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On the evolution of the monetary policy transmission mechanism ☆

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ABSTRACT

This paper investigates whether the monetary transmission mechanism has changed or whether apparent changes are due to changes in the volatility of exogenous shocks. Also, the question of whether any changes have been gradual or abrupt is considered. A mixture innovation model is used which extends the class of time-varying vector autoregressive models with stochastic volatility. The advantage of our extension is that it allows us to estimate whether, where, when and how parameter change is occurring. Our empirical results indicate that the transmission mechanism, the volatility of exogenous shocks and the correlations between exogenous shocks are all changing.

1. Introduction

Questions of interest to policymakers typically involve the inter-relationships between several macroeconomic variables. To investigate such questions, it is common to build a macroeconomic model (e.g. based on a vector autoregressive, VAR, model) where exogenous shocks impact on the variables under study. The manner in which the exogenous variables affect the variables of interest is referred to as the transmission mechanism. Traditionally, estimation of the transmission mechanism (or features such as impulse responses which shed light on it) was considered a major goal of many macroeconomic papers. However, empirical researchers have realized two important things. First, the transmission mechanism may not be constant over time. Second, the way the exogenous shocks are generated (and, in particular, their variance) can change over time.

Consider, for instance, U.S. monetary policy and the question of whether the macroeconomic events of the 1970s were due to bad policy or bad luck. Some authors (e.g. Boivin and Giannoni, 2006; Cogley and Sargent, 2001; Lubik and Schorfheide, 2004) have argued that the way the Fed reacted to inflation has changed over time (e.g. under the Volcker and Greenspan chairmanship, the Fed was more aggressive in fighting inflation pressures than under Burns). This is the "bad policy" story and is an example of a change in the transmission mechanism. Others (e.g. Sims and Zha, 2006) have emphasized that the variance of the exogenous shocks has changed over time and that this alone may explain many

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apparent changes in monetary policy. This is the "bad luck" story. Yet others (e.g. Primiceri, 2005) have found that both the transmission mechanism and the variance of the exogenous shocks has changed over time.

This brief (and very incomplete) discussion of the literature is intended to motivate the basic point that an understanding of monetary policy should be based on multivariate models where the transmission mechanism and the variances of the exogenous shocks can both potentially change over time. Another important issue is whether any such change is gradual or abrupt. Many models have been used to investigate such issues in the literature. However, most of them (including some of the DSGE-based models), use extended versions of VARs as building blocks. There is a large literature (e.g. George et al., 2008) which points out that even standard VARs can be over-parameterized and tries to find various ways of minimizing this problem. When one turns to extensions of VARs with time-varying parameters such over-parameterization worries become even more serious. Such considerations motivate the present paper. In it, we re-examine some of the existing empirical literature on U.S. monetary policy using a class of models which is flexible enough to nest many of the existing specifications, but is more tightly parameterized in key dimensions. Most importantly, it allows us to estimate the form and nature of how parameters (and, thus, the transmission mechanism) evolve over time.

Our model is based on a time-varying VAR similar to that used in Primiceri (2005) or Cogley and Sargent (2001, 2005), but extends this type of model in important ways. Like Primiceri (2005) and Cogley and Sargent (2005), we have a multivariate model where both the transmission mechanism and the error covariance matrix can change over time. However, unlike Primiceri (2005) and the related time-varying parameter VAR (TVP-VAR) literature (e.g. Cogley and Sargent, 2001, 2005; Cogley et al., 2005), we do not impose as many restrictions on the time variation of the parameters. Instead, to model the change in parameters over time, we draw on the mixture innovation approach of Gerlach et al. (2000) and Giordani and Kohn (2008) as a way of letting the data speak about how parameters evolve as well as keeping the model more tightly parameterized in key dimensions. Exact details will be provided in the next section. But, to motivate the basic ideas, note that there are two main approaches to modelling changes in parameters over time: one can estimate a model with a small number of structural breaks (usually one or two). Alternatively, one can estimate a time-varying parameter (TVP) model where the parameters are allowed to change with each new observation, usually according to a random walk. A TVP model can be interpreted as imposing $T-1$ breaks in a sample of size T. Thus, we have two extremes: models with very few (but usually large) breaks or those with many (usually small) breaks. The approach adopted in this paper allows for the estimation of the number of breaks. Thus, we nest the two extreme cases and can let the data tell us if there are few (or no) changes in the parameters or whether change is constant and gradual. Another advantage of our approach relative to the TVP-VAR literature is that, by estimating the parameters to be constant over periods, we can obtain a more parsimonious model, mitigating concerns about over-parameterization. Our model also allows for the three different blocks of parameters we work with (the VAR coefficients, a block which relates to the error variances and another relating to error covariances) to evolve in completely different ways (or even for some or all blocks not to change at all). Thus, we can estimate whether and how change occurs in a very flexible manner, as opposed to assuming a specific model with parameter change of a particular sort.

After developing our model and appropriate Bayesian econometric methods, we present empirical results. We work with a standard system involving inflation, unemployment and interest rates. We present results relating to the transmission mechanism and the volatility of exogenous shocks. We find evidence of gradual change in all of our parameters and reinforce the findings of Primiceri (2005). Relative to the existing literature, a crude summary of our results might run as follows. The model of Primiceri (2005) is best, but the model of Cogley and Sargent (2005) is not too bad (although there are some restrictions in this model which are rejected, these have only minor macroeconomic implications). Models which only have time variation in the error covariance matrix (i.e. with constant VAR coefficients) are a bit worse. They accurately recover patterns in the exogenous shocks, but can be misleading about the transmission mechanism. However, models with a constant error covariance matrix such as Cogley and Sargent (2001) or a traditional VAR are strongly rejected and can yield seriously misleading policy inferences.

2. The models

The models used in this paper all begin with a state space model involving a measurement equation:

$$y_t = Z_t\alpha_t + \varepsilon_t \tag{1}$$

and a state equation

$$\alpha_{t+1} = \alpha_t + R_t\eta_t, \tag{2}$$

where y_t is an $p \times 1$ vector of observations on the dependent variables, α_t an $m \times 1$ vector of states (in our case, these are the VAR coefficients), ε_t are independent $N(0, H_t)$ random vectors and η_t are independent $N(0, Q_t)$ random vectors for $t = 1, \dots, T$. The errors in the two equations, ε_t and η_s, are independent of one another for all t and s.[1] Z_t is the appropriate $p \times m$ matrix of data on explanatory variables. In our case, we are working with extensions of VARs and, hence, each row of

[1] This is the standard assumption, but it can easily be relaxed if desired.