Seasonality in the Business Survey

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Introduction

In 1961 the European Commission, in association with government departments or research institutes in Member States, instituted a harmonised monthly survey of the business attitudes held by managements of firms in the manufacturing sector. With Ireland's accession to the EEC the survey would have been extended here. However, there was already a quarterly survey on businessmen's intentions in operation. Beginning with the fourth quarter of 1961, the Confederation of Irish Industry (CII) and The Economic and Social Research Institute (ESRI) had been conducting a quarterly survey of businessmen's attitudes in the Republic of Ireland and publishing (from 1968) an account of the results of the latter's *Quarterly Economic Commentary*. On Ireland's accession, the CII-ESRI survey was revised so as to ensure comparability with other member countries, and the first monthly survey was carried out in March, 1974. Results are now reported in the Commission's Business Survey publication and in Ireland in a CII monthly report.

All survey findings are subject to variability and imprecision, even when viewed only as indicators of how businessmen see the current state of their environment. At any point in time imprecision can arise from sampling variation and non-response, while over time deviations from trends can be caused by irregular fluctuations, however transient, in business sentiment. Viewed as devices for economic forecasting, further sources of uncertainty enter in, including the qualitative rather than quantitative nature of Business Survey data, at least at firm level. However, it is reasonable to expect some degree of positive correlation between Business Survey series and corresponding official statistical series when examined over a reasonably long time span. Again, the level of variability in Irish Survey data ought not to be out of line with that from other countries, unless unique explanations exist in terms of the structure or evolution of the economy.

At the request of the Commission's Directorate for Economic and Financial Affairs the ESRI made a special study (Conniffe, 1984) of the correlation between Survey series and official series, the sources of variability in the Irish Survey and the measures that might be taken to improve precision. This paper is concerned with just one source of variability — seasonality — although the study looked at various sources. Factors related to the sample composition and weighting systems are, of course, very important in relation to precision, and the paper by Scott (in this issue) describes the recent improvements made in

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these aspects of the Survey's methodology. Any mentions in this paper of such factors refer to the old sample.

1. The Survey Questions and the Discounting of Seasonality

The core questions, asked every month, seek management opinions on production trends, state of order books, stocks, and production and price expectations. The forms of answers are qualitative at firm level — for example, same, higher or lower. Quantitative measures are produced for more aggregated levels from industrial sub-group up to manufacturing industry as a whole. These measures are basically the percentages of firms giving each qualitative reply, weighted first by the relative importance of the firm and second by that of the sector. The details of the weights and of the computations have been described by Neary (1975) and are reconsidered in the Scott (1985) paper.

Clearly quantities shown by order books, etc., will display seasonal variations. If it is considered essential to eliminate these effects, two approaches are possible. One is to ask respondents to adjust for seasonality when answering, and this is the approach in the Business Survey. The other would be to allow seasonal effects in answers, but to mathematically deseasonalise the series subsequently. Of course, this is impossible to do with just one month's replies, but if data banks of the Survey were built up, deseasonalising would be feasible.

Asking respondents to adjust is a preferable procedure provided they are willing and able to do so adequately. Mathematical deseasonalising has several limitations. The measurement of seasonal effects will inevitably involve estimation errors, which will have effects, however small, on all subsequent inferences. Also, the estimation process usually requires the assumption of a stable seasonality pattern over time, that is, the current month's results are deseasonalised according to the average relative position of the month in previous years. If the seasonal pattern is unstable, deseasonalisation can give unsatisfactory results.

But if some respondents fail to discount seasonal effects in spite of requests to do so, the month-to-month fluctuations will contain these effects. Besides making data interpretation more difficult this could distort the relative variability of the Irish series as compared with those of other countries. The correlations between Business Survey series and deseasonalised official statistical series would also be reduced because of this extra "noise" variation.

The explicit question wordings are shown in Table 1. Note the occurrence of such terms as "for the time of year", "allowing for seasonal variation" and "excluding seasonal variation". Whether or not these wordings, or their interpretation by respondents, are sufficient to eliminate seasonal effects from the Survey was tested by analysing some of the series published in the Commission's *Results of the Business Survey*.

