学位請求論文要旨

題目：ESSAYS ON ECONOMETRIC MODELS OF LINEAR DYNAMICS

学位申請者：千木良 弘朗

The purpose of this dissertation is to develop the econometric procedures for analyzing dynamic systems. Because many economic relationships are dynamic, a large variety of econometric models concerned with dynamics have been proposed to examine the validity of economic models, to forecast variables and to estimate structural parameters. This dissertation is particularly concerned with the cointegrated time series and dynamic panel data models among them. Econometric procedures are developed with emphasis on ease of calculation and improvement of numerical performance in finite samples.

In Chapters 2, 3 and 4, we deal with some econometrically important aspects of cointegrated systems. Chapter 2 proposes a new testing procedure for the short-run Granger non-causality in cointegrated systems and also proves that the two well-known expressions of the long-run relationship based on cointegration are equivalent. Chapter 3 develops a forecasting procedure and a test of cointegration for large cointegrated processes. In Chapter 4, we give a test that can be used to examine some economic hypotheses, e.g., the unbiased hypothesis in foreign exchange markets. Specifically, we develop a method of testing whether deviations from a cointegration relationship are serially uncorrelated. Chapter 5 is concerned with the estimation of the autoregressive parameter of dynamic panel data models.

We now provide a brief description of each chapter.

Chapter 2 is concerned with dynamic relationships between time series that have unit roots. This chapter involves constructing a test for short-run Granger non-causality, that is, Granger non-causality at one period ahead, in cointegrated systems. Granger non-causality is a basic concept for describing dynamic relationships. Following Toda and Phillips (1993) and others, the term "Granger non-causality" by itself is taken to mean "short-run Granger non-causality". The usual Wald test for Granger non-causality in cointegrated VAR processes is known to have asymptotically nonstandard distribution due to the problem of unit roots. A few alternative (inefficient) methods that give the asymptotically standard distribution have been proposed. Among them, only the Lag augmented VAR (LA-VAR) approach proposed by Toda and Yamamoto (1986) appears to be practical for use in finite samples because it is easy to calculate and has moderate size distortion. The only drawback of the LA-VAR approach seems to be relatively low power of the test because of its inefficient estimation. We therefore propose a new procedure that always gives the asymptotically standard distribution with higher power of test than the LA-VAR approach, by suitably combining the standard Wald test and the generalized inverse procedure. We also propose a few simple modifications to the test statistics in order to obtain a better empirical size of the test in finite samples. Our Monte Carlo experiments reveal that our proposed procedure works better than the LA-VAR approach.

In addition, Chapter 2 considers the long-run relationship between variables in cointegrated VARs. In stationary systems, the impact of a single unit shock on predictions of the variable converges to zero as the horizon goes to infinity. Whereas, in cointegrated systems, the impact in an infinite horizon exists due to the existence of unit roots. Investigations of the long-run relationship have commonly been based on the MA impact matrix, which is sometimes called the C matrix[1]. For a VEC model, it is well known that the C matrix is expressed using parameters in the model. The statistical inference about the matrix was established by Johansen (1995) and Paruolo (1997). On the other hand,

[1] In fact, the concept of long-run neutrality and long-run Granger non-causality introduced by Bruneau and Jondeau (1999) is based on the C matrix, see also Yamamoto and Kurozumi (2003) and Chigira (2003).

Phillips (1998) expressed the long-run relationship as the limit of the impulse response function and investigated the statistical inference about the long-run impulse response function. As a consequence, there are two expressions of the long-run relationship; one is given by Johansen (1995) and Paruolo (1997), and the other by Phillips (1998). In this chapter, we give a formal proof of the equivalence between the two expressions. We show that these expressions are analytically equivalent. That means we can derive a numerically equivalent inference about the impact matrix based on either Johansen (1995) and Paruolo (1997) or Phillips (1998). In other words, this chapter clarifies the connections between long-run neutrality, long-run Granger non-causality, and impulse response analysis.

In Chapter 3, we consider forecasts for variables in large cointegrated processes. It is widely recognized that imposition of the cointegration constraint is useful in forecasting cointegrated processes (see, e.g., Engle and Yoo (1987), Lin and Tsay (1996) and Christoffersen and Diebold (1998), among others). However, there are some practical problems in forecasting large cointegrated processes by the VEC models. First, it is hard to identify the cointegration rank in large models. Second, since the number of parameters to be estimated tends to be large relative to the sample size in large models, estimators will have large standard errors and so will forecasts. The purpose of this chapter is to propose a test for cointegration and a procedure for forecasting in large cointegrated processes that are free from the above problems. We may note that our test and forecasting procedures are robust in the sense they do not require a VAR representation of the process or Gaussian innovations. Our Monte Carlo experiments show that our forecasting procedure works well in short to medium run even if the sample size is small. In addition, the Monte Carlo study indicates that if sample size is sufficiently large, when the number of variables in the process increases while the ratio of the number of unit roots to the number of variables in the process is large, our forecasting procedure gains accuracy. This means that it is to our advantage to work with a larger model as long as the ratio is large. For empirical illustration, we apply our procedure to stock price forecasts of Japanese pharmaceutical companies.

