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Inflation, forecast intervals and long memory regression models

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Abstract

We examine recursive out-of-sample forecasting of monthly postwar US core inflation and log price levels. We use the autoregressive fractionally integrated moving average model with explanatory variables (ARFIMAX). Our analysis suggests a significant explanatory power of leading indicators associated with macroeconomic activity and monetary conditions for forecasting horizons up to 2 years. Correcting for the effect of explanatory variables, we still find fractional integration and structural breaks in the mean and variance of inflation in the 1970s and 1980s. We compare the forecasts of ARFIMAX models and ARIMAX models over the period 1984–1999. The ARIMAX(1, 1, 1) model provides the best forecasts, but its multi-step forecast intervals are too large. The multi-step forecast intervals of the ARFIMAX(0, *d*, 0) model prove to be more realistic.

Keywords: Long memory; Inflation; Time series; Recursive estimation; Multi-step forecasting

1. Introduction

This paper concerns the usefulness of the ARFIMA model for US inflation for out-of-sample forecasting. We consider both point and interval forecasts and we also examine the usefulness of explanatory variables for different forecast horizons. Therefore we do not only consider time variation in the coefficients for the mean of inflation, but also time variation in the forecast error variance.

The most useful explanatory variables for US consumer price inflation are connected with the Phillips curve, with oil price shocks, and with changes in monetary policy. Gali and Gertler (2000) give references for relevant recent explanations. Unemployment, output gap variables and real unit labour costs correspond with the Phillips curve. Hooker (1999) summarises evidence on the effect of oil price shocks on postwar US inflation. Ball and Mankiw (1995) stress the effect of the sectoral distribution of price changes.

The relevant literature reveals that some variables are important for the explanation of short term inflation dynamics, whereas others may help to explain the longer run dynamics.

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Moreover, the effects of some variables, like the effect of the oil price on overall inflation, seems to have changed significantly over time. After 1980, oil price shocks did not have the same impact as in the 1970s, and monetary policy seems to have decreased both the mean and the variance of inflation, ceteris paribus. The empirical part of the economic literature also shows the sluggishness of inflation adjustment in adjusting to fundamentals. Indeed, many lags of inflation are statistically significant in reduced form equations of economic models, which is consistent with long memory behaviour found in time series analysis of inflation series, see Bos, Franses, and Ooms (1999) and the references cited therein.

We examine the predictive ability of the dynamic regression models for several horizons, extending results of Stock and Watson (1999), who analysed only 12 month ahead forecasting. We confine our analysis to only a few relevant explanatory variables. Therefore we rule out large-scale leading indicator variables and sectoral asymmetry variables. Moreover, we take a statistical time series approach, where we derive multi-step forecasts from the likelihood for the model for one-step ahead predictions. In agreement with Stock and Watson (1999) we use a simulated out-of-sample forecasting framework, but we use fixed specifications for the recursive forecast evaluation period.

The remaining part of our paper is organised as follows. Section 2 starts with a recursive ARFIMAX analysis of monthly US inflation and three leading indicators. We compare specifications for the error process up to an ARFIMAX(1, *d*, 1) model and allow for deterministic regime changes. We use likelihood based time domain estimators based on the algorithm of Sowell (1992), see Doornik and Ooms (1999). This allows us to extend the model with macroeconomic leading indicators from the database developed by Stock and Watson (1999). Our starting point is a model with two level shifts in the period 1960–1999. We investigate the stability of the explanatory effects and we examine how they complement the simple level shift specification. We compare the forecasting ability of the models. We find that forecast intervals are too wide. Section 3 therefore analyses the results of weighted forecasting based on structural shifts in the variance. Section 4 employs statistical tests on the forecasts. Section 5 concludes.

2. Recursive ARFIMAX forecasting

We consider a monthly US consumer price index, as provided by the Bureau of Labor Statistics' (BLS) website, July 2000. It concerns the influential core consumer price index, that is the US city average all items less food and energy, 1982–1984 = 100, BLS code `CUUR0000SA0L1E`. We use data from 1960:04 to 1999:12 in our statistical analysis. Core inflation has not been affected by many outliers and it is therefore easier to interpret and analyse than other CPI indices.

2.1. Basic features of US core inflation

Fig. 1 shows a time series plot of monthly core inflation, measured as 100 times the first differences of the logarithms of the index. We seasonally adjust the series with two sets of centred seasonal dummies, allowing for a break in the seasonal pattern in 1984. This break roughly corresponds with a change in the seasonal pattern detected by the official seasonal adjustment procedure used by the BLS. The autocorrelation functions of inflation and changes in inflation establish the long memory property of inflation, that is the inflation series appears nonstationary, while the differenced inflation series appears to follow an MA(1) process. The combined information of Fig. 1 suggests an order of integration larger than zero,