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Inflation, inflation uncertainty and output growth in the USA

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ABSTRACT

Employing a multivariate EGARCH-M model, this study investigates the effects of inflation uncertainty and growth uncertainty on inflation and output growth in the United States. Our results show that inflation uncertainty has a positive and significant effect on the level of inflation and a negative and significant effect on the output growth. However, output uncertainty has no significant effect on output growth or inflation. The oil price also has a positive and significant effect on inflation. These findings are robust and have been corroborated by use of an impulse response function. These results have important implications for inflation-targeting monetary policy, and the aim of stabilization policy in general.

1. Introduction

The relationship between inflation uncertainty, inflation, output growth uncertainty and output growth is always interesting and controversial for economists. Recently, most of the central banks are fraught by trying to keep inflation low. Inflation is increasing all over the world due to rising oil and commodity prices. It seems that monetary policy in most the countries, and especially in the US, is not effective in maintaining low inflation and stable economic growth. Declining economic growth most probably will be the cause of recession.

Economists are divided regarding the relationship between inflation and growth. There are several studies in which economists have found positive, negative or no relationships between inflation and growth. Thus it is not surprising that the empirical literature on this subject is divided. But most economists agree that the cost of higher inflation and inflation uncertainty on growth and welfare are significant, especially in the context of a rising oil price environment. Much attention has been focused on the relationship between inflation and inflation uncertainty. Although there are a few studies in the areas of inflation uncertainty, growth uncertainty and growth, we believe that the coverage of the topic is not adequate, and as such more investigations are required in this area.

While both theoretical and empirical literature on inflation–growth relationships remains unresolved, there is another, less studied, link between the inflation process and economic performance.[1] Both Okun [2] and Friedman in his 1977 Nobel Lecture [3] argue that increased uncertainty reduces the information function of price movements and hinders long-term contracting, thus potentially reducing growth. Friedman [3] also argues that high inflation leads to higher inflation uncertainty. Ball [4] formalizes the positive relationship between inflation and inflation uncertainty. In Ball's model, the public does not know the preferences of the policy maker, but uncertainty of the policy maker's preferences only affects inflation uncertainty when inflation is high.

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1 For a good survey of both theoretical and empirical literature, see [1].

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Thus, more recent studies use conditional variance as a measure of uncertainty, following the path-breaking work of Engle [5] on the autoregressive conditional heteroskedasticity (ARCH) approach. The studies (e.g. [1,6,7]) that use the generalized ARCH (GARCH) approach, find significant positive relationships between inflation and inflation uncertainty and significant negative impacts of inflation and inflation uncertainty on growth in industrialized countries.[2] Using ARIMA–GARCH, Payne [12,13] found that inflation increased the inflation uncertainty for the US and Thailand. Using bivariate GARCH modelling, both Shields et al. [14] and Grier et al. [7] found that inflation uncertainty decreased inflation and output growth for the US, but output uncertainty increased growth but reduced inflation. There are only a few such studies (e.g. [15,16]) involving middle-income countries. Nas and Perry [15] found that inflation significantly raised inflation uncertainty in Turkey during the period 1960–1998. Their study does not include the effect of inflation uncertainty on growth. Using multivariate EGARCH-M, Grier and Grier [16] found that inflation uncertainty had a negative and significant effect on output growth in Mexico during the period 1972–2001. Berument and Dincer [17] found that inflation caused inflation uncertainty for G-7 countries using a "Full Information Maximum Likelihood Method" with extended lags.

The examination of the impact of inflation on inflation uncertainty is crucial according to Okun [2] and Friedman [3], as it is through inflation uncertainty that high inflation can adversely affect economic growth. That is, if high inflation does not cause inflation uncertainty then we are unlikely to observe a negative relationship between inflation and economic growth.