2. Methodology

The series chosen corresponded to the six core questions of Table 1 repeated for each of three categories: Industry as a Whole, Consumer Goods and Investment Goods. In spite of the title, Industry as a whole does not contain the food, drink and tobacco sectors in accordance with the conventions of the Commission's report. In the CII's report these sectors are included, but it is the

Commission's series that are analysed in this paper. For each question and level of aggregation the published Survey gives the (weighted) percentages of respondents seeing no change and also the (weighted) net balance of positive over negative replies. The latter is the more interesting indicator and was chosen for analysis.

Although the Business Survey has been underway in Ireland since 1974 there are considerable problems in analysing a data series continuously through to a recent date. The variable Production Trend is derived from the first question listed in Table 1 and this has only been asked since 1979. Although the remaining questions date back to 1974, there are other difficulties associated with 1979, most importantly a long running postal strike that disrupted the survey for half the year. It is possible to interpolate for missing values in a series, but to interpolate for several consecutive months can make the drawing of inferences from the series quite a risky matter. For example, the test for seasonality could be affected, in various ways, depending on how the interpolation method operated. Even more importantly, comparison of Irish series with those of other countries could be invalidated. So the series finally analysed run from August 1979 to March 1984. One or two problems remained with an occasional missing value or extreme outlying value and statistical estimations were used to resolve them. Such problems are almost unavoidable in time series of this nature because of severe although "once-off" effects, for example, a major strike.

It is interesting to test if seasonality with monthly data occurs in other countries' series. Some comparisons are inappropriate. There are no monthly figures on Production Trend for the UK, only quarterly. Denmark does not provide monthly data for any of the six core questions. There are no published

TABLE 1: Wording of the Business Survey Questions

Production Trend For the time of year (i.e., allowing for seasonal variation) the value of Production by your firm in the past month compared with the previous month was:	Higher Same Lower	
Order Books Do you think that your present Total Order Book is for the time of year:	Above normal Normal Below normal	
Export Order Books Again excluding seasonal variation do you think that in the future months your firm's exports will be:	Higher Same Lower	
Stocks of Finished Products Do you consider that your present stocks of Finished Products are, for the time of year:	Excessive Adequate Insufficient	
Production Expectations Again excluding seasonal variations do you think that over the next three months your firm's Production will be:	Higher Same Lower	
Selling Price Expectations Do you think that over the next three or four months your Selling Prices will be:	Higher Same Lower	

data for the Netherlands on either Export Order Books or Selling Price Expectations. This leaves West Germany, France, Italy, Belgium and Luxembourg. Along with Ireland, including all of these, would have required analysis of a lot of series. Taking half of them seemed more feasible in terms of analysis time, so that the final choice for comparisons were the series from Belgium and Italy. Obviously enough, corresponding time periods were chosen for all the series.

The method of statistical analysis chosen was one currently employed in time series analysis. Each original series was decomposed into three component series — a trend-cycle component, a "seasonal" component and an irregular or "random" component. The reality of the "seasonal" component was tested by a procedure analogous to the well known F test of the analysis of variance. The computer program employed was the X-11 program developed by the US Bureau of the Census. Besides being able to perform the decomposition already described, the program contains other facilities including the ability to test for and deal with outliers and occasional missing values.

3. Seasonality in the Irish Series

Commencing at the most aggregated level — the results for Industry as a Whole — the decomposition of the original series into trend-cycle, seasonal and random components permitted tests for seasonality and estimation of the magnitude of effects. Table 2 gives the significance tests and the percentage of month to month variation in the original series accounted for by the seasonal component. A large percentage does indicate strong seasonal effects, although a smaller one could still be compatible with real seasonal effects depending on how the remaining variation was distributed between the trend-cycle and random components. The F test allows for this.

Production Trend, Export Order Books and Production Expectations all showed significant evidence of seasonality, although the magnitude of the effect was less pronounced for Production Expectations. In the case of Stocks of Finished Products perhaps it should be remarked that, although 5 per cent significance levels are conventional in statistical tests, the F ratio is not small and would just exceed the 10 per cent value. That is, one could suspect some seasonality even if the effects are not large enough to be definitely detected.

