TOWARDS A COMPOSITE CYCLICAL LEADING INDICATOR FOR PRIVATE CONSTRUCTION NEW ORDERS

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This paper undertakes through experimental analysis to identify leading indicators for UK commercial and industrial construction new orders. A leading indictor is best thought of as a variable whose cyclical pattern over time tends to precede the cyclical pattern of another variable by a reasonably constant time interval. The most suitable leading indictors are then used to form a composite indictor for construction new orders. The research involves examining a large number of macro - economic time series that, based on intuitive reasoning and published literature that would seem to follow a reasonably constant cyclical relationship with the 'reference' series. After testing for the strength and timing of the relationship between the indicators and the reference series a composite index for construction new orders is presented and its examined for its ability to chart turning points in the reference series.

Keywords: Composite index, cycles, indictors, new orders.

INTRODUCTION

Indicator methods, originally developed by the National Bureau of Economic Research (NBER), for the US economy have found favour in many government departments and commercial and consultancy organisations throughout the world. It is suggested by Hoptroff et al. (1991), that leading indicators provide the most promising approach to the forecasting of cycles and their turning points. In the UK a system of cyclical leading indicators has existed for over 20 years, originally based on work done by O'Dea (1975) and subsequently developed over the years by the Central Statistical Office (CSO), see CSO (1975, 1976, 1980, 1983, 1993) for detailed information. The leading indicators in the UK are constructed to provide predictors of movements in the 'business cycle', represented by the cyclical movements found in GDP. Particular attention is placed on the indicator's ability to predict turning points in the business cycle whilst maintaining a strong coherence with the actual cycle.

The construction industry in the UK is subject to shocks and fluctuations from time to time just like any other industry, causing disruption to work levels and employment. Moreover, globally the construction industry would seem to suffer more from fluctuations than other areas of the economy. Indeed, Snyman (1989) claims that fluctuations in workload have substantial effects on building costs. The view that the construction industry is subject to more profound fluctuations in demand is , according to Hindle (1996), the accepted view. Hindle, points to the fact that there is agreement between Hillebrandt (1984), Edmands and Miles (1984) and Newcombe *et al.* (1990), that the situation (fluctuations) is exacerbated by the fact that the construction industry is often used as an economic regulator by governments.

Dorward, F, Akintoye, A and Hardcastle, C (1997) Towards a composite cyclical leading indicator for private construction new orders. *In:* Stephenson, P (Ed.), *13th Annual ARCOM Conference*, 15-17 September 1997, King's College, Cambridge. Association of Researchers in Construction Management, Vol. 2, 588-97.

THE ROLE OF LEADING INDICATORS AND THEIR HISTORICAL DEVELOPMENT

Cyclical indicators chart movements in the economy over the business cycle. In particular they aim to give early warning of cycle turning points, that is where economic growth is reaching a maximum (peak) and so about to enter a downswing stage, also known as a trough or minimum level, and from here back on the upswing to a peak value again to complete the cycle. Indicators do not attempt to measure the absolute level of output or growth they are only concerned with the identifying of these cyclical turning points

According to Moore (1975), there are three types of indicators; leading, coincident and lagging.

Leading indicators represent the decisions or commitment to economic activity in the months ahead and economic decisions take time to work through their full effect. *Coincident indicators* measure the amount of economic activity and mark the contraction and expansions and turning points of the economic cycle. *Lagging indicators* historically reach their peaks and troughs after the economic cycle turning points.

The rationale for using leading indicators to study a particular time series (reference) is that if changes occur in the movements of the leading indicators, then the change is likely to be felt in the reference series at some later date. The key to using leading indicators to forecast movements in the reference series is to have a reliable and consistent leading relationship over time, therefore confidence can be placed on the future direction of the reference series by close examination of the indicators.

The use of leading indicators has been around for a number of years, particularly in the US. The technique can be traced back to 1919, when Professor Persons at Harvard University constructed an index of speculation, based on three price variables coupled with the index of share prices as a proxy for expectations. This work was then continued by the NBER, founded in 1920 in the United States.

The NBER is responsible for the development of leading indicator analysis and the major contributors to the theory have been (Burns and Mitchell, 1938, 1946; Moore, 1961, 1975, 1986; Lahiri and Moore, 1991, Zarnowitz 1991, 1992). Berk and Bikker (1995) point to the fact that almost every industrialised country in the world now uses some form of leading indicator analysis. They also point to the fact that the simultaneous calculation of leading indicators for more than one country has also arisen from the NBER system such as EC(1982), Klein and Moore (1983, 1985) and OECD (1987).

CONSTRUCTION MARKETS AND THE CHOICE OF ‘REFERENCE SERIES’.

Ofori (1990), claims that attempts to estimate demand for construction are fraught with problems, owing to the characteristics of the building process and end product. He suggests that one of the main reasons that difficulties exist is because of the market structure of the construction industry, particularly the fact that perfect competition seems to be far from the construction model (Smith, 1981), that is construction goods tend to be:

- not homogeneous, each can be considered unique;

- large, indivisible and very expensive, the market therefore consists of few buyers and sellers;
- immobile, goods cannot be relocated to areas of high demand, hence demand tends to be location specific;
- subject to a wide range of external (political, sociological, cultural and economic) reasons;
- susceptible to government policy, which is a major client.

In order to address some of the structural problems of the construction industry and to facilitate the identification of turning points in the construction series, the paper is concerned with only the sub - sectors of industrial and commercial construction, placed by the private sector, formally known as the 'reference series' in this paper. Indicators that influence the demand for housing have been identified by several writers (Hillebrandt, 1984; Lange and Mills, 1979; Shutt, 1982; Stone, 1983, Briscoe, 1988; Ofori, 1990; Tang *et al*., 1990; Raftery, 1991) and the determinants of repair and maintenance have been addressed by Ofori (1990).

The basis for exclusion of public sector orders, all housing and repair and maintenance is because these sectors have determinants that are fundamentally different from those suggested by investment theory (Sampson and Skinner, 1996).

Several potential leading indicators of construction demand, drawn from economic theory, have been suggested by Hillebrandt (1985) and summarised by Killingsworth (1990). Killingsworth (1990) examined several economic time series as potential leading indicators of USA construction demand, using graphical techniques and multiple regression. The results of this investigation on US data, suggests that economic shocks tend to lead the construction cycle by six quarters, with interest rates and the demand for goods leading construction by two and three quarters respectively.

THE CONSTRUCTION OF CYCLICAL INDICATORS

Most time series are subject to some form of trend, Nelson and Plosser (1973). This is however a major problem when trying to identify the cyclical nature of the series. If a strongly rising secular trend is found in many variables, down turns seldom, if ever occur (CSO, (1973)). Therefore, the existence of a trend in the data would tend to result in a series with long periods of expansion and brief if any contractions. Obviously, this result would largely ignore the cyclical properties of the series and render the examination useless. For a comprehensive discussion of detrending methods see Berk and Bikker (1995).

The NBER have defined the length of the US economic cycle to be roughly 75 months or 6 years and 1 quarter. In the UK the CSO has found that the post war general economic cycle has lasted on average about 5 years, CSO (1983). Given this knowledge the CSO have considered that any long term trend is likely to be best defined by a centered 5 year moving average, assuming that the series has been seasonally adjusted.

The benefits from using this technique are that since long term growth is likely to be changing over time, the long span moving average would be better able to follow the underlying growth, whilst smoothing out the cyclical variations.

The CSO method has the problem that when moving averages are applied the first and last 2.5 years are not calculated. Therefore the trend for these periods has to be

estimated using another technique. This is done by specifying a regression equation that takes account of the cyclical properties of the series, see CSO (1983) for further explanation. The regression equation is as follows:

$$Y = \beta_0 + \beta_1 T + \beta_2 SIN\left(\frac{\Pi_t}{30}\right) + \beta_3\left(COS\frac{\Pi_t}{30}\right)$$

where $\left(\frac{\Pi_t}{30}\right)$ represents monthly data, for quarterly data the formula $\left(\frac{\Pi_t}{10}\right)$ is used, T is a simple time trend.

The reasoning behind this formula is that the 5 year cycle is being mapped onto a phase shifted sine wave to represent what is actually happening in the economy.

Once the coefficients from the regression have been computed, the trend can be calculated for each observation. It must be noted that it is only the first and last 2.5 years that are being estimated. It is however, necessary to use the first and last 5 years data, this is to ensure that the trend is estimated with enough information, therefore a better trend should be obtained and any cyclical effects will have more or less been cancelled out.

Lastly the trend is removed from the data by expressing the series as a percentage above trend, that is achieved by the use of this formula:

$$100 \times \left\{\frac{A_t - T}{T}\right\}$$

Where At is the actual seasonally adjusted series (contains trend) and T is the trended series.

Potential indicators of construction new orders were examined using the experimental methodology outlined and following the criteria advocated by Akintoye (1991), where:

1. The indicators must have influence and importance over major aspects of the economy.
2. The indicators are fairly amenable to further analysis.
3. There must be a direct or indirect relationship with activities surrounding the construction process, activity or industry.

Given these criteria, 25 time series were chosen for analysis. A detailed description of each time series can be found in Dorward (1997).

ANALYSIS OF THE PREDICTIVE ABILITY OF POTENTIAL INDICATORS

The time series were then tested for their cyclical conformity and timing against the reference series following the criteria advocated by both the NBER and the CSO. To this end Bernanke (1990), has proposed a simple method that considers the cyclical patterns in the basic variables and the reference series. This is done by assessing the predictive power of the individual time series with respect to the New Orders through regression analysis. This analysis looks into the strength of the time series in predicting New Orders over time, the ones that produce a consistent prediction of New

Orders over time can be considered leading indicators. The following regression is used to calculate the predictive ability of the potential indicators:

$$REF = Constant + \alpha_1 TREND + \alpha_2 REF_{t-1} + \alpha_3 VARIABLE_i$$

Where,

REF = Reference series (New Orders)

TREND = Trend in Reference Series (5 year moving average imposed on phase shifted sine wave for first and last 2.5 years observations).

REF_{t-1} = A quarter lag of the reference series.

$VARIABLE_i$ = Indicators (lagged by quarter i = 0 to 8)

The above equation is calculated for lags (0 - 8) of all the time series, thus yielding 9 estimating equations per time series. Those time series producing a consistent prediction of the reference series over time can be considered leading indicators of New Orders.

The equations test the predictive power of each of the lags of the time series and the associated probability values from the T - values of the *VARIABLE* coefficient indicate whether the relationship between the time series and the reference series is a strong one or not at each successive lag.

RESULTS

Considering the time series and predictive power analyses outlined earlier, various indicators were chosen for further study as suitable candidates for inclusion into a composite indictor. The following time series, found to generally lead New Orders over time have been chosen, these indicators have been chosen in accordance with the methodologies and results outlined earlier concerning the selection of indicators.

1. Undistributed profits of commercial and industrial firms;
2. Volume of new car registrations;
3. CBI - Business optimism survey;
4. Gross profits of Commercial and Industrial firms;
5. Treasury Bill Yield
6. Interest Rates
7. Surplus/Deficit of commercial and industrial firms.

It is clear from the list of indicators that the majority represent financial variables, especially based on the profitability of firms. This suggests that the availability of capital is an important determinant of planned expansion or investment in construction products. This is a notion supported by Kopcke (1985), he suggests that cash flow is the principle source of funds for investment. If a firm cannot rely on cash flow or profits to fund expansion then the firm will tend to look for external sources of finance, such as loans or debt financing. When a firm is faced with this situation then they assume commitments and risks which have to be offset against future surpluses or deficits in the company’s current account. Therefore, interest charges and expectations of future levels are also important determinants when firms consider recruiting construction services to increase productive capacity.

