USVAR: An Implementation of Under-identified SVAR Model

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Abstract

1 Introduction

2 Mathematical Model

For a $m \times 1$ vector of variables, we can define the Structural VAR(SVAR) Model with p lags, in its reduced form, as the following

$$Y_t = \mathbf{B_1} Y_{t-1} + \mathbf{B_2} Y_{t-2} + \ldots + \mathbf{B_p} Y_{t-p} + u_t, \mathbf{E}[u_t u_t^{'}] = \mathbf{\Sigma}, \tag{1}$$

where B_k are the coefficient matrices for $k = 1, \ldots, p$, and u_t is the time t error with covariance matrix $\mathbf{\Sigma}$. Structral shocks ε_t to the reduced form error u_t are often assumed to be related in the following way:

$$u_t = \mathbf{Z}\varepsilon_t, \mathbf{E}[\varepsilon_t \varepsilon_t^{'}] = \mathbf{I}_m, \mathbf{Z}\mathbf{Z}^{'} = \mathbf{\Sigma} \tag{2}$$

We define $\mathbf{Z}$ to be the short-run impact matrix. The SVAR model described in 1 and use sign restrictions to determine those appropriate $\mathbf{Z}$s among infinitely many $\mathbf{Z}$s that satisfy the condition $\mathbf{Z}\mathbf{Z}^{'} = \mathbf{\Sigma}$.

3 Methods and Functions

3.1 Overview

3.2 Impulse Responses

3.3 Historical Decompositions of Model Errors

4 Example

4.1 Data

In this section, we demonstrate the use of functions by estimating a model on the data set from Smets & Wouters (2007), and we try to replicate the results in the first example given in Binning (2013). The author used variables including interest rate, GDP growth, CPI inflation, hours worked, and wage inflation. The author attempts to identify the following shocks: the monetary policy shock, the aggregate demand shock, the aggregate supply shock, the wage mark-up shock

and a shock that is left unidentified. In particular, the author uses the following identification scheme:

$$f(\mathbf{Z},\mathbf{B}) = \begin{array}{c} \\ i_0 \\ \Delta log(Y_0) \\ \pi_0 \\ H_0 \\ \Delta log(W_0) \\ i_\infty \\ \Delta log(Y_\infty) \\ \pi_\infty \\ H_\infty \\ \Delta log(W_\infty) \end{array} \begin{array}{c} \begin{array}{ccccc} \varepsilon^{MP} & \varepsilon^{AD} & \varepsilon^{AS} & \varepsilon^{WM} & \varepsilon^{U} \end{array} \\ \begin{pmatrix} + & + & - & - & \times \\ - & + & + & + & \times \\ - & + & - & - & \times \\ \times & \times & \times & + & \times \\ \times & \times & \times & - & \times \\ \times & \times & \times & \times & \times \\ 0 & 0 & \times & 0 & 0 \\ \times & \times & \times & \times & \times \\ \times & \times & \times & \times & \times \\ \times & \times & \times & \times & \times \end{pmatrix} \end{array}$$

4.2 Impulse Response

Given the estimated model from author that uses OLS with lag 2 which has the lowest BIC, we can obtain the impulse response by using the function *usvar*. The following plot is a impulse response plot of all the variables against different shocks with t_0 at Jan 1996.

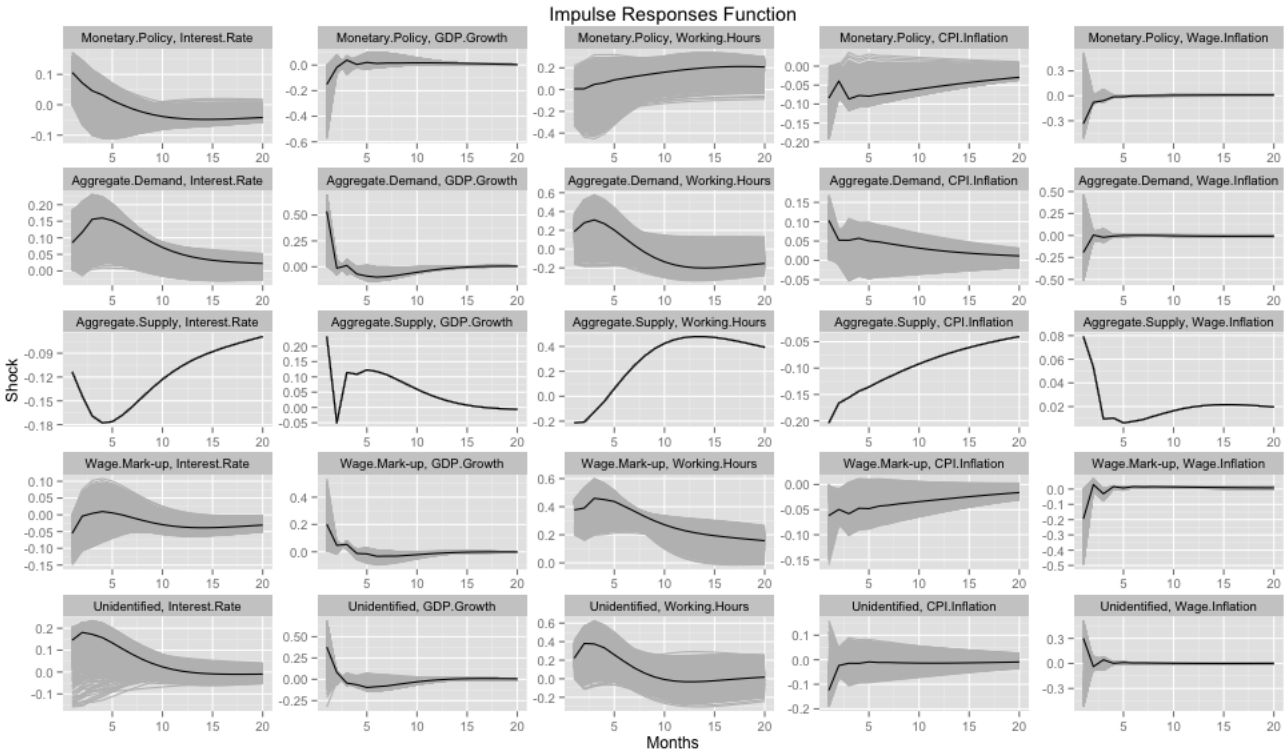

Figure 1: Impulse Response Functions