutual correlation is a mere .077. This indicates that studying the determinants of these two components separately might give better results than the aggregate equations in §4.5 and §4.6. However, the pay-off from still further disaggregation seems more tenuous.

The "all manufactures" and "non-food manufactures" columns of Table 4.4 demonstrate this. The former is simply an aggregation of the five commodity groups, food, drink and tobacco. clothing and footwear, durable household goods and other goods. This is heavily weighted by the food group and, as can be seen, it gives rather similar results to the food group alone and is highly correlated with that group. Similarly, the non-food manufactures index has much the same relationship with the independent variables as has the total non-food index, to which it is closely correlated. These similarities suggest that the only large dichotomy is between food and other items, and that further disaggregation is unlikely to lead to any marked improvement in the fit of equations. Accordingly the remainder of the analysis in this Part of the Study is confined to a separate examination of the food and total non-food indices.

§4.8 *Regression Analysis, Food Index*

As was demonstrated in Table 4.4, food prices are closely related to agricultural prices. Indeed it would be most surprising if this were not so in a country which is largely self-sufficient in food production. Thus agricultural prices provide the main independent variable in this analysis. Both the total agricultural index and that for livestock alone are included. The remaining variable, apart from seasonal dummies,

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[6] "Irish Statistical Bulletin", December 1970, p. 286.

is the unit value index for imports of food, drink and tobacco. The analysis is in terms of simple percentage first differences, and all variables have been tested both in current terms and with a lag of one and two quarters. The results are set out in Table 4.5.

At first sight the results appear reasonably good in terms of the fit of the equations and the absence of residual autocorrelation. However, closer inspection reveals that this appearance is misleading. As part C of the table shows, the regression coefficients of X1 and X2 are highly unstable, with X2 exhibiting the "wrong" negative sign if used in conjunction with X1. Moreover the behaviour of the dummy variables, which

TABLE 4.5: CONSUMER PRICE INDEX, FOOD, NET OF TAX. SIMPLE PERCENTAGE CHANGES.

A. *Variables*

Dependent Y = consumer price index, food items, net of tax.
Independent X1 = agricultural price index, all items.
X2 = agricultural price index, livestock.
X3 = unit value index, imports of food, drink and tobacco.
X4,5,6 = seasonal dummy variables.

Notes. The period of observation for Y is from 4th quarter 1958 to 4th quarter 1970. All variables except X4,5,6, are expressed in % 1st differences.
The subscript $_{-1}$ after a variable denotes a lag of one quarter, $_{-2}$ two quarters.
The seasonal dummies are included in all equations, but for ease of presentation their significance and coefficients are omitted.

B. *Significance and Fit*

Equation No.	Variables Significant at 1%	5%	10%	25%	Not Significant at 25%	$\bar{R}^2$	F	S.E.E.	DW
D1	1					.482	12.2	1.416	2.04
D2	1_{-1}					.555	16.0	1.312	2.20
D3	1_{-1}		1	1_{-2}		.587	12.4	1.265	2.18
D4	2_{-1}					.576	17.3	1.282	1.93
D5	2_{-1}		2_{-2}		2	.586	12.3	1.266	1.90
D6				2_{-1}	1_{-1}	.568	13.6	1.293	2.01
D7	1,2			1_{-1}	2_{-1}	.738	20.3	1.008	1.93
D8			3			.454	11.0	1.454	1.71
D9	1,2	3				.645	15.5	1.172	1.83
D10	1,2			1_{-1},3	2_{-1},3_{-1}	.739	16.1	1.006	1.87

Notes. See Table 4. 1, Section B
The standard deviation of Y is 1.968.