Confidence or expectations regarding the future also assumes a significant role in the leading indicators. Apart from the index of confidence, which one would expect to lead New Orders based on the fact that managers have to make planning decisions, the volume of car registrations is shown to have a significant leading relationship with New Orders. Since cars are likely to be the biggest capital outlay (ignoring housing) facing a household each year, the purchase is likely to be made with a view to the future, more so than with retail expenditure. The future direction of the economy will have significant effects on the resale value of the car and the perceived 'need' for a new car in the first place. This suggests that expenditure on relatively capital intensive items both for households and firms is tactically placed, in so much that expectations and future economic confidence play a large part in the decision making process.

CREATING A COMPOSITE CYCLICAL INDICTOR FOR CONSTRUCTION NEW ORDERS

Given that a set of indicators has been selected based on the criteria highlighted previously, it is now necessary that these indicators are combined to form composite indicators that will establish the tracking pattern of the cycle, that is leading, lagging etc. Combining indicators is done to reduce the risk of obtaining false signals and to increase forecasting performance, as individual series tend to be more susceptible to random shocks than combined series. Nilsson (1987) suggests that a group of indicators combined into a composite indicator should be more reliable over time than any of its individual components.

The CSO use a modified NBER methodology to analyse the cyclical properties of the UK economy. There are 5 major steps which a prospective series (indicator) will pass through on its way to forming a composite series. These steps are as follows and are roughly the same for each series.

1. The component series is detrended using the centered moving average techniques outlined previously.
2. The detrended series is smoothed if appropriate. It is necessary to ensure that all the series have roughly the same level of volatility, such that one series cannot dominate the index. This results in the period changes in the index being due to cyclical rather than irregular movements.
3. The smoothed series is scaled, whereby series of different units of measurement are converted to a common scale thus preventing any series from obtaining an undue weighting based on its measurement size. Following the OECD methodology each component series is subtracted of its mean value and then divided by the mean of the absolute value of the difference from the mean.

The normalised series are then converted into index form by adding 100. This process differs from that used by the CSO to scale their series. Again, equal weighting is used but the CSO divide the detrended series by a 5 year centered moving average and then multiply the series by 5. The problem with using this method is that the length of the data series used in the study is quite short 1970Q1 - 1995Q4 and by using this method the start and end of the series cannot be estimated. This is partially resolved by using the nearest value of the moving average that is available, not by estimating a trend for the beginning and end years.

4. The scaled series is inverted if a negative relationship is found to exist, this would be the case if a series such as unemployment was to be used as an indicator as its movements are inversely related to economic growth. To invert a series it is simply multiplied by -1.
5. The series are combined to form the cyclical composite indicator. The index is obtained by taking an arithmetic mean of the series. At this stage it is necessary to evaluate the plausibility of the cyclical pattern of the composite indicator relative to the reference series, in some cases indicators may be dropped to produce the most effective composite index.

RESULTS

The following table indicates the cyclical characteristics of the composite indicator, with the mean values of the cycles over the period 1970Q1 - 1995Q4 displayed.

Phase Timing		***Phase Duration***		***Cycle Duration***	
Trough (Date)	***Peak (Date)***	***Peak to trough (Quarters)***	***Trough to peak (Quarters)***	***Trough to trough (Quarters)***	***Peak to peak (Quarters)***
---	1973Q1	---	---	---	---
1975Q2	1978Q1	9	11	---	20
1980Q3	1983Q3	10	12	21	22
1986Q2	1988Q2	11	8	25	19
1991Q2	---	12	---	20	---
1.Mean Duration		10.5	10.33	22	20.33
2.Mean Duration		11.25	9.75	21	20.67

Table 1: Composite Indicator 1. New orders 2.

In the following chart, periods of downturn in the New Order cycle are represented by dark bands with the peaks and troughs occuring at the start and end of the band.

