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Abstract : This paper examines numbers of acquisitions for the UK and demonstrates that actual values are predictable and the time-series properties for the series can also be established. A link between economic conditions and acquisition levels seems likely and such models can be easily produced. The economic factors and the time-series properties are then combined in an ARMAX model producing better results and demonstrating that takeovers are prompted both by economic conditions and the influence of recent acquisition behaviour. Changes in takeover numbers, however, are highly volatile and cannot be easily predicted.

Introduction

The corporate control market operates continually as companies grow and evolve. It appears to move in a cyclical manner with levels of increasing and decreasing activity. Here the behaviour of the corporate control market in the UK is analysed during a period, 1974 to 1994, that included the last period of excessive acquisition activity to take place in this country.

To date there is still no coherent theory that can explain levels of takeover activity that holds in any given time period. Models that work in one country do not seem to be effective in another or over a different time period from the one used in their construction. This paper analyses UK data and, after establishing that numbers of acquisitions are not random, combines time-series information with the influence of exogenous variables. These factors are often separated in the previous papers on this subject but it seems highly likely that using the combination here will enhance the degree of information that the data can reveal about acquisition levels in the UK.

Following Golbe and White (1993) the emphasis here is upon levels of acquisition activity rather than changes. If the primary concern is establishing whether takeovers move in waves then analysing the levels is far more meaningful than examining the changes. This paper concentrates on demonstrating that the behaviour of acquisitions in the UK is cyclic and that it moves in approximate synchronisation with the economic cycle and consequently examining the levels is the best way to proceed. Results dealing with the changes in numbers of acquisitions are included purely for completeness.

Previous research on levels of acquisition activity

Previous research on numbers of acquisitions is divided broadly into two types. Firstly there are papers that have studied takeover levels using time-series methodologies. Here some authors have found that acquisition activity is random and therefore unpredictable. For example, Shugart and Tollison (1984) found that numbers of acquisitions are best described by a random walk and declared that this meant that the series was random but, as Golbe and White (1993) observed, Shugart and Tollison appear to have confused the analysis of acquisition levels with that of differences and their final conclusions actually imply that, whilst differences are random, takeover levels are autoregressive. More recently, Chowdhury (1993) used unit roots tests to show that the changes in merger numbers are random although he did not investigate levels of takeover activity.

The second type of article concerning acquisition activity has concentrated on the influence that macro-economic factors appear to have on takeover levels. One of the earliest papers of this type was by Gort (1969) in which the author found that acquisitions took place because the economic conditions changed in such a manner that the values of the firms were significantly altered. Following Gort other papers have also attempted to link the level of activity in the corporate control market to specific macro-economic factors. In 1975 Steiner linked numbers of acquisitions to stock prices and GNP. Melicher, Ledolter and D'Antonio (1983) proposed their "merger activity - economic prosperity" theory (Melicher, Ledolter and D'Antonio, 1983, page 424) which links changes in the expected level of economic growth and

the capital market conditions to acquisition levels. More recently Golbe and White (1988) used regression models to analyse the link between the level of takeovers in America and the economic situation and found that similar economic variables were significant.

This paper extends previous work on UK takeovers by considering both the time series and cross-sectional properties of numbers of acquisitions and then combining the information from both these investigations to form models for both the number of acquisitions and the differences.

Methodology

Tests of Random Behaviour

The first hypothesis that needs to be tested here is the notion that the behaviour of the acquisition market is not random. It is unlikely that the series will prove to be random as there are precedents in other areas of research concerning takeovers that strongly suggest that the behaviour is predictable. For example, existing research indicates that firms that become involved in takeovers can be identified and this finding relies on takeover activity being predictable.[1] If this aspect of takeover activity, or any other, is predictable then it is highly unlikely that the numbers of takeovers will be random.

Random behaviour in a sequence of numbers is easily identified by the absence of any link between consecutive terms in that series. Two tests for this will be used here.

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[1] The reader is directed to papers such as Dietrich and Sorensen (1984), Palepu (1986) and more recently Powell (1997) for details of research in this area.

The first one is the Run Test as used by Golbe and White (1988). This test involves the examination of the residuals created by the regression of the number of acquisitions against a simple time trend. If the residuals come in runs of either positive or negative terms then this means that the behaviour of the acquisition market is cyclic and not random. If the expected number of runs is approximately equal to the observed number then the series is random. Conversely, if there are fewer observed runs of residuals than the expected number then the series is moving in a cyclic manner. The expected number of runs of either positive of negative residuals of any given length is given in equation 1 below.

$$E(R) = \left(\frac{1}{2}\right)^{i+1} N \qquad (1)$$

where i is the length of the run of residuals and N is the number of observations.