Most of the studies have used a univariate GARCH or EGARCH specification for the estimation of the inflation uncertainty. Univariate models do not allow studying the joint determination of more than one series. This problem can be overcome by using a bivariate model. Grier et al. [7] and Shields et al. [14] used a bivariate GARCH specification for the estimation of the inflation uncertainty and output uncertainty. However, there are some disadvantages of the use of GARCH modelling. Our paper differs from the previous papers in two ways. First, in this paper we have used bivariate EGARCH modelling, which we believe to be a better approach. This approach also allows us to discuss time-varying correlation between inflation and output growth. Bivariate EGARCH developed by Nelson [18], captures potential asymmetric behaviour of inflation and output growth and avoids imposing non-negativity constrains in GARCH modelling by specifying the natural logarithm of the variance ($\ln \sigma_t^2$). It is no longer necessary to restrict parameters in order to avoid negative inflation and output uncertainty. Secondly, we have included a newly constructed oil price dummy to capture the impact of oil price[3] on inflation. Thus, this paper aims to re-examine the inflation–growth relationship in the US by employing a more appropriate econometric method, the multivariate EGARCH-M model. The use of higher frequency data makes it possible to use EGARCH-M model to estimate inflation uncertainty and investigate the impact of inflation on inflation uncertainty, and hence on growth.

Thus the hypotheses we are going to test are as follows.

(i) Does inflation uncertainty reduce economic growth?
(ii) Is there a significant relationship between inflation and inflation uncertainty?
(iii) Does the oil price have any influence on the level of inflation?

The paper is organized as follows: Section 2 provides a brief review EGARCH methodology and data description. Section 3 explains the estimated results and checks the robustness of findings by using appropriate diagnostic tests and explains the statistical significance of innovations of the variables using Generalized Impulse Response Function. Section 4 contains concluding remarks.

2. Model specification and data description

A brief description is provided here for the bivariate EGARCH model with time-varying correlations relating the growth rate in output and the inflation. We denote the inflation by π_t, the annualized monthly difference of the natural logarithm of P_t, the producer price index: $[(\ln P_t - \ln P_{t-1}) \times 1200]$ and the growth rate in output by Δy_t, the annualized monthly difference of the natural logarithm of y_t, the industrial production index: $[(\ln y_t - \ln y_{t-1}) \times 1200]$ for the period April 1957 to April 2007. The data used in this study are obtained from the DX-Econ data-OECD Main Economic Indicators.[4] The interaction of the expectation part with the risk (captured by contemporaneous standard deviation of the residual) in the relationship is described by the following equations:

$$\pi_t = \alpha_\pi + \beta_{\pi,1}\pi_{t-1} + \beta_{\pi,2}\pi_{t-2} + \beta_{\pi,3}\Delta y_{t-1} + \beta_{\pi,4}\Delta y_{t-2} + \beta_{\pi,5}\sigma_{\pi,t} + \beta_{\pi,6}\sigma_{\Delta y,t} + \beta_{\pi,7}D_{\text{oil},t} + \varepsilon_{\pi,t}, \quad (1)$$

$$\Delta y_t = \alpha_{\Delta y} + \beta_{\Delta y,1}\pi_{t-1} + \beta_{\Delta y,2}\pi_{t-2} + \beta_{\Delta y,3}\Delta y_{t-1} + \beta_{\Delta y,4}\Delta y_{t-2} + \beta_{\Delta y,5}\sigma_{\pi,t} + \beta_{\Delta y,6}\sigma_{\Delta y,t} + \varepsilon_{\Delta y,t}, \quad (2)$$

where $\sigma_{\pi,t}$ and $\sigma_{\Delta y,t}$, the standard deviations of the residuals of the inflation and the growth rate in output, are our inflation uncertainty and growth uncertainty, respectively. In Eq. (1), Δy_{t-1} and Δy_{t-2} will capture the lagged output effect on

[2] Also, see [8] for uncertainty on macroeconomic performance; [9] for inflation and inflation uncertainty in the UK; [10] for inflation and inflation uncertainty for developed and emerging countries; and [11] for inflation-uncertainty hypotheses in the US, Japan and the UK.

[3] Previous studies failed to incorporate the oil price while calculating the inflation uncertainty. An increase in oil price can increase inflation directly by raising the energy cost component of inflation and indirectly by increasing the cost of production. Therefore, the inclusion of an oil price dummy in this research is most appropriate.

[4] Data used in this study are seasonally adjusted. We have also checked the data and no seasonal variations were found. Notably, previous researchers, e.g. Shields et al. [14] and Grier [7], did not use a seasonal dummy.