Workshop on
spatial and spatio-temporal
data analysis

Program and Abstracts

November 10, 2017

Tohoku University

Program

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10:00-10:50	Jaromir Antoch,: Structural breaks in panel data Large number of panels and short length time series
10:50-11:40	Dieter Wang: Estimating Dynamic Spillover Effects with Spatial State-Space Models
11:40-13:00	Lunch
13:00-13:30	Navruzbek Karamatov: Spatial CAPM and Spatial model for international stock markets
13:30-14:00	Takashi Matsuki: Linear and nonlinear comovement in Southeast Asian local currency bond markets: a stepwise multiple testing approach
14:00 14:15	Coffee break
14:15-14:45	Naoki Awaya: Particle rolling MCMC with double block sampling: conditional SMC update approach
14:45-15:15	Takaki Sato: Spatio-temporal autoregressive conditional heteroscedasticity model
15:15-15:30	Coffee break
15:30-16:00	Yoko Konishi: Measuring the Value of Time in Freight Transportation
16:00-16:30	Daisuke Murakami: Moran coefficient basedmixed effects approach to investigate spatially varying relationships
18:00-	Banquet at Restaurant Hagi

Structural breaks in panel data
Large number of panels and short length time series
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Abstract: The detection of the (structural) break or so called change point problem has drawn increasing attention from both theoretical and applied economic and financial research over the last decade. A large part of the existing research concentrates on the detection and asymptotic properties of the change point problem for panels with a large time dimension T. In this lecture we will present a different approach, i.e., we will consider the asymptotic properties with respect to N (number of panel members) while keeping T fixed. This situation ($N \to \infty$ but T being fixed and rather small) is typically related to the large data sets containing information about an enormous number of units across a limited number of time moments (years/quarters/months).

It is worth of noticing that in recent years also the spatial econometrics literature has exhibited a growing interest in the specification and estimation of econometric relationships based on spatial panels, typically referring to data containing time series observations of a number of spatial units (municipalities, regions, states, jurisdictions, etc.). This interest can be explained by the fact that the spatial panel data offer an extended modeling possibilities as compared to the single equation cross-sectional setting, which was the primary focus of the spatial econometrics literature for a long time, and allow for the specification of more complicated behavioral hypotheses, including effects that cannot be addressed using pure cross-sectional approach.

In our contribution a general approach for testing for the break(s) in considered setup, which also allows their detection, will be presented. The asymptotic behavior of the test statistics, along with an alternative wild bootstrap procedure that can be used to generate the critical values of the test statistics, will be shown. In the practical application will be demonstrated the testing procedure in the framework of the four factors CAPM model. In particular, we will concentrate on eventual breaks in monthly returns of the US mutual funds during the period January 2006 to February 2010, covering the subprime crises.

Key words: Change point problem; stationarity; panel data; bootstrap; four factor CAPM model; spatial econometrics; US mutual funds.

REFERENCES

[1] Antoch, J., Hanousek, J., Horváth, L., Hušková, M., and Wang, S. Structural breaks in panel data: Large number of panels and short length time series. The Centre for Economic Policy Research, March 2017.
http://cepr.org/active/publications/discussion_papers/dp.php?dpno=11891

[2] Arellano, M. *Panel Data Econometrics*. Oxford University Press, Oxford, 2004.

[3] Bai, J. Common breaks in means and variances for panel data. *J. of Econometrics* **157**, 78–92, 2010.

[4] Baltagi, B.H. Econometric analysis of panel data (3rd ed.). J. Wiley, New York, 2005.

[5] Baltagi, B.H., Kao, C., and Liu, L. Estimation and identification of change points in panel models with nonstationary or stationary regressors and error terms. *J. of Econometrics* **191**, 176–195, 2016.

[6] Elhorst, J.P. Specification and estimation of spatial panel data models. International Regional Science Review **26**, 244-268, 2003.

[7] Elhorst, J.P. Spatial panel data models. In: Handbook of Applied Spatial Analysis, Eds. Fischer M.M. and Getis A. 377–407, Springer, Berlin, 2010.

[8] Fama, E.F., and French, K.R., A five-factor asset pricing model. Fama-Miller Working Paper, September 2014. Available at http://dx.doi.org/10.2139/ssrn.2287202

[9] Fama, E.F., and Kenneth, R.F. Common risk factors in the returns on stocks and bonds. *J. of Financial Economics* **33**, 3–56, 1993.

[10] Horváth, L., and Hušková, M. Change–point detection in panel data. *J. of Time Series Analysis* **33**, 631–648, 2012.