The analyses were repeated at the somewhat less aggregated levels of investment goods and consumer goods sectors. It should be said that in examining sectors rather than all industry, the percentage variation attributable to trend/cycle and seasonal effects will tend to fall, while that identified with the irregular or residual component will tend to rise. This is because the sample size is

TABLE 2: Seasonality Tests — Industry as a Whole

	F*	Percentage of Monthly Variations
Production Trend	8.7 ***	68
Order Books	1.7 N.S.	30
Export Order Books	4.6 ***	63
Stocks of Finished Products	1.9 N.S.	22
Production Expectations	4.3 ***	30
Selling Price Expectations	1.6 N.S.	21

*All F tests are based on 11 and 44 degrees of freedom.
N.S. = Not significant at 5 per cent level. *** = significant at .1 per cent level.

decreasing and the variance of the residual component tends to be inversely related to the number of firms comprising the sector. There may be some exceptions to this statement, because some sectors might be particularly prone to seasonality and others not, and also because of the operation of the weighting systems. However, it should usually be true.

The series that showed no seasonality for Industry as a Whole — Order Books, Stocks of Finished Products and Selling Price Expectations — behaved similarly at sectoral level. The results for the remaining series are shown in Table 3.

TABLE 3: Seasonality Tests — Investment Goods and Consumer Goods Sectors

	Investment Goods Sector		*Consumer Goods Sector*	
	F	Percentage of Monthly Variation	F	Percentage of Monthly Variation
Production Trend	2.4 **	48	3.4 **	43
Export Order Books	1.9 N.S.	43	1.8 N.S.	12
Production Expectations	2.2 *	39	1.9 N.S.	24

N.S. = Not significant at 5 per cent level. * = significant at 5 per cent level
** = significant at 1 per cent level

For Investment Goods the tests showed seasonal effects for Production Trend and for Production Expectations at the 1 and 5 per cent levels, respectively. The non-significant result for Export Order Books, taken with the fact that there was a significant test for this series for industry as a whole, might suggest that it does not contain seasonal effects in this sector, but does in others. However, this may not be the situation. For the reason already explained, the residual or irregular variation becomes relatively more important as sample size decreases and since the test compares between month variation to residual, the increased size of the latter makes it harder to prove the existence of seasonality. Export Order Books is particularly prone to this problem because, since not all firms export, the sample size would have been smaller to start with. Given that the F value in Table 3 is not small — it exceeds the 10 per cent significance value — and that the percentage of monthly variation attributable to seasonality is substantial, it seems more plausible to conclude that the series that exhibited seasonality for industry overall continue to do so for the Investment Goods Sector.

The corresponding seasonal tests for the Consumer Goods Sector detect significant seasonality for Production Trend but not for Export Order Books. Production Expectations shows no significant effects either, again testing at the conventional 5 per cent level. Nor are the percentages of month-to-month changes attributable to seasonality as high as for the Investment Goods Sector. It might still be going too far to say that Export Order Books and Production Expectations are free of seasonality for this sector (the F ratios are still sizeable) but it is certainly less pronounced than for Investment Goods. The investigation of seasonality could be pursued to the level of industrial sectors and subsectors and, in fact, the report by Conniffe (1984) did so. But as sample sizes fall the statistical detection of seasonality becomes more difficult and, in any event, it is the aggregated series that receive most attention as economic indicators.

The seasonality detected in some series must mean that some respondents to the questionnaire fail to discount seasonal effects when answering. All respondents do not so fail, because if they did the seasonal effects would have been so large as to be obvious from even a casual glance at the series. Yet this situation of some respondents discounting seasonality and others not, is probably the worst of all situations. If all respondents were told to reply and make no effort to exclude seasonal variation the questionnaire would be easier to reply to and the resulting seasonal series could always be deseasonalised mathematically just as is done by the Statistics Offices of Member States to various objective series.