C. *Regression Coefficients*

Equation No.	X1	$X1_{-1}$	$X1_{-2}$	X2	$X2_{-1}$	$X2_{-2}$	X3	$X3_{-1}$	Intercept
D1	.286								−.995
D2		.391							.943
D3	.191	.294	.149						.079
D4					.240				1.501
D5				.030	.223	.100			.999
D6		.100			.189				1.434
D7	.933	.217		−.481	.105				−3.043
D8							.246		−.203
D9	.995			−.507			.253		−4.690
D10	.947	.229		−.514	.073		.140	.027	−3.380

D. Selected Equations
See text §4.8.

are not shown in the table, is disturbing. Not only are their coefficients unstable, they are also in many cases extremely high, in one case reaching more than 7.0. Such a value for a seasonal dummy is quite unacceptable where the standard deviation of the dependent variable is only 1.97. This behaviour of the seasonal dummy variables suggests that the difficulty in this piece of the analysis lies with the treatment of seasonality. Where both the dependent variable and one or more of the independent variables are subject to considerable seasonal variation, as here, the use of seasonal dummies tends to prove unsatisfactory. It therefore seems preferable not to select any of the equations from Table 4.5 for further testing. Before Part 3 of the Study is undertaken it will be necessary to conduct the analysis of the food index using seasonally corrected data, perhaps including one or two extra variables.

Meanwhile Table 4.5 does tend to confirm the findings of §4.5 and §4.6 that the agricultural price index has the greatest effect on the consumer price index with a lag of one quarter, although the current term does also possess some significance. This emerges from equations D1 to D3. Equations D4 and D5 show that it also applies to the price index for livestock only, and that the most successful single variable in explaining the consumer price index for food is the agricultural price index for livestock lagged by one quarter. The remaining equations, D6 to D10, are best ignored at this stage, in spite of their apparently satisfactory fits.

§4.9 *Regression Analysis, Non-Food Index*

The consumer price index for all non-food items is not subject to a significant degree of seasonal variation, and is thus suitable for analysis with the aid of seasonal dummy variables. In this case the independent variables chosen are industrial earnings, output per head (in its smoother five quarter average form), the unit value index for all imports, and the rate of interest on overdrafts. The analysis is in terms of simple percentage first differences, except for the interest rate, which as usual is used in absolute form.

The results are shown in Table 4.6. In may ways they are quite similar to those of Table 4.2. The single-lagged earnings variable $X1_{-1}$ is in all cases significant at the 1% level, and its coefficient, quite stable at about 0.3, is about the same as in Table 4.2. In this case the double-lagged form, X_{-2}, does improve the fit of equations and emerges as significant in some of them. Once more the productivity variable proves disappointing, possessing little significance and only marginally improving the fit of the equations which contain it, although at least its coefficient displays the expected negative sign in this analysis. Also in distinction to table 4.2, it is the double lagged term, $X2_{-2}$ which performs best now.

The import unit value index for all items (X3 in this analysis, X4 in Tables 4.2 and 4.3) behaves more as it did in Table 4.3 than in Table 4.2. Thus it is the double-lagged term which performs best, albeit with varying degrees of significance and a rather unstable coefficient. The possibly spurious relationship of the current term, which was a feature of Table 4.2, does not emerge in this analysis. Yet again, the coefficient of $X4_{-1}$ the interest rate variable, is consistently positive, and the variable is significant in most equations which contain it.

Overall, the equations are about as satisfactory as those in Table 4.2 in terms of fit and significance, although the standard errors are slightly higher in relation to the standard deviation of Y, and there is evidence of residual autocorrelation. It is a little disappointing that with a more homogeneous dependent variable there has been no general improvement in the results compared with Table 4.2. Nevertheless, the results obtained are sufficiently good to select two equations, E5 and E7, for further testing in Part 3 of the Study.

TABLE 4.6: CONSUMER PRICE INDEX, NON FOOD, NET OF TAX. SIMPLE PERCENTAGE CHANGES.

A. *Variables*

Dependent Y = consumer price index, non-food items, net of tax.
Independent X1 = average weekly earnings in manufacturing industry.
X2 = output per head in manufacturing industry (5-quarter moving av. SC)
X3 = unit value index, all imports.
X4 = ordinary overdraft rate of associated banks.
X5,6,7 = seasonal dummy variables.

