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FEEDBACK

Working's Effect Revisited—Fitting Univariate Time Series to Stock Price Data: A Reply

THE PAPER BY K LAM [1] in this issue presents some critique against empirical applications of ARIMA models in fitting stock price data. As an illustration of mishandling the data and misinterpretation of the results Lam considers our paper "Forecasting stock market prices in a thin security market" [2].

The basis for Lam's critique is the idea that our paper is a study of the weak efficiency of the Finnish stock market with quarterly indices used as the data. Further, according to Lam: although the ARIMA models identified have a nice fit with the data, the authors have problems when interpreting the results, because the quarterly indices have been computed as arithmetic means of the monthly values. This is essentially due to two technical reasons: Working's effect and over-differencing the data.

It is a great pleasure for us that Lam has shown interest in our paper and has read it. Unfortunately, his familiarity with the paper is only superficial and partial. Although the two technical issues proposed by Lam are—among a huge number of other things—important in studying the weak efficiency of stock market, their speculative consideration has no relevance in connection with our paper. We were familiar with these effects when carrying out the research. Working's effect has been taken into account when making any conclusions, see e.g. [2, pp. 149]: "The interpretation must be seen, however, in the light that it is based on the use of average values (monthly or quarterly) in the analysis", whereafter a reference to Working's paper [3] follows. Seeing over-differencing as a problem in our analysis is also based on inaccuracy in reading or misunderstanding, as will be shown later on.

Lam classifies our paper as an efficiency study ("Virtanen and Yli-Olli studied the weak efficiency of the Finland stock market by fitting ARIMA model to quarterly indices in years 1975-1984"). This is the point where the most serious mistake

by Lam takes place. The purposes of our study, entitled "Forecasting stock market prices in a thin security market", were [2, pp. 145-146]:

- (1) To analyze whether, to what extent, and in which form, a general monthly and quarterly stock market price index is predictable on a thin security market like the Helsinki Stock Exchange.
- (2) To compare the forecasting results based on univariate time-series analysis and multivariate econometric models with each other.
- (3) To develop composite forecasting models for stock prices and examine the forecasting improvement of these models relative to the time-series and econometric models.

The above definition of the research problem shows that our paper concentrates in constructing and comparing two different forecasting models, one a univariate time-series model and the other a multivariate econometric model. Further, using these two models as components, a composite forecasting model is built. All the derived models, both in monthly and quarterly form, are compared with each other as well for their estimation diagnostics as for their forecasting accuracy measures. Thus, it is unambiguously clear that our paper is not a weak efficiency study as Lam wants to see it.

Stock market efficiency forms, however, the general framework for our study. We make references to several earlier papers where stock market efficiency has been tested in European and Finnish markets [2, pp. 145-146]. The results show deviations from the semi-strong, even from the weak efficiency hypothesis. These earlier results and findings made it possible and sensible to try (and to succeed) to build the forecasting models: "These anomalies and deviations from market efficiency are the starting point of this research"

[2, pp. 146]. To make it totally clear we still cite a more comprehensive report of this research project: "This study is not an efficiency but a forecasting study. The proper efficiency studies—especially when the weak form of efficiency is concerned—must be done using daily price and return data of individual shares" [4, pp. 75].

A misunderstanding and, as a consequence of this, misclassifying our work as an efficiency study have lead Lam to his critique. Above we have shown this critique unjustified. In the following, we present some additional detailed comments on Lam's memo. Our models were constructed for forecasting purposes. Therefore, it was natural and necessary to choose the quantity to be forecast from the publicly available Finnish indices. We chose the most comonly used general stock market index, the Unitas index [2, pp. 146]. When modelling and forecasting this index, it must be used, of course, in the form it is computed and published. This means averaging for the aggregated values. For forecasting purposes, as in our study, this has no harmful effects. For efficiency studies the results can be, as also Lam quite correctly points out, only tentative. The motivation for the use of the Unitas index as the prediction variable was given in the paper.

As clearly stated, the study was not an efficiency study. Even bearing Working's effect in mind [2, pp. 149], the results can, however, be interpreted as a support for the earlier findings of anomalies and deviations from weak-form market efficiency on the Finnish stock market. This is due to a clear identification of nicely behaving stock price models, not only of a quarterly ARIMA model—which Lam only deals with—but of a monthly model as well. The monthly models are the primary tools in our analysis, the quarterly models are estimated mainly to control and confirm the results. It is not possible that the very clear and, in different levels of aggregation, consistent pattern in stock price data would be totally

generated by the averaging process, there exists a non-random component in the time series.

Over-differencing is another technical mis-handling of stock price data considered and experimented by Lam. As stated earlier, avoidance of this trap has been carefully managed in our study. An attentive reader can find this also documented [2, pp. 148, especially Section 2.2.2 and Table 1].

In his memorandum, K Lam stresses the careful use of statistical techniques and their computer software packages in connection with empirical economic (finance) applications. This is a good advice for every researcher working with empirical data. But also the reader of this type of article has his responsibilities. A fast and superficial reading of a research report may lead to erroneous interpretations of the results, even to misunderstanding of the main objectives of the study.

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