The second test of randomness is the Box Jenkins procedure which provides a way to test the underlying nature of a series. The Box Jenkins methodology explains that data should be stationary in the univariate context. [2] The identification procedure using the correlogram typically yields a test of randomness using the Box Pierce statistics. If the number of acquisitions are not random then this procedure will also yield information concerning the time-series properties of the data which can be incorporated in regression models.

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[2] This is not necessarily the case in the multivariate case, however. There is an interesting example for bivariate MA models in differences which yields a bivariate VAR in differences and levels, see Burke and Hunter (1998). This generalises to a more complex structure as in Johansen (1991).

Ordinary Least Squares Regression and ARMAX models

Assuming that the series of numbers of acquisitions proves to be cyclic and not random then it should be possible to determine the relationship between this series and the economic conditions in the periods immediately before. This part of the investigation will use the Ordinary Least Squares (OLS) methodology in conjunction with the general to specific methodology. If the sequence of numbers of acquisitions contains either an autoregressive or moving average component then this can be combined in the regression model forming an ARMAX model, the second type of result generated here. This type of model is generally represented as in equation 2.

$$y_t = \mu + \gamma_1 y_{t-1} + ... + \gamma_p y_{t-p} + \beta'x + \varepsilon_t - \theta_1 \varepsilon_{t-1} - ... - \theta_q \varepsilon_{t-q} \qquad (2)$$

where $\beta'x$ is a vector of exogenous terms and coefficients.

The general to specific approach will be used to systematically restrict equation 2 until it reaches a more parsimonious explanation of the data. [3] This approach is particularly useful when financial and economic theory suggest interaction across markets which yield a broad range of potential influences on this particular type of activity. General to specific modelling provides a mechanism for selection when the final choice is not clear at the beginning of the modelling procedure. Melicher, Ledolter and D'Antonio (1983) claimed that most takeovers are planned in the two periods before the acquisition is announced so that supposition will be used that to limit which lags will be included in the general model.

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[3] Parsimony in the model is a feature linked to the Box Jenkins methodology

In the previous research concerned with the analysis of acquisition activity as a whole a great many different macro-economic variables have been used. The selection used here is based on previous papers and also upon articles that have attempted to identify factors that can alter stock prices, such as Chen, Roll and Ross (1986). The dependent variable is the total number of takeovers in the period and the independent variables that will be used here are (i) business confidence, (ii) the effective exchange rate, (iii) FTSE all-share price index, (iv) gross domestic product, (v) interest rate, (vi) oil prices and (vii) treasury bills. Each of these variables can have an impact on the financial position of a firm, its ability to fund investments such as takeovers and the competitive position of companies both domestically and globally. Further information on these variables including a detailed account of the influence that each is expected to have on numbers of takeovers and references to their use in existing empirical work can be found in the Appendix.

Empirical Results

The process of analysis starts with the Run Test. The null hypothesis here is that the behaviour of the series of numbers of acquisitions is random. Table 1 contains the results for the Run test and the pattern of positive and negative runs is clear.

[Table 1 goes here]

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There are eighty four observations in the acquisition data but the residuals generated by this process form just twelve runs of positive and negative numbers. If the series was random then there would be approximately forty two runs in the residuals. This result demonstrates that the random activity hypothesis can be rejected UK acquisition levels. This is unsurprising given the quantity of previous research that is based on the assumption that aspects of takeover activity are predictable. Instead of a random series there appears to be a clear link between consecutive terms in the series of numbers of acquisitions suggesting that an autoregressive component exists in the series. This test, however, whilst suggesting the existence of an autoregressive component is incapable of confirming the order of that component and a more formal test of the time-series properties is required.

The Box Jenkins procedure confirms the absence of random behaviour and confirms the presence of an autoregressive component in the series, as Shugart and Tollison (1984) found. This autoregressive element is of order one meaning that the best predictor of the number of acquisitions that will take place in any period is the number of takeovers that occurred in the previous period.

The results for both the OLS and ARMAX models can be found in Table 2, below. These results represent the specific models and they are all well specified.

[Table 2 goes here]

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Models of Acquisition Levels

The level of business confidence is consistently positively linked to the number of takeovers. High levels of business confidence will inspire firms to attempt riskier projects and, since acquisitions are very risky investments, it follows that high levels of takeover activity will correspond to high business confidence. This result is mirrored by the importance of the FTA index. If the stock market is high companies may feel that the time is right for an acquisition leading to an increase in takeover numbers.

The GDP variable is also positively linked to numbers of acquisitions. An high industrial production leads to higher profits for the involved companies. This higher profits means that firms will be able to invest more and, as a result, more companies may find themselves in a position where they can afford to enter the market for corporate control heralding an increase in the overall level of acquisition activity.

