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研究課題名（和文）Estimation and inferences of structural changes in panel data models

研究課題名（英文）Estimation and inferences of structural changes in panel data models

研究代表者
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研究成果の概要（和文）：本研究課題では、パネルデータモデルにおける構造変化の分析手法について、主として以下の結果を得た。(1)同時点の構造変化の検定手法を開発した。(2) 構造変化点の特性を分析した。 (3) クロスセクション間の相関を考慮し、新たな構造変化の検定を提案した。（４）大規模な金融データやマクロ経済データを用いた実証分析ができた。

研究成果の学術的意義や社会的意義
本研究では、パネルデータモデルにおける新たな構造変化の検定と推定手法を開発した。大規模な経済データを用いた経済政策分析に応用することで、重要な学術的意義と社会的意義を持つ。

研究成果の概要（英文）：In this research project, I have developed new approaches for break points detection in panel data models. (1) I propose an approach to test whether the break in parameters in panels occurs at a common location across individuals. (2) I investigate the statistical properties of the change point estimators. (3) New tests for structural changes are introduced in a general and realistic panel data model, which allows for cross-sectional dependence in error terms. (4) The empirical analyses using financial and macroeconomic datasets strongly demonstrate the usefulness of the proposed methods.

研究分野：Econometrics

キーワード：structural change　panel data models　common break estimator　cross section dependence

１．研究開始当初の背景

Economic time series often exhibit sudden structural changes, as a result of a technological change, a change of policy, a supply shock, a financial crash, or extreme events such as a war. **If we ignore such parameter instability, inferences can be biased and forecasts lose accuracy.** Recently, the issue related to structural changes has been shifted from a single time series to panel data set. By combining N individual observations across time T, **panel data can produce more efficient break date estimates** than pure cross-section or time series estimators and allow us to study some problems that are not feasible in a time series framework.

(1) Many advantages of the panel data analysis rest on the common breaks assumption, under which the breaks occurred at a common location for all individuals. Nevertheless, as the institutional and cultural background, preferences, and level of economic development vary substantially among different individuals, the break points may be distinct across individuals. When common breaks assumption does not hold, inferences based on it are typically misleading. On the other hand, if complete heterogeneity in breaks is allowed, the advantages of using panel data can be lost, and even the estimation might be impossible. **The trade-off** between the **theoretical common breaks assumption** and **realistic individual heterogeneity** raises questions: a) How to determine whether the break for each series occurred at a common location in panel data? b) If the common breaks assumption fails, we are interested in the efficiency of the change point estimators.

(2) **A major concern** for the panel data model **is the unobserved heterogeneity** due to unobservable common factors or spatial spillover effects. The change point statistics can provide misleading results if cross-sectional dependence is not adequately accounted for.

２．研究の目的

This project aims to **develop econometric methodologies for change point detection and estimation in general and realistic panel data models.**

(A) Propose a test to evaluate the validity of common breaks assumption.

(B) Analyze the efficiency of the change point estimation procedure when the common breaks assumption fails.

(C) Develop break detection procedures in panel data models allowing the unobserved heterogeneity.

(D) Combine theory with application to analyze economic issues.

３．研究の方法

In order to achieve the above four purposes, this project is organized as follows.

(1) Theoretical analysis

A comprehensive review of relevant literature to identify research gaps and areas for improvement is conducted. The relevant theories are applied to design new techniques to overcome the limitations and shortcomings of the existing methods.

(2) Monte Carlo simulation

To verify the efficiency of the proposed methods, Monte Carlo experiments are designed to simulate various scenarios and assess the performance of the proposed methods under different conditions.

(3) Empirical analysis

The empirical analysis involves collecting and analyzing data from various sources, such as financial and macroeconomic databases, to test the feasibility of the proposed methods. The results will be compared to those of existing methods to evaluate the superiority of the proposed approach.

(4) Domestic or international conferences

The proposed methods and results are presented at domestic or international conferences and reviewed by peer reviewers to ensure the validity and reliability of the findings. Feedback from conferences and peer reviewers will be used to improve the project. The papers will be submitted to academic journals.

