A Bayesian Analysis of Inventory Investment

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Summary: A new methodology for applied econometric work has recently been proposed by Learner. This paper illustrates some of the aspects of this methodology through a study of aggregate inventory investment in Australia.

Introduction

Inventory investment is an important component of aggregate demand. An understanding of its behaviour is important in macroeconomic model-building. The purpose of this paper is to present some evidence on the behaviour of aggregate inventory investment in Australia using a new Bayesian methodology proposed by Learner [1978].

Bayesians and non-Bayesians alike would agree that we often possess prior information about our models. In this case the issue is how do we integrate this information with our data evidence. For the Bayesian the answer is straight-forward, apply Bayes' rule.

For the non-Bayesian though, the answer is not always as clearcut. A common situation in applied econometric studies is the use of a search procedure that involves the fitting and refitting of equations with frequent appeal to the "plausibility" of the results. The reported equations represent a haphazard mixture of prior and sample information.

The Bayesian approach makes the incorporation of prior information explicit, although this also is not without its problems. We may have prior information or a set of beliefs but often it is incomplete or difficult to specify. For example, we often hold beliefs about the values of parameters while at the same time have difficulty determining the precision of these beliefs. Further, it will rarely be the case that these prior beliefs are held universally. For these reasons it is necessary to analyze the sensitivity of the posterior distribution to changes in the prior distribution to enable the reader to evaluate the validity of the results.

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2) I gratefully acknowledge the comments of E. Learner.
3) For non-Bayesian procedures for incorporating prior information into the formulation and estimation of models see Theil [1963] and Theil/Goldberger [1961].
Leamer's methodology and associated computer program, SEARCH, enables one to pool prior and sample information while determining how sensitive these pooled results are to the prior distribution that is specified. We will attempt to illustrate several aspects of the methodology although for a more technical and complete discussion see Leamer [1978] and Leamer/Leonard [1979].

A Model for Inventory Investment

We will focus on the relationship between inventory investment and sales, especially important will be a consideration of the dynamics of this relationship.

The model to be used can be summarized as follows:

\[ I_t^* = \alpha S_t^e, \quad \alpha > 0 \]  
\[ S_t^e = \theta (L) S_t \]  
\[ I_t^P - I_{t-1}^P = \phi (I_t^* - I_{t-1}^P), \quad 0 < \phi < 1 \]  
\[ I_t = I_t^P - (S_t^e - S_t^e) \]

where

- \( I_t^* \) \equiv optimum level of inventories at the end of period \( t \)
- \( I_t^P \) \equiv level of inventories firms plan to hold at the end of period \( t \)
- \( I_t \) \equiv actual level of inventories at the end of period \( t \)
- \( S_t^e \) \equiv level of expected sales in period \( t \)
- \( S_t \) \equiv actual sales in period \( t \)
- \( \theta (L) \equiv \) polynomial in the lag operator \( L \).

Equation (1) represents a situation where firms consider the costs of holding inventories and determine the optimal inventory/sales ratio. This ratio is expressed in terms of the optimal level of inventories and expected sales. Planned inventories may not correspond to this optimal level because of adjustment costs. To represent this situation a partial adjustment mechanism is given in (3).

Sales expectations are thought to be generated by past and present values of sales. This is given by (2) where expected sales are given as a distributed lag on actual sales. Finally (4) shows that the level of planned inventories will deviate from the actual level to the extent that firms incorrectly forecast sales.

\[ ^4 \) This model is similar to that presented by Smyth [1979].