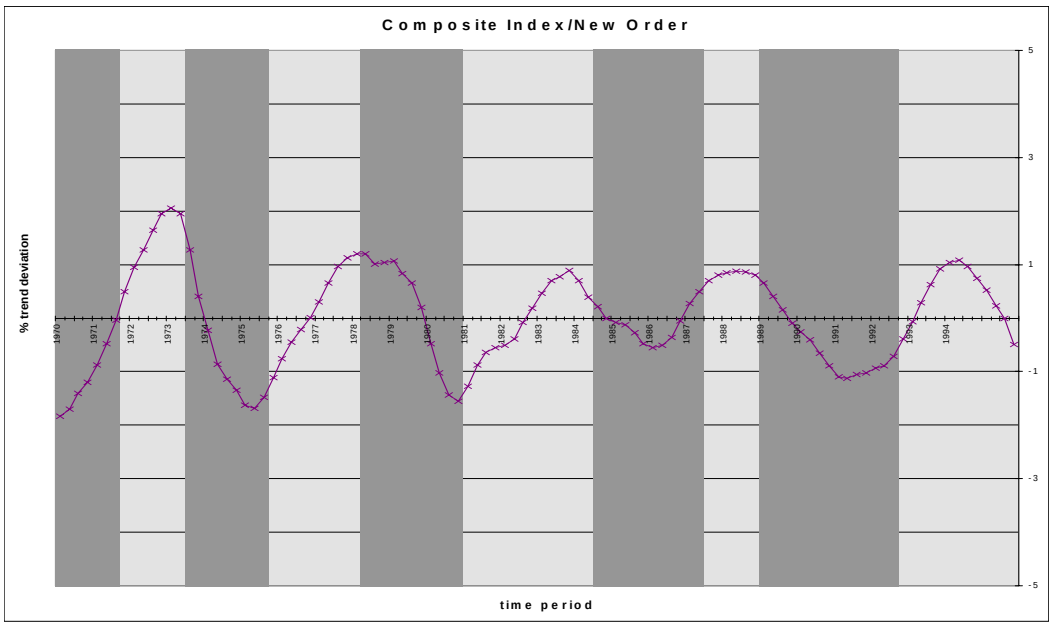

Figure 1. Composite Cyclical Indicator.

Table 1 and figure 1 gives information concerning the timing characteristics of the composite indicator. In terms of leading the reference cycle at turning points, the composite indicator has a median lead value of 2 quarters entering into a peak position, and a lead value of 3 quarters entering a trough point. One noticeable feature

of the composite indicator is that in the more recent years the length of lead time has increased at both peaks and troughs, rising from 1 quarter in the 1970's to between 3 and 5 quarters during the 90's. This could perhaps be explained by the emphasis placed on monetary policy by governments since 1979.

The desire to control inflation by setting targets for the level of money supply has an inevitable effect on the cost of capital. If interest rates are to be used as instruments of government economic policy then changes in the absolute level of interest will have ramifications for the economy, not least those firms proposing future expansion through construction services. Moreover, in an economy where uncertainty exists regarding the future cost of capital, it may be more prudent for firms to postpone investment, by doing this firms will incur additional opportunity costs in the form of lost potential revenue but will not find themselves at the mercy of the money market.

It is quite conceivable that since investment in construction New Orders is influenced by confidence and expectations, as well as measures of profitability, any real change in the relative standing in the economy will take time to filter through to firms undertaking the planning arrangements. It can also be argued that the filtering process is likely to take more time when the economy is subject to uncertainty regarding future costs of capital.

Another reason for lags in New Orders over the composite indicator is that to undertake a full design specification and arrangement of contractors, finance, land etc., takes time and money to carry out. Therefore, this is essentially a sunk cost of the business, if the plans do not go ahead then resources have been wasted and all the time the firm has to decide if their competitors are likely to follow the same game strategy.

CONCLUSIONS

The cyclical composite indicator developed in this report produces a fairly good approximation to the construction cycle over time, however the inherent judgement used in the method of analysis means that a certain degree of caution must be used when interpreting the results. The average length of the construction cycle and the average length of the composite index are very close. It is also clear that in terms of the indicators chosen for the composite index, financial variables and measures of confidence tend to predate New Orders. Given the nature of the construction process, and the inevitable time it takes to arrange finance, design teams, contractors etc. those involved in the construction industry should perhaps look further ahead when anticipating New Orders for their construction services.

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