Notes.—The period of observation for Y is from 4th quarter 1958 to 4th quarter 1970.
Variables X1,2,3, are expressed in % 1st differences, X4 in absolute values.
The subscript $_{-1}$ after a variable denotes a lag of one quarter, $_{-2}$ two quarters.
The seasonal dummies are included in all equations, but for ease of presentation their significance and coefficients are omitted.

B. *Significance and Fit*

Equation No.	Variables Significant at				Not Significant at 25%	$\bar{R}^2$	F	S.E.E.	DW
	1%	5%	10%	25%					
E1	1_{-1}					.487	12.4	.576	1.56
E2	$1_{-1},1_{-2}$					.558	13.11	.535	1.76
E3	$1_{-1},1_{-2}$			2_{-2}		.564	11.34	.532	1.76
E4	3_{-2}					.159	3.28	.738	1.24
E5	$1_{-1},3_{-2}$					.560	13.24	.534	1.62
E6	4_{-1}					.246	4.91	.699	1.37
E7	1_{-1}	4_{-1}	3_{-2}			.595	12.75	.512	1.75
E8	1_{-1}		3_{-2}	$2_{-2},4_{-1}$	1_{-2}	.601	10.05	.508	1.84

Notes. See Table 4.1, Section B.
The standard deviation of Y is 0.805.

C. *Regression Coefficients*

Equation No.	$X1_{-1}$	$X1_{-2}$	$X2_{-2}$	$X3_{-2}$	$X4_{-1}$	Intercept
E1	.325					.392
E2	.315	.194				.072
E3	.309	.194	−.177			.254
E4				.227		1.054
E5	.295			.152		.429
E6					.341	−1.341
E7	.268			.107	.154	−.601
E8	.270	.080	−.174	.093	.114	−.296

Selected Equations

$$E5\ Y_c = 0.429 + .295X1_{-1} + .152X3_{-2} - .573X5 + .381X6 - .556X7$$

$$E7\ Y_c = -.296 + .270X1_{-1} + .080X1_{-2} - .174X2_{-2} + .093X3_{-2} + .114X4_{-1} - .407X5 + .424X6 - .479X7.$$

§4.10 *Conclusions*

The various pieces of regression analysis in this Part of the Study have shown that most of the expected relationships between potential explanatory variables and the "net of tax" consumer price index appear to hold good. In particular, there appears to be a close relationship between changes in average weekly earnings in manufacturing industry in a particular quarter and changes in the consumer price index about eight weeks later. Most of the equations calculated suggest that if other factors remain constant, an increase of 1% in earnings is likely to be followed by an increase of about 0.3% in the consumer price index.

The agricultural price index also appears to exert a strong influence on the cost of living index, the relationship being significant in practically all the equations shown. In this case, there seems to be some immediate impact, but the greatest influence is after a lag of about three months. The coefficients tend to average about 0.25, implying that a rise of about 0.25 per cent in the consumer price index is likely to follow a rise of 1 per cent in the agricultural price index.

The evidence concerning changes in output per head in manufacturing industry and changes in the level of import prices is less satisfactory. The former do have the expected negative effect in those equations in which they are statistically significant, while the latter have the expected positive effect. However, the low significance of these variables and the varying lags which perform best in different sets of equations preclude any general statement as to the precise relationship between them and the consumer price index.

Interest rates on bank overdrafts are positively, and, on the whole, significantly, related to changes in consumer prices in the following quarter. Thus high interest rates in one quarter tend to be followed by greater than average increases in prices in the next, especially in the non-food sector. This argues perhaps that, with the exception of agriculture, cost-plus pricing is the general rule and that interest rates are regarded as an important cost of production or trading. On the other hand, a capacity utilisation variable also had a significant positive effect, indicating that market conditions also have an influence on pricing policy.

From the point of view of obtaining forecasting tools, several of the equations look promising. These equations will be tested for predictive ability in Part 3 of this Study. Tests will also be made on the stability of their coefficients through time, as the analysis so far may have obscured a tendency for relationships to change over the years. Further analytical work will need to be carried out in order to obtain potential forecasting equations for the food index, which can then be subjected to the same tests as those equations selected for the non-food and all items indices.

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