Studying Trends in Scrapie Reporting in Great Britain Using Multivariate Time Series.

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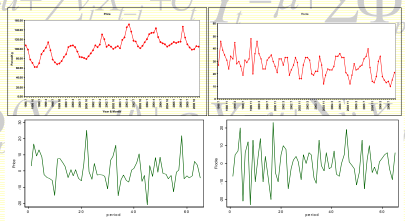
The data for this study were obtained from the Scrapie Notifications Database (SND), the Meat and Livestock Commission (MLC) and the English Beef and Lamb Executive (EBLEX).

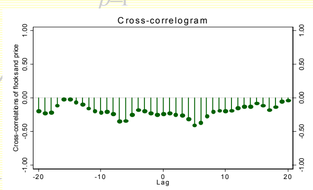
In previous works (1,2), the authors showed the suitability of time series analysis to flag out a significant reduction in the number of reported cases in the last months of 2004 close to the introduction of the compulsory scrapie flocks scheme (CSFS) following EU legislation (3). It was suggested that the decrease was an artefact and not a real drop in the incidence of the disease as farmers reacted to the imminent introduction of a new set of restrictive EU regulations. Previous work (4) have also indicated the effect of farmers' reporting patterns on the observed incidence of the disease in the U.S. High compensation payments and a favourable regulatory context explained a substantial proportion of the varying number of reported cases of scrapie across the years.

Following a rationale similar to that of (4), we hypothesize that economic factors such as meat prices may affect the scrapie reporting level. The objective of this study is twofold: i) to assess if seasonal changes in meat prices show any association with the reporting levels and ii) to find a suitable model to capture and describe this relationship.

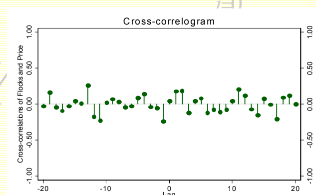
There are limitations for the analysis: the occurrence of under ascertainment which is reported by various sources (5). Consequently, our analyses will build on the reporting level and not on the actual disease level. Only those flocks where at least one clinical case was reported to the SND, from July 1998 when new legislation came into force, are considered in this study. Data from 2001 have not been included because of the foot-and-mouth outbreak.



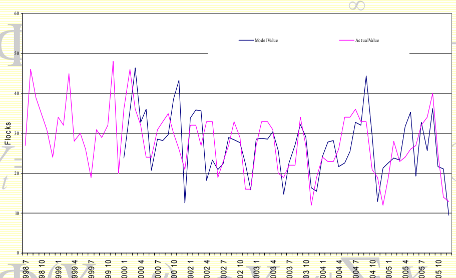
The plots of meat prices and flocks, monthly observations in each case, clearly show a seasonal pattern and trend (Figures 1 and 2). We difference both series to make them stationary and allow the fit of a suitable model. After differencing, at lag 1 and lag 12 for the prices and the flocks, we examine the plots and apply Dickey-Fuller unit root tests to confirm that stationarity has been achieved for the two series.



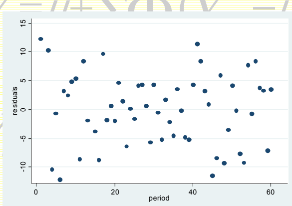
We plot a cross-correlogram of the undifferenced data to test the cross-correlation between meat prices and reporting levels (plot on the left) All the correlations are negative: when the price of meat drops the reporting levels rise. We also plot a graph of differenced data (plot on the right) to assess the time delay in the cross-correlation between the two series.



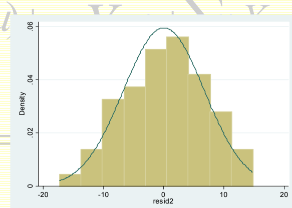
We use autocorrelation, cross correlation, plots of the residuals of the model and AIC (Akaike information criterion) to choose a suitable model. We choose a Vector Autoregressive model (VAR) of order 5. We estimate our model parameters by the least squares method. We also checked other models VAR(3), VAR(4) and VAR(6); VAR(5) seemed the most appropriate model by weighing up the principle of parsimony and goodness of fit. This model can be used to forecast the future reporting levels and prices and study any significant changes in these series.



An alternative approach when only one variable needs to be used as output in multivariate analyses is transfer function modelling. We also use a transfer function model to estimate the model parameters with flock level AR(5) as output variable and price AR(5) as input variable. The transfer function model provides very similar fit.



The plot and histogram of the residuals confirm that the model provides an adequate fit. The residuals do not show any pattern and they are normally distributed. Portmanteau test for cross correlation of residuals also confirms that the model is satisfactory.



We have seen a significant relationship between meat prices and reporting levels. However, we do not claim that one series, the prices, are the cause of the variability in the other series, the reporting levels. Many other factors will also contribute to such variability. In fact, there is as much evidence to support a causal relationship between the two series as there is to consider them independent. Our objective was not to prove the former nor dismiss the latter. The negatively correlated series however showed that, even if not remotely related, prices seem to be a good predictor of the reporting levels in Great Britain during the period of study. There is scope for further multivariate analyses with more variables (i.e. one-off impacts from the application of specific control measures). Further work could also be undertaken to include other scrapie surveillance schemes such as the fallen stock survey, the abattoir survey and the compulsory scrapie flocks scheme.

References:

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2. 2. Ali, M. & Del Rio Vilas, V.J. Evidence for changes in incidence of prion diseases in small ruminants in the UK. Prion Diseases of Domestic Livestock, May 2006, London.
3. 3. Anon., 2003. Commission Regulation (EC) No 1915/2003 amending Annexes VII, VIII and IX to Regulation (EC) No 999/2001.
4. 4. Kuchler, F. and Hamm, S. (2000). Animal disease incidence and indemnity eradication programs. Agricultural Economics 22, 299-308.
5. 5. Del Rio Vilas, V.J., Sayers, R., Sivam, K., Pfeiffer, D.U., Guitian, J. and Wilesmith, J.W. (2005). A case study of capture-recapture methodology using scrapie surveillance data in Great Britain. Prev Vet Med 67, 303-317.

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