Modeling and Forecasting Gold and Dollar Prices Using Robust Simulation-based Estimation

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Abstract:
Multivariate time series data are often modeled using vector autoregressive moving average (VARMA) model. However, the presence of outliers can violate the stationary assumption and may lead to wrong modeling, biased estimation of parameters and inaccurate prediction. Therefore, a new robust simulation-based estimation for parameters of the VARMA model was introduced in this research. The simulation-based estimation as a kind of indirect estimation uses the estimation of the simple vector autoregressive (VAR) model with large order rather than the estimation of the complex VARMA model. To do this, the VAR model was first fitted on observation. Then, the data from different VARMA models were simulated and on each simulated data, the VAR model was fitted. The simulation-based method is based on the distance between the estimation of the VAR model on the simulation and observation data. The values of the parameters that use the VARMA model in the simulation and provide the minimum distance are indeed the estimates of the VARMA model parameters. Thus, if the estimates of VAR model are solid, we expect the VARMA model to be stable as well. For this reason, the robust BMM method of Muler and Yohai (2013) was used to estimate the VAR model. The simulation-based estimator has

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simulation study in the data without outliers showed that the ratio of the mean square error of this estimator to the conditional maximum likelihood estimator was between 0.6 and 0.7 which is allowable for a robust estimator. Besides, when the 0.05 data is contaminated by the outliers, the mean square error of the robust simulation-based estimator is lower than the conditional maximum likelihood estimator.

As a real example, the gold and dollar price data in the Tehran free market were collected and investigated weekly in the period 2013-2018. It should be noted that gold and dollar prices are often affected by economic, political, and war crises which, in turn, create outliers. Thus, a robust method was used to reduce the bad effects of these outliers to estimate the model correctly. As gold and dollar prices are highly correlated, the VARMA model can be used to predict the gold and dollar interactions. Fitting the VARMA (1, 1) model to these data shows that the variance of the gold price error in the robust model to the conditional maximum likelihood reduced by 38%. However, the variance of dollar error in the robust model to the maximum conditional likelihood reduced by 30%. In other words, using robust method leads to better predictions with less variance. According to the fitted vector model, the gold price forecast for each week was obtained using the gold price of the previous week and the gold and dollar errors of the previous week. Besides, a forecast of the dollar for each week was obtained by the dollar and dollar error of the previous week.

JEL classification**:** C3, C15, C22, E31, E37

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