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Reexamining the income inequality in China: Evidence from sequential panel selection method

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ABSTRACT

This study aims to understand whether incomes across different regions in China are converging or diverging. We propose a novel approach to panel unit root testing–sequential panel selection method (SPSM) by using panel Kapetanios et al. (KSS) test with a Fourier function, which is sufficiently efficient to control for structural breaks and nonlinearity as well as cross-sectional dependency. SPSM classifies the whole panel into a group of stationary and nonstationary series. The method also clearly determines how many and which series in the panel are stationary processes. Using the panel data obtained from 31 regions in China, we find out that the real gross domestic product per capita from 1979 to 2010 does not converge in 20 of the 31 regions in China. The evidence of income divergence has important policy implications for China.

1. Introduction

The economic implications of income inequality have long been the focus of research and policy in development economics. Examples include the functioning of labor markets, supply responses of workers, redistribution policies, minimum wage legislation, and policy jurisdiction. Bénabou (1996) showed that very equal distribution of income played a significant role in the development of South Korea and other East Asian countries, whereas the concentration of wealth in the Philippines and Latin America seriously impeded growth. Industrialized countries with growing income inequality, including the United States (US), have seriously examined this problem. Economic authorities may be concerned about the large portions of the population that are not reaping the benefits of economic growth. Attempts at circumventing this social problem lead to the investigation of regional income difference. That is, areas within an economic region that are significantly different in income level are identified.

Numerous studies empirically examined the income convergence hypothesis with varying results. With the null hypothesis that incomes are diverging, which indicates unit root in GDP per capita, studies validate the overall evidence of income convergence in the panel study. Bénabou (1996) associated income inequality with growth, and found evidence in support of income inequality convergence in various countries. Ravallion (2001, 2003) suggested that within-country income inequalities have slowly converged since the 1980s, and inequality tends to fall (or rise) in countries with initially high (or low) inequality. Bleaney and Nishiyama (2003) demonstrated that inequality convergence has been significantly slower in developing countries. For European regions, Ezcurra and Pascual (2005) used the data supplied by the European Community Household Panel and revealed the existence of inequality convergence at regional levels. Gomes (2007) examined 5507 Brazilian municipalities to investigate income inequality convergence and suggested that Brazilian municipalities exhibited inequality convergence at level greater than that in 2000. Panizza (2001) studied 48 contiguous states in the US and found inequality convergence. Similarly, a more recent study by Lin and Huang (2011) found overwhelming income inequality convergence in a large panel of annual data for 48 US states from 1916 to 2005. The results were obtained by implementing the panel LM unit root test, which allows for structural breaks and heterogeneity in the panel.

A number of studies in the same field have also been conducted for China. With variation in the periods and the methods, empirical studies generally suggest that no convergence was observed before 1978 but that mild convergence has occurred since the China's economic reforms. Lyons (1991) pioneered a study examining regional disparity with the newly available provincial income account data. Focusing on the coefficient of variation of per capita income across provinces, Lyons showed that disparity across provinces increased during the period of "Mao radicalism" (1966 to 1976) and decreased

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during the "early years of liberalization" (1962 to 1965) and the first stage of economic reform (1978 to 1983). Using the 1952 to 1985 data, Tsui (1991) reported that interprovincial income gaps did not narrow but that a mild decline in regional inequality occurred since the economic reform. Chen and Fleisher (1996) reported on the conditional convergence of per capita production across 25 provinces in China from 1978 to 1993 after controlling for the variables of employment, physical capital, human capital, and the dummy for the coastal zone. Jian et al. (1996) presented evidence of convergence from 1952 to 1965 and 1978 to 1990, and strong evidence of divergence from 1965 to 1978. From 1990 to 1993, regional incomes started to diverge again, although convergence continued within the coastal provinces. Using cross-sectional data, Gundlach (1997) demonstrated convergence of the regional output per worker across 29 Chinese provinces between 1979 and 1989. The author applied the neoclassical growth model and predicted the slowdown in convergence after 1989 because of fiscal decentralization. Raiser (1998) observed a reduction in interregional income inequality over the course of economic reforms from 1978 to 1992 and a decline in the convergence rate since 1985 because of the reform shift from rural to industrial sectors and fiscal decentralization.

Using the per capita real GDP data of 31 Chinese regions covering the period from 1979 to 2010, we reexamine the income inequality in China in the present study. This study is the first to use the sequential panel unit root test to distinguish income convergence and divergence within the context of panel unit root analysis, with consideration of possible nonlinearity and structural breaks in the GDP per capita series as well as cross-sectional dependence across panel members. Unlike previous studies on China, the proposed approach to panel unit root testing presents new evidence of income divergence in Chinese regions. Therefore, income inequality continues to exist in China, which affects the economic policies of the country.

China provides an interesting research arena for several reasons. First, the country has made remarkable economic progress over the past two decades. The average annual Chinese economic growth rate over the past two decades (1990 to 2010) was 9.818%. In 2010, GDP per capita in China was US $7518 (purchasing power parity-adjusted). Second, China becomes the first largest trading country with foreign exchange reserves estimated at US $2.62 trillion at the end of 2010. Third, China started its open policy in the late 1970s; thus, sufficient data are available for evaluating the effects of economic liberalization on various economic phenomena.

The conventional way to examine income inequality is to test the unit root on real income. Studies used the univariate unit root tests. However, the consensus is that univariate unit root tests, that is, Augmented Dickey and Fuller (1981, ADF), Phillips and Perron (1988, PP), and Kwiatkowski et al. (1992, KPSS) tests, disregarded the information across regions and performed inefficiently compared with near-unit-root but stationary alternatives. To address the difficulties in univariate unit root tests, these studies proposed the panel unit root approach, which combines information from both time and cross-sectional dimensions. This technique increases the statistical power of unit root tests. First-generation panel-based unit root tests, namely, the Levin–Lin–Chu (Levin et al., 2002), Im–Pesaran–Shin (Im et al., 2003), and MW (Maddala and Wu, 1999) tests, have been developed. However, the serious disadvantage of first-generation panel-based unit root tests is that they do not consider (possible) cross-sectional dependence in the panel-based unit root test procedure. Second-generation panel-based unit root tests control cross-sectional dependence (see among others, Bai and Ng (2004), Choi (2002), and Pesaran (2007)). Despite the capability of second-generation panel unit root tests to capture the effect of cross-sectional dependence in unit root testing, such tests provide no information on the number of stationary processes series when the null hypothesis is rejected.

This paper adopts the sequential panel selection method (SPSM) proposed by Chortareas and Kapetanios (2009) to classify a whole panel into groups of stationary and nonstationary series. To distinguish between stationary and nonstationary series, SPSM uses a sequence of panel unit root tests. According to Chortareas and Kapetanios (2009), given a large panel such as the data in this study, if more than one series are nonstationary, then using panel methods to investigate the unit root properties of the set of series may be more efficient and more powerful compared with univariate methods. The panel method first implements a panel unit root test to all time series in the panel. If the null is not rejected, the nonstationary hypothesis is accepted and the procedure stops. If the null is rejected, then we remove from the set of series the one with the minimum individual Dickey–Fuller *t*-test (or KSS statistics in our study) and repeat the panel unit root test on the remaining set of series. The procedure is continued until either the test does not reject the null hypothesis or all series are removed from the set. The result shows the separation of a set of variables into a set of stationary variables and a set of nonstationary variables. In each SPSM trial, we develop tests for unit roots that jointly consider structural breaks and nonlinear adjustments. Structural breaks are modeled by a Fourier function that allows for infrequent smooth temporary mean changes. Perron (1989) argued that if a structural break exists, the power to reject a unit root decreases when the stationary alternative is true, and the structural break is ignored. Becker et al. (2004, 2006) and Enders and Lee (2004) developed tests modeling any structural break of an unknown form as a smooth process via flexible Fourier transforms. Several authors, including Gallant (1981), Becker et al. (2004), Enders and Lee (2004), and Pascalau (2010), demonstrated that a Fourier approximation can often capture the behavior of an unknown function even if the function itself is not periodic. Nonlinear adjustment is modeled using an exponential smooth transition autoregressive (ESTAR) model for the "band of inaction." In this model, time series data may revert to their mean only when the data are sufficiently far from their mean but behave as nonstationary processes when they are close to their mean. Ucar and Omay (2009) proposed a nonlinear panel unit root test by combining the nonlinear framework of Kapetanios et al. (2003, KSS) and the panel unit root test procedure developed by Im et al. (2003). Such combination has been proven useful in testing mean reversion in a time series.

The main contribution of this paper is the distinction of income convergence from divergence in a panel of 31 provinces in China. The overall evidence for income convergence is validated by conventional panel unit root tests. Independence is well recognized as a non-realistic assumption because the real GDP of different regions may be contemporaneously correlated. We approximate the bootstrap distribution of the tests to control for cross-sectional dependence among the data sets. This distribution was not performed in the previous study in which cross-sectional independence was assumed. O'Connell (1998) showed that the true size of both tests can further exceed the normal size when the underlying data generation is characterized by cross-sectional dependence. This current study is expected to reconcile the existing gaps in the literature. To the best of our knowledge, the present study is the first to use the SPSM with KSS unit root test and Fourier function on income convergence among the regions in China.

This paper is organized as follows: Section 2 presents the data used in our study. Section 3 briefly describes the SPSM test proposed by Chortareas and Kapetanios (2009) and presents the empirical results. Section 4 concludes the paper.

2. Data

This empirical study uses the annual real GDP per capita (2005 = 100) for 31 regions in China (i.e., Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia, Liaoning, Jilin, Heilongjiang, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangdong, Guangxi, Hainan, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi,