ECONOMICS

CONVERGENCE AND TRANSITIONAL DYNAMICS OF CHINA'S INDUSTRIAL OUTPUT: A COUNTY-LEVEL STUDY USING A NEW FRAMEWORK OF DISTRIBUTION DYNAMICS ANALYSIS

by

Tsun Se Cheong
Business School
University of Western Australia

and

Yanrui Wu
Business School
University of Western Australia

DISCUSSION PAPER 14.21
CONVERGENCE AND TRANSITIONAL DYNAMICS OF CHINA'S INDUSTRIAL OUTPUT: A COUNTY-LEVEL STUDY USING A NEW FRAMEWORK OF DISTRIBUTION DYNAMICS ANALYSIS

Tsun Se Cheong*, Yanrui Wu
Business School, University of Western Australia, 35 Stirling Highway, Perth, WA 6009, Australia
*Corresponding author. Tel.: +618 64885639
Email addresses: Tsun.Cheong@uwa.edu.au (T. S. Cheong), Yanrui.Wu@uwa.edu.au (Y. Wu).

DISCUSSION PAPER 14.21

Abstract:
Many scholars have argued that the huge increase in regional inequality in China can be attributed greatly to the disparity in industrialization. This paper contributes to the literature by providing empirical evidence on the transitional dynamics of industrial output by employing a new framework of distribution dynamics analysis, namely the Mobility Probability Plot (MPP), and a county-level database which is made up of counties and county-level cities. The new framework can address several inadequacies of the traditional display tools used in the distribution dynamics literature. Stochastic kernel analyses are performed for the nation, the economic zones and the provinces individually so as to provide an in-depth understanding of the evolution and convergence of industrial output. This study fills the gap in the literature and provides information on mobility of the county-level units, which can greatly aid the policy making process.

Keywords: China; county-level; convergence; distribution dynamics; industrialization

JEL codes: O14, O53, R11
1. Introduction

China has experienced dramatic economic growth since the initiation of economic reforms in 1978. The gross domestic product (GDP) of China increased from 365 billion Yuan in 1978 to 51.89 trillion Yuan in 2012, while GDP per capita in China increased from 381 Yuan to 38420 Yuan (State Statistical Bureau, 2013). In that period, GDP per capita increased at an annual real rate of 8.8%, whilst the annual growth rate of GDP was 9.9%. The real growth rate of the primary sector in this period was 4.6%, a figure dwarfed by the growth rates of the secondary sector (11.5%) and the tertiary sector (10.9%)\(^1\). The annual growth rate of GDP is very close to the growth rate of the secondary sector in that period, thus hinting there was a possible link between the two. It is widely postulated that industrialization has strongly promoted economic growth, for example, Yu (2012) claims that the impressive economic growth can be attributed mainly to the successes in structural transformation and industrial upgrading.

However, regional inequality in China also increased dramatically in that period. Basically, the increase in inequality can mainly be attributed to the extremely unbalanced industrial development in the country. Cheong and Wu (2012a) proved that the percentage contribution of inequality amongst the county-level units to overall regional inequality had increased gradually over time, and had exceeded 60% in 2007. In another paper, Cheong and Wu (2014b) showed that the secondary sector contributed more than 50% to overall inequality in 2010. These findings show that the inequality in industrial outputs amongst the county-level units is the crux of the problem of regional inequality in China. This finding is also demonstrated by Huang, et al. (2003) who showed that the disparity in industrial output (value-added) is the largest contributor to regional inequality. Given that an increase in inequality in China can exert adverse impacts on the well-being of the people (Klasen, 2009), the progress of poverty reduction (Fosu, 2009; Rupasingha & Goetz, 2007; Zhuang, 2008), the economic growth (Alesina & Perotti, 1996; Alesina & Rodrik, 1994; Deininger & Squire, 1998; Huang, et al., 2009; Persson & Tabellini, 1994), and even social stability (Cheong & Wu, 2014a). Therefore, it calls for a thorough examination of the disparity, evolution and convergence of industrialization in China. However, most of the studies on inequality in industrial output have been based on provincial level data, and thus the policy implications derived from these studies are valid for formulating policies at the provincial level only. Hence, many scholars argue that it is necessary to include county-level or prefectural level data in research (Akhmat & Bochun, 2010; Akhmat & Bochun, 2010;)

\(^{1}\) All the economic activities in China can be categorized into three strata of industries, namely, the primary industry, which refers to agriculture, forestry, animal husbandry and fishery and services in support of these industries; the secondary industry, which refers to mining and quarrying, manufacturing, production and supply of electricity, water and gas, and construction; and the tertiary industry, which refers to all other economic activities not included in the primary or secondary industries (State Statistical Bureau, 2013).
Herrmann-Pillath, et al., 2002a, 2002b; Li & Wei, 2010; Wei, 1999, 2002; Wei & Fan, 2000; Wei & Kim, 2002; Wei & Ye, 2004; Wei & Ye, 2009; Yu & Wei, 2007), but because of the difficulty in data preparation, most of the studies are still confined to the use of provincial level data. Even though a few studies have been conducted using county-level or prefectural level data, they are plagued by the problems of a short time-span (for only a particular year) and limited coverage (only for a few provinces).

Given that situation, the existing literature cannot provide policy-makers with relevant county-level information on industrialization when looking at mitigating regional inequality. In the absence of this material, this study aims to fill the gap in the literature by examining the inequality of industrial output through performing county-level transitional dynamics analysis. The database used in this study is made up of counties and county-level cities in China, and includes more than 20000 county-level data from 1997 to 2010. To the best of the authors’ knowledge, this is the most comprehensive research ever undertaken at the county-level for investigating disparity and convergence of industrial output in China by using distribution analysis. Stochastic kernel analyses are carried out for the nation, the economic zones\(^2\) and the provinces individually so as to provide an in-depth understanding of the evolution and convergence of industrial output in China. Moreover, this paper also proposes a new analytical framework for interpreting mobility probability which can be used in conjunction with a contour map or three-dimensional plot. The proposed new framework offers additional insights and greatly enhances the traditional distribution dynamics analysis (Quah, 1993a, 1993b, 1996a, 1996b, 1996c, 1997). By adopting the new framework, this study can also provide a comparison of the transitional dynamics of the four economic zones. This will reveal the effectiveness of regional development campaigns in mitigating regional inequality. Finally, this paper evaluates the possibility of convergence in industrial output for every individual province. The findings foster better understanding of the role of industrialization and provide relevant information for formulation of regional industrial policies in alleviating intra-provincial regional disparity.

The remainder of the article is organized as follows: Section 2 presents the literature review; Section 3 presents the data preparation procedure; Section 4 provides a discussion of the methodology and proposes a new framework of presentation for distribution dynamics analysis; empirical results are presented in Section 5; finally, conclusions and perspectives for future researches are provided in Section 6.

---

\(^2\) Before 2006, China was divided into three economic zones, namely, the eastern, central and western zones. The eastern zone is also termed as the ‘coastal’ region. The ‘inland’ region (some refer to it as the ‘interior’ region) is comprised of the central and western zones. However, in the Eleventh Five-Year Plan, the Chinese government started to divide China into four economic zones, namely, the eastern, central, western and the newly added north-eastern zones.
2. Literature Review

Kuznets (1955) suggests that industrialization will lead to an increase in inequality in the early stages of economic development. His argument is widely accepted and many researchers suggest that industrialization in China has exacerbated regional inequality (Golley, 2002; Kanbur & Zhang, 2005; Pradhan, 2009; Rozelle, 1994, 1996; Tsui, 2007; Tsui, 1996; Wei, 1998; Yang, 2002). It is worth noting that in the early stage of economic reforms, the township and village enterprise (TVE) sector played a prominent role in industrialization in rural China and many researchers found that the unequal development in that sector had led to an increase in regional inequality (Wan, 2004; Yao, 1997; Zhang, 1999). These studies all confirm that industrialization in China is positively correlated with inequality.

However, other researchers have focused on the study of inequality in industrial output and its impact on overall regional inequality. Huang, et al. (2003) performed a decomposition of the Gini coefficient by using provincial data from 1991 to 2001, and they found that the inequality in the secondary industry sector was the primary contributor to the inequality in total regional economic development. This finding was supported by that of Cheong and Wu (2014b), who showed that the inequality in the secondary industry sector was the principal contributor to regional inequality at all the spatial levels (namely, the provincial, economic zonal, inland-and-coastal, and national levels) during the period from 1997 to 2010. The authors even showed that national inequality in China could be lowered by half if industrialization was distributed evenly.

Although the importance of understanding inequality in industrial output is well established, no research has been conducted on the distribution dynamics of industrial output at the county-level. In fact, many researchers have employed a distribution dynamics approach in studying convergence and evolution of different economic characteristics in China (He & Zhang, 2007; He, 2010; Herrerías, 2012; Herrerías, et al., 2010; Herzfeld, 2008; Ho & Li, 2006, 2010; Li, 2003; Liao & Wei, 2012; Liu & Zou, 2011; Pu, et al., 2005; Sakamoto & Fan, 2010, 2013; Sakamoto & Islam, 2008; Villaverde & Maza, 2012; Villaverde, et al., 2010; Wang, 2011; Wang & Zhu, 2013; Wei & Ye, 2009; Zhou & Zou, 2010; Zhu, et al., 2008). However, most of these researchers focused on the inequality in per capita income or GDP, whereas some of them employed distribution dynamics analysis in studying the inequality in other socioeconomic issues. For example, Zhu, et al. (2008), Wang (2011) and Herrerías (2012) examined the convergence of productivity, while Wang and Zhu (2013) used a distribution dynamics approach to investigate city-size distribution measured by urban or nonagricultural population in each city. Sakamoto and Fan (2013) even used it to study the evolution of four value-added components, namely the compensation of employees, operating