[11] Horváth, L., and Rice, G. Extensions of some classical methods in change point analysis (with discussions). *Test* **23**, 219–290, 2014.

[12] Hsiao, C. *Analysis of Panel Data, 2nd ed.* Cambridge University Press, Cambridge, 2003.

[13] Lemmon, M.L., Roberts, M.R., and Zender, J.F. Back to the beginning: Persistence and the cross-section of corporate capital structure. *J. of Finance* **63**, 1575–1608, 2008.

[14] Millo, G. and Piras, G. **splm**: Spatial panel data models in R. *J. of Statistical Software* **47**, 1–38, 2012.

[15] The Oxford Handbook of Panel Data. Ed. Baltagi, B.H. Oxford University Press, New York, 2015.

Dieter Wang, Vrije Universiteit Amsterdam, Nederland

Estimating Dynamic Spillover Effects with Spatial State-Space Models

Abstract:

We propose a spatial state-space model (SpatialSSM) as a novel framework to quantify time-varying spillover effects in economic networks. Similar to spatial econometric models, this framework distinguishes between parameters for spatial lag and spatial error components. We interpret these parameters as spillover intensities for a given network. However, these parameters are often assumed to be constant, which is restrictive for the analysis of time-variant systems. The key innovation of SpatialSSMs is that they model these parameters as latent states with stochastic components. To estimate the resulting highly nonlinear state-space models with stochastic volatility, we propose the smooth marginalized particle filter (SMPF). The good finite sample properties of the SMPF are demonstrated in an extensive simulation study for a variety of network types. As an application, we examine financial contagion between the 24 largest banks in the Eurozone for the period 2014Q1-2016Q2. Using confidential supervisory datasets we construct a portfolio overlap network to capture spillovers between banks. We find that SpatialSSMs improve upon established regression models. The network structure in particular helps explain a major component in the structural regression residuals. Furthermore, we find that default risk peaks are mainly driven by the spatial error component, and that neglecting the network will likely overstate the importance of structural regressors.

Navruzbek Karamatov, Tohoku University

Spatial CAPM and Spatial model for international stock markets

Abstract:

Co-movements among international stock markets have been studied for a long time in econometrics and portfolio performances. Especially after the 2007-2009 financial

crisis, a large number of studies have been published based on Spatial statistical models. We will review several works on Spatial Contagion of international financial (stock) markets and Spatial CAPM (or APT) model from the viewpoints of the following:

(a) How they look the dependency and/or metric distance between the markets
(b) How they depict the contagion, how they measure the degree of contagions
(c) How they depict the change of "distance" and degrees of contagions, statistically.
(d) How the financial theory can be constructed, too much Simplifications?

The papers we have looked at were only several among many. They are listed below.

Kou et al (2017) proposes Spatial CAPM (Capital Asset Pricing Model) and Spatial APT (Arbitrage Pricing Theory) with mathematical proofs by extending the classical models and APT. Their approach includes the impacts of spatial impacts in the risk-return relationships for financial assets. Then they study the empirical implication by using the data of European countries (euro-currency-zone) over the period 2001-2013.

V. Fernandez (2011) defines/assumes a spatial CAPM by formulating a statistical model with a spatial statistical terms added to the classical CAPM statistical model (Market model). This paper studies a spatial dependency in Latin American firms inform Brazil, Chile and Mexico over the period 1997-2006.

G. Fernandez-Aviles (2015) takes up the questions of modelling the propagation of a financial crisis where daily stock market indices from major international stock exchanges are studied for contagion in financial markets, using spatio-temporal statistical models. This uses multidimensional scaling (MDS) to obtain "a financial distance" between the stock markets.

Durante et'al (2014) proposes a contagion measure that is based on a conditional Spearman's correlations. This can be used to measure an asymmetric linkages in the financial systems.

Reference:
1. Viviana Fernandez (2011). "Spatial linkages in international financial markets", Quantitative Finance. Vol.11, No.2. pp.237-245.
2. Gema Fernandez-Aviles (2015). "Spatio-Temporal Modelling of Financial Crisis Propagation". International Conference on Regional Science: Innovation and Geographical Spillovers; New Approaches and Evidence.
3. Steven Kou, Xianhua Peng and Haowen Zhong (2017). "Asset Pricing with Satial Interaction".   Management Science. Articles in Advance pp1-19.
4. Fabrizio Durante, Enrico Foscolo, Piotr Jaworski and Hao Wang (2014) "A Spatial Contagion Measure for Financial Time Series". Expert Systems with Applications Vol.41. pp.4023-4034.