Chapter 4 gives a test that can be used to examine the validity of some economic models. In particular, we develop a method of testing whether deviations from a cointegration relationship are serially independent. Because whether deviations are serially independent is an important issue in the study of economics as described later, the test offers benefits to applied economists. Some economic models imply that a variable x_t forms prediction of y_{t+1} as

$$E(y_{t+1}|I_t) = a + bx_t,$$

where a and b are constants and I_t is information that is available on date t. As an illustrative example of such a economic model, we take the unbiased hypothesis in foreign exchange markets. Under the unbiased hypothesis $E(S_{t+1}|I_t) = F_{t,1}$, where S_t and $F_{t,1}$ are the spot rate at date t and the forward rate at date t to be delivered at date $t+1$, should hold. A popular test for its relevance involves estimating

$$s_{t+1} = a + bf_{t,1} + u_{t+1},$$

where s_t and $f_{t,1}$ are the natural logarithms of S_t and $F_{t,1}$, respectively, and testing whether $a = 0$, $b = 1$ and u_t is serially uncorrelated (see, e.g., Frenkel (1981), among others). If s_t and $f_{t,1}$ have a unit root, a test argues s_{t+1} and $f_{t,1}$ are cointegrated with vector (1,-1) and deviations from the cointegration relationship ought to be serially uncorrelated (see, e.g., Hakkio and Rush (1989) and Sephton and Larsen (1991), among others). However, as Zivot (1998) notes, many applied economists fail to address the question of serial correlation. This chapter, therefore, develops a method of testing whether deviations from a cointegration relationship are serially uncorrelated in VEC format.

Chapter 5 is concerned with inferences from the autoregressive parameter of dynamic panel data models. Though some estimators of the autoregressive parameter have been proposed and widely used, they have been found to have considerable bias and size distortions, especially when the autoregressive parameter is close to unity and/or the sample sizes are small. To correct for the both bias and size distortion, we apply the method proposed by Kurozumi and Yamamoto (2000) to an estimator of the dynamic parameter. The bias correction is feasible without estimating the unknown parameters that constitute the bias of an estimator. Moreover, we can reduce the size distortion the without any preliminary estimator. As a result, we can easily reduce both the bias and the size distortion of an estimator. Further, we propose an additional instrumental variable in order to obtain better small-sample properties. We apply the correction to an estimator based on the modified version of Blundell and Bond's (1998) system GMM estimator, and the Monte Carlo experiment reveals that the proposed estimator outperforms the original estimator in terms of bias and size distortion in small samples.

References

Blundell, R. and S. Bond (1998): "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models," *Journal of Econometrics,* 87, 115–143.

Bruneau, C. and E. Jondeau (1996): "Long-Run Causality, with an Application to International Links between Long-Term Interest Rates," *Oxford Bulletin of Economics and Statistics*, 61, 545-68.

Chigira, H. (2003): "Test for the Long-Run Causality," (in Japanese) M.A. Thesis, Department of Economics, Hitotsubashi University.

Christoffersen, P.F. and F.X. Diebold (1998): "Cointegration and Long-Horizon Forecasting," *Journal of Business and Economic Statistics*, 16, 450–458.

Engle, R.F. and S. Yoo (1987): "Forecasting and Testing in Cointegrated Systems," *Journal of Econometrics*, 35, 143–159.

Frenkel, J.A. (1981): "Flexible Exchange Rate, Prices, and the Role of 'News': Lessons from 1970's ," *Journal of Political Economy*, 89, 665–705.

Hakkio, C.S. and M. Rush (1989): "Market Efficiency and Cointegration: An Application to the Sterling and Deutschemark Exchange Markets," *Journal of International Money and Finance*, 8, 75–88.

Johansen, S. (1995): *Likelihood-Based Inference in Cointegrated Vector Autoregressive Models*, Oxford University Press, Oxford.

Kurozumi, E. and T. Yamamoto (2000): "Modified Lag Augmented Vector Autoregressions.," *Econometric Reviews*, 19, 207–231.

Lin, J.L. and R. Tsay (1996): "Co-integration Constraint and Forecasting. An Empirical Examination," *Journal of Applied Econometrics*, 114, 519–538.

Phillips, P. C. B. (1998): "Impulse Response and Forecast Error Variance Asymptotics in Nonstationary VARs," *Journal of Econometrics*, 83, 21–56.

Sephton, P.S. and M.K. Larsen (1991): "Tests for Exchange Market Efficiency: Fragile Evidence from Cointegration Tests," *Journal of International Money and Finance*, 10, 561–570.

Toda, H.Y. and P.C.B. Phillips (1993): "Vector Autoregression and Causality," *Econometrica*, 59, 229–255.

Toda, H. Y. and T. Yamamoto (1995): "Statistical Inference in Vector Autoregressions with Possibly Integrated Processes," *Journal of Econometrics*, 66, 225–250.

Yamamoto, T. and E. Kurozumi (2003): "Tests for Long-Run Granger Non-Causality in Cointegrated Systems," Discussion paper 2003-12, Graduate School of Economics, Hitotsubashi University.

Zivot, E. (1998): "Cointegration and Forward and Spot Exchange Rate Regressions," University of Washington, http://econwpa.wustl.edu/eps/em/papers/9812/9812001.pdf