The other approach is to try to eliminate the remaining seasonality in the replies from some respondents, which suggests investigating why some questions led to series displaying seasonality, while others did not. Taking Production Trend and Order Books, for example, there are evident differences. Production Trends asks for a comparison of the current month with the previous one, while allowing for seasonal variation. Taken literally, this could be very difficult. In effect, the respondent must try to remember what that difference was for several years past, calculate an average and then see if the current change exceeds (or whatever) that average. The question on Order Books is much simpler and asks if they are above or below normal "for the time of year". This does not require month-to-month differencing and the wording perhaps suggests comparisons with the same month in previous years, so eliminating seasonal effects.

Again, both Export Order Books and Production Expectations, through the references to future months, could be taken as requiring averaged inter-month comparisons. Stocks of Finished Products, however, is worded like Order Books and it is therefore tempting to associate differences in wording with the findings about seasonality. Selling Price Expectations would seem the exception then, but this was a relatively stable series apart from a fairly pronounced trend-cycle component. Future selling prices were always expected to be higher, but over the 1979 to 1984 time period the expected increase was falling steadily. The trend-cycle component removed 90 per cent of the variation of the original series.

4. Seasonality in Belgian and Italian Series

It is of interest to see if Ireland is alone in experiencing these seasonality effects in Business Survey series, or if the problem occurs in other Member States also. If the latter were the case a harmonised approach to restructuring the questionnaire (or perhaps choosing to mathematically deseasonalise) would be appropriate. If the former were the case, then deseasonalisation by respondents through question wording has been achieved elsewhere, so it should just be a matter of "educating" Irish respondents to do the same. The reasons for choosing Italian and Belgian data have already been given and precisely the same analysis was applied as to the Irish series. The results for Industry as a Whole are shown in Table 4.

The results for the Italian series are mainly similar to the Irish ones. Production Trends, Export Order Books and Production Expectations show significant seasonal effects while Order Books and Selling Price Expectations do not.

TABLE 4: Seasonality Tests — Industry as a Whole

	Italy		Belgium	
	F	% Variation Explained	F	% Variation Explained
Production Trend	7.2 ***	70	14.1 ***	75
Order Books	1.0 N.S.	20	4.4 ***	27
Export Order Books	3.9 ***	27	2.5 **	28
Stocks of Finished Products	3.8 ***	40	0.8 N.S.	27
Production Expectations	16.5 ***	69	16.9 ***	51
Selling Price Expectations	0.9 N.S.	25	13.3 ***	59

N.S. = Not significant at 5 per cent level. ** = Significant at 1 per cent level.
*** = Significant at .1 per cent level.

However, Stocks of Finished Products did display significant seasonality which had not been detected for the Irish data. The freedom of the Order Books series for seasonality does not extend to the Belgian data, where the test is statistically significant although the percentage of month-to-month variation explained by seasonality is relatively low. Again, Export Order Books and Production Expectations show significant seasonality, in agreement with both Ireland and Italy. Stocks of Finished Products show no statistical detection of seasonality, in agreement with Ireland but disagreement with Italy. The most unexpected result, however, at least on the basis of the Irish and Italian results, is the highly significant seasonal effect in Selling Price Expectations. Detailed examination of the series showed that higher price increases were expected in winter than in summer, consistently across years.

It has already been mentioned that detecting statistical significance can depend on the magnitude of the residual or random variation as well as on the size of seasonal effects. One might hypothesise that there is some degree of seasonality in all series in all countries, and the more precise the survey and smaller the residual standard deviation, the more likely it is to be detected. The standard deviations of the residual series for Industry as a Whole, after elimination of trend-cycle and seasonal effects, are shown in Table 5.

TABLE 5: Standard Deviations of Residual Series — Industry as a Whole

	Belgium	Ireland	Italy
Production Trend	2	4	2
Order Books	1	3	3
Export Order Books	1	6	4
Stocks of Finished Products	1	3	2
Production Expectations	2	5	3
Selling Price Expectations	2	3	2

The Belgian standard deviations are always lower than the Irish ones and equal to, or less than, the Italian figures. This may explain some of the inter-country differences; for example, why Order Books showed significant seasonality in the Belgian series even though the magnitude of the effects was apparently as great in the Irish data. But not all the seasonality effects can be explained in this way. The Belgian data had smaller standard deviation than the Italian for Stocks of Finished Products and yet seasonality was not detected in the Belgian data, but was in the Italian data. Again, the standard deviations

for Price Expectations were the same for these countries, but substantial seasonality was found in the Belgian series but not in the Italian one. Although the precision of the Survey, and consequent variability of the residual series, may be one factor in detecting seasonality, differences between respondents in the three countries in their interpretation of questions seem to matter also.

5. Conclusions and Discussion

Seasonality occurs in some of the Irish series and not in others and may be related to the wording of the questions. This suggests that there should be experimentation with other wordings to try to eliminate the problem. However, since seasonality is not just a feature of Irish data but of Belgian and Italian data also, a co-ordinated approach to the experimentation is desirable. If re-wording fails to solve the problem, the published series should be deseasonalised. Indeed, in this case the question could be simplified by not trying to eliminate seasonality through wording but relying totally on mathematical deseasonalisation. The simpler questions could help reduce the non-response problem. On the other hand, *qualitative* questions ignoring seasonality can sometimes be almost meaningless, for example if comparing months where all respondents would expect the same direction of change.

The presence of seasonality in the currently published series inflates the apparent variability and may mean that deductions, made on the supposed absence of seasonality, are seriously misleading. Uneliminated seasonality in some questions is also undoubtedly one of the reasons for the poor correlations found by Conniffe (1984) between the Survey series and objective series based on CSO data on monthly industrial production and trade statistics. It is true that the choice of "objective" series is not all that clear cut — for example, the mention of "future months" in the Export Order Books question is too vague to uniquely identify an objective series and also must have been variously interpreted by respondents — but this is also a consequence of the wording and cannot excuse the poor correlations.

Of course, seasonality is not the only problem that can occur. The sample size and distribution of the sample over industrial sectors can be important, especially if structural change is occurring within industry. The weights for aggregating from firm to sector level and for further aggregation can also affect precision unless they are regularly revised. Occasional non-response by firms, especially if in sectors that are sparsely represented in the sample, can also increase the observed variability in a series. As regards relationship with objective series it could possibly be even claimed that seeking substantial correlations between monthly changes is excessively ambitious and that differences over wider time periods — quarterly or even annually — might show greater association. In the early years of the Irish Survey, Baker (1968) found greater correlations with quarterly data. Again, it could be argued that it is not so much a high correlation with an objective series that is required as the capacity to detect major "change-points" in such a series.

However, the fact that there are sources of variation other than seasonality is no reason not to attempt to eliminate seasonal effects. The series would then be more easily interpreted and would show less irrelevant variation. Appropriate measures are being discussed, but will obviously have to be assessed over

time. In the meantime, users of the series should bear in mind the existence of substantial seasonality. The series analysed in this paper differed from those published by the CII in that the food, drink and tobacco sectors were excluded. However, this does not mean the CII series are any freer of seasonality and, in fact, the food sector series exhibit some of the most pronounced effects.

References

BAKER, T. J., 1968. "The FII-ESRI Joint Industrial Survey", *Quarterly Economic Commentary*, September, pp.25-32.

COMMISSION OF THE EUROPEAN COMMUNITIES, (various years). *Results of the Business Survey*, various issues, Brussels.

CONNIFFE, D., 1984. *Analysis of the Irish Business Survey*, Report commissioned by the Directorate for Economic and Financial Affairs, Brussels.

NEARY, P., 1975. "The CII-ESRI Quarterly and Monthly Surveys of Business Attitudes: Methods and Uses", *Quarterly Economic Commentary*, March pp.27-36.

SCOTT, S., 1985. "The Revised CII-ESRI Survey — A Note", *Quarterly Economic Commentary*, July, pp. 36-43.

US BUREAU OF THE CENSUS, 1967. *The X-11 Variant of the Census Method II Seasonal Adjustment Program*, Technical Paper No. 15, Washington, D.C.: US Government Printing Office.