Takashi Matsuki, Osaka Gakuin University

Linear and nonlinear comovement in Southeast Asian local currency bond markets: a stepwise multiple testing approach

Abstract:
This study investigates the existence of long-run comovement in the returns of local currency denominated bonds of ASEAN-5 countries (Indonesia, Malaysia, the Philippines, Singapore, and Thailand). We explore the pairwise cointegration between Asian local currency bond returns indices using stepwise multiple testing. This helps to identify which pairs of bond indices are cointegrated, while avoiding over-rejection of the null hypothesis or the multiplicity problem. This method is adjusted to deal with possible cross-sectional correlation among the countries. In addition, we assume linear as well as nonlinear models in order to capture potential gradual and asymptotic adjustment of a linear combination of bond indices toward its mean. We find long-term stable relationships among local currency bond returns for some pairs of countries. Specifically, close inter-linkages captured as nonlinear cointegration are evident for at least four pairs of countries, namely, Indonesia and the Philippines, Malaysia and the Philippines, the Philippines and Thailand, and Singapore and Thailand. In addition, a relatively weak but significant relationship

between Malaysia and Thailand is found. Although the adjustment process toward long-run market equilibrium is characterized by the linear model, comovement in bond returns is observed between Malaysia and Singapore.

Naoki Awaya, University of Tokyo

Particle rolling MCMC with double block sampling: conditional SMC update approach

Abstract:
An efficient simulation-based methodology is proposed for the rolling window estimation of state space models. Using the framework of the conditional sequential Monte Carlo update in the particle Markov chain Monte Carlo estimation, weighted particles are updated to learn and forget the information of new and old observations by the forward and backward block sampling with the particle simulation smoother. These particles are also propagated by the MCMC update step. Theoretical justifications are provided for the proposed estimation methodology. As a special case, we obtain a new sequential MCMC based on Particle Gibbs. The computational performance is evaluated in illustrative examples, showing that the posterior distributions of model parameters and marginal likelihoods are estimated with accuracy. Its application to S&P 500 data analysis is also provided.

Takaki Sato, Tohoku University

Spatio-temporal autoregressive conditional heteroscedasticity model

Abstract:
This study proposes a spatio-temporal extension of time series autoregressive conditional heteroskedasticity (ARCH) models. We call the spatio-temporally extended ARCH models as spatio-temporal ARCH (ST-ARCH) models. ST-ARCH models specify conditional variances given same time surrounding observations and past time observations, which constitutes a good contrast with time series ARCH models that specify conditional variances given past observations. A spatial weight matrix which quantify the closeness between observations is used to express effects from surrounding observations. We estimate the parameters of ST-ARCH models by a two-step procedure of least squares and the quasi maximum likelihood estimation to avoid bias of least squares estimators. We demonstrate the empirical properties by real data analysis of stock price data in the Japanese market to show the relation between volatility of a particular stock and change rates of same time and past time other stock prices.

Yoko Konishi, RIETI

Measuring the Value of Time in Freight Transportation

Abstract:
This paper presents an alternative approach to measuring the values of transport time for freight transportation, and examines its applicability through empirical analysis. We develop a model of the freight transportation market, in which carriers incur the cost associated with the effort to reduce transport time, and transport time is endogenously determined in the market. We estimate the freight charge function, expressway choice model, and transport time function, using microdata of freight flow in Japan collected by the Ministry of Land, Infrastructure, Transport and Tourism. Based on the estimated freight charge function, we obtain the values of

transport time for shippers as an implicit price in the hedonic theory. The estimated values of transport time for shippers are larger than those obtained by the widely adopted method based on the discrete choice model. We also develop a method to evaluate the benefit of time-saving technological change (including infrastructure improvement) based on the hedonic approach. Application to the evaluation of expressway construction suggests that the benefits calculated by our method tend to be larger than those based on the other methods.

Daisuke Murakami, Institute of Statistical Mathematics

Moran coefficient-based mixed effects approach to investigate spatially varying relationships

Abstract:
This study develops a spatially varying coefficient (SVC) model by extending a spatial mixed effects approach called random effects eigenvector spatial filtering. The developed model has the following properties: the SVCs are interpretable in terms of the Moran coefficient, which is a diagnostic statistics for spatial dependence; unlike conventional approaches, the developed approach allows for estimating scales of each SVC; it yields an approximation of a Bayesian SVC model; and, it is computationally efficient and applicable for large samples. Results of a Monte Carlo simulation reveals that our model outperforms conventional approaches, including the geographically weighted regression (GWR) and the eigenvector spatial filtering approaches, in terms of the accuracy of the SVC estimates and computational time. We empirically apply our model to a land price analysis of flood hazards in Japan.

List of Participants

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