Oil prices are negatively linked to the number of acquisitions and highly significant. An high oil prices reduce the number of acquisitions that follow. When oil prices are high most companies would simply pass the cost on to their customers, however for some companies high oil prices could dramatically alter production costs and, consequently, reduce the profits that the company can generate which makes funding an acquisition impossible. It is also possible that rising oil prices make companies more cautious which could also lead to a decrease in takeover activity.

Finally, there is the numbers of acquisitions term which appears in the ARMAX models. This variable greatly improves the predictive abilities of the models and is consistently the most significant term in the results. The importance of this term supports the theory that an increase in numbers of acquisitions can lead to a further increase in takeover activity in the following periods, the autoregressive component identified in the time-series analysis. Takeovers can radically change the composition of an industry and may force the remaining firms to acquire in order to protect themselves from the changed circumstances, although this idea may be enough to account for the vast importance of this term. More likely is the suggestion that companies are led by the behaviour of other firms and, in times of high acquisition activity, may want to attempt the same form of investment simply because many other companies have done the same.

Model of Differences

The changes in numbers of acquisitions are difficult to model using economic factors and they display no time-series properties. Only two of the terms in the models are significant. Decreases in the interest rates and il prices are followed by increases in takeover activity. These two variables both influences the ease with which firms can fund takeovers and decreases in both series would make it easier for more takeovers to occur in the following months as these results demonstrate.

The volatility of the series of numbers of acquisitions is very high and although it is possible to predict the directions in which the changes will go no model could be produced that could precisely represent the magnitude of the changes. This is not

unexpected as authors of previous research, for example Blair, Lane and Schary (1991), have commented on the excessive volatility demonstrated by numbers of acquisitions. It appears that it is relatively straight forward to predict the level of the series, however, the calculation of forecasts for a series that is considered non-stationary in the univariate context is fraught with difficulties although a simple eye-ball test and predictive failure tests do confirm the above supposition. Alternatively, transforming the model into differences clearly demonstrates that the volatile data is better explained when the levels information is incorporated in the model

Conclusion

This paper aimed to investigate the behaviour of the market for corporate control in the UK. Specifically it was concerned with testing whether the volume of acquisition activity is random and, if this is not the case, how well takeover levels can be explained using both economic factors and time-series information about the sequence of takeover numbers.

The idea of random activity for the level of UK acquisition activity was refuted after conducting the run test and a Box Jenkins procedure. Following this result OLS and ARMAX models were used to examine the links between takeovers and the economic conditions. The most important economic factors in these results were business confidence, share prices, industrial production and oil prices. The most important term of all was the previous number of takeovers which made a considerable improvement in the performance of the models and was the most significant term of any that were considered.

The empirical models presented here demonstrate a clear link between the cycle of numbers of acquisitions and the economic cycle but there are times when the link is relatively weak. The years 1986 to 1991 exhibit a very large increase in the level of acquisition activity as Figure 1 demonstrated. The heights which acquisition activity reached were far greater than any other economic factor during those years. This rise seems to be prompted by the autoregressive component in the series, as it vastly exceeds the level of the economy at that time, but it is difficult to understand why the level of takeovers should rise so drastically far no obvious reason. It is true to say that acquisition activity involves a strong human element that is not predictable but if this sort of rise is prompted solely by previously high takeover levels it would appear that the managers of acquiring firms are very easily led and completely irrational which seems unlikely on such a considerable scale. This strange behaviour remains an area suitable for previous research.

Appendix

The total number of acquisitions is recorded by the Central Statistical Office and quarterly figures can be found in the HMSO publication "Financial Statistics". Numbers of acquisitions were analysed for a twenty year period from the beginning of 1974 to the end of 1994. Takeover levels in the period appear to be cyclic although the years 1986 to 1991 show excessive levels of acquisition activity, as Figure 1 demonstrates.

[Figure 1 goes here]

All of the macro-economic factors were collected from Datastream for the same twenty year period as the numbers of acquisitions and with the same quarterly frequency. The variables are:

- Business confidence. This is a composite series constructed from the results of the CBI surveys in the UK. This term represents expectations for future economic performance which could influence investment decisions and, as a result, may be expected to influence acquisition levels.

- The effective exchange rate was used by Priestley (1994) as one of the factors that can alter the value of asset prices and is also referred to by Rock (1994) who claimed that the relative competitiveness of firms internationally will influence acquisition activity and could also alter the level of funding available for takeovers.

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- FTSE All-Share Price Index. This is another term that was very popular in the previous papers that attempted to link economic factors to numbers of acquisitions and it was often significant in the previous empirical work.

- GDP. Gort (1969), Steiner (1975), Melicher, Ledolter and D'Antonio (1983), Golbe and White (1988) and Rock (1994) all found that this factor was positively linked to takeover numbers whilst Beenstock and Chan (1988) and Priestley (1994) both found that it influenced asset prices as high levels of industrial production are linked to higher sales which, in turn, produce high profits and increase share prices.

- Interest rate. Here the one year Interbank rate is used following results in the previous papers that suggest that terms referring to longer time periods are better indicators of takeover activity. This term represents is the link between economic conditions and funding for acquisitions.

- Oil prices. According to Chen, Roll and Ross (1986) this term should be included as an important economic factor that can influence share prices since OPEC become a major force in the world economy. Changes in oil prices may affect numbers of acquisitions by reducing the level of funds that firms have available for investing.

- Treasury bills are represented by the return on three month t-bills. Beenstock and Chan (1988) used this as an alternative measure of changes in the capital markets, which could alter future asset prices corresponding to theories for acquisition activity used by both Steiner (1975) and Rock (1994).

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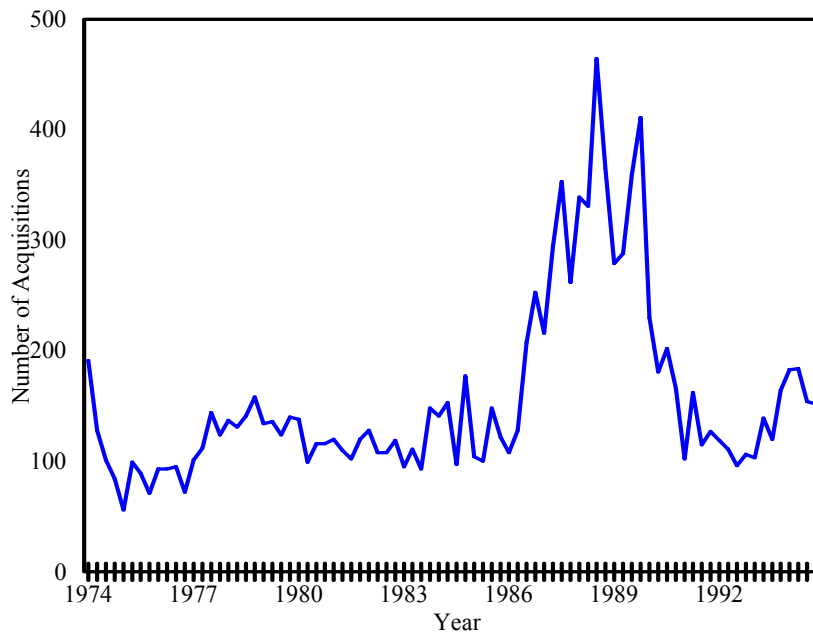Figure 1. Total Numbers of Acquisitions in the UK 1974 - 1994

Table 1. Runs Test Results

Run length	Number of positive	Number of negative	Total	Expected total for random sequence
84 Observations				
1	2	2	4	21.00
2	2	0	2	10.50
3	0	0	0	5.25
4	0	0	0	2.63
5	0	0	0	1.30
6	0	1	1	0.66
7	0	0	0	0.34
8	1	0	1	0.16
9	0	0	0	0.08
10	0	0	0	0.04
11	0	0	0	0.02
12	0	1	1	0.01
13	0	0	0	0
14	0	0	0	0
15	1	0	1	0
16	0	0	0	0
17	0	1	1	0
18	0	1	1	0
Total	**6**	**6**	**12**	**@42**

Table 2. OLS and ARMAX Results for Numbers of Acquisitions

Variable	Numbers of Acquisitions			Rate of change	
	Lags	OLS model	ARMAX model	Lags	OLS model
Constant	---	-100.1 ** (-2.46)	-101.2*** (-1.79)	---	-0.05 (-1.14)
Numbers of Acquisitions	1	---	0.56 * (4.32)	---	---
Business confidence levels	2	2.02 ** (2.49)	1.01 *** (1.7)	1	0.25 (1.42)
Effective foreign exchange rate	1	1.16 (0.48)	0.57 (0.28)	1	1.81 (1.62)
FTSE All share index	2	0.24 ** (2.53)	0.1 *** (1.8)	1	0.56 (1.26)
GDP	1	14.9 * (3.33)	5.09 ** (2.17)	1	4.92 (1.64)
Interest rate	2	-13.98 (-1.18)	-4.99 (-0.89)	2	-0.76 *** (-1.69)
Oil prices	1	-6.75 * (-3.31)	-3.76 ** (-2.05)	1	-0.32 *** (-1.95)
Treasury bills	2	-8.9 (-0.82)	-3.27 (-0.36)	1	-0.48 (-1.3)
Adjusted R^2	---	0.55	0.69	---	0.38
Durbin-Watson Statistic	---	1.80	2.25	---	1.76
T statistics are in parenthesis					
Denotes term is significant at 1% *, 5% **, 10% ***					