4．研究成果

(1) I propose an approach to test whether the break in parameters in panels occurs at a common location across individuals. I contribute to the literature in three ways. First, I **fill in the gap to introduce a test for the common break assumption**. The second major contribution is that I investigate the statistical properties of the estimated common break point when the common break assumption fails. It is verified that **the common break estimate cannot be consistent for each series, but will be restricted to a specific region**. Third, the test **delivers monotonic power** as the magnitude of the breaks increases. Monte Carlo simulations show that the test can successfully reject the null hypothesis of a common break against various types of alternatives and has nontrivial power for large breaks. This paper was published by Econometrics and Statistics in February 2023.

(2) I relax the common breaks assumption and allow the break points to be common in each group but vary across groups. **If the break structure is mis-specified and a single-break model is estimated**, I show that **the estimated break point is still consistent for one of the true break points**. Monte Carlo Simulations confirm this consistency result and indicate that if the number of break points is known, all break points can be consistently estimated one by one by using the sample splitting method.

(3) **A new test** for structural change is proposed in a general and realistic panel data model, which **allows for cross-sectional dependence in error terms**. I apply the common correlated effects estimator of Pesaran (2006) to eliminate the unknown factors such

that it does not require estimating the number of latent factors. Then, I derive the asymptotic distributions of the testing statistics under the null hypothesis and show the consistency of the tests under the alternative hypothesis. There are two advantages of the proposed tests. (i) The test statistics have the **same asymptotic distribution with/without the cross-sectional dependence**. Moreover, the model is more realistic because the regression coefficients are allowed to be fixed or random variables. (ii) The existing break tests are invalid if the cross-sectional dependence among the panels is too strong. However, the proposed test **performs well** in terms of size and power, in the presence of **both weak and strong cross-sectional dependence**.

(4) The empirical analyses of the proposed methods are conducted using financial and macroeconomic datasets. First, I apply the test for common breaks assumption to study the financial crisis of 2008 in a panel of mutual fund data. The test suggests that the break did not occur at a common location before 2007, but occurred at a common location during the sub-prime crisis. Second, I analyze the relationship between income and the emission of the chemicals. Accounting for the cross-sectional dependence in panels, the proposed test indicates one break in 1990, and the environmental Kuznets curve (EKC) hypothesis is successfully confirmed before and after the break point.
Overall, the empirical analysis **strongly demonstrates the usefulness of the proposed methods** in addressing real-world economic issues. The proposed methods are expected to contribute to future research in this field.

[1] Pesaran, M.H., 2006. Estimation and inference in large heterogeneous panels with a multifactor error structure. Econometrica 74, 967-1012.

５．主な発表論文等

〔雑誌論文〕　計1件（うち査読付論文　1件／うち国際共著　0件／うちオープンアクセス　0件）

１．著者名 Peiyun Jiang, Eiji Kurozumi	４．巻 -
２．論文標題 A new test for common breaks in heterogeneous panel data models	５．発行年 2023年
３．雑誌名 Econometrics and Statistics	６．最初と最後の頁 -
掲載論文のDOI（デジタルオブジェクト識別子） 10.1016/j.ecosta.2023.01.005	査読の有無 有
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 －

〔学会発表〕　計5件（うち招待講演　0件／うち国際学会　1件）

１．発表者名 Peiyun Jiang
２．発表標題 A new test for common breaks in heterogeneous panel data
３．学会等名 2021 Annual Conference of the International Association for Applied Econometrics（国際学会）
４．発表年 2021年

１．発表者名 Peiyun Jiang
２．発表標題 A new test for common breaks in heterogeneous panel data
３．学会等名 2021 China Meeting of the Econometric Society
４．発表年 2021年

１．発表者名 Peiyun Jiang
２．発表標題 A new test for common breaks in heterogeneous panel data models
３．学会等名 The 7th Hitotsubashi Summer Institute
４．発表年 2021年

１．発表者名 Peiyun Jiang
２．発表標題 Consistency of the common break estimator in panel data models under misspecification
３．学会等名 Kansai Keiryo Keizaigaku Kenkyukai
４．発表年 2022年

１．発表者名 Peiyun Jiang
２．発表標題 Testing for structural change in heterogeneous panels using common correlated effects estimators
３．学会等名 Kansai Keiryo Keizaigaku Kenkyukai
４．発表年 2023年

〔図書〕　計0件

〔産業財産権〕

〔その他〕

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６．研究組織

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７．科研費を使用して開催した国際研究集会

〔国際研究集会〕　計0件

８．本研究に関連して実施した国際共同研究の実施状況

共同研究相手国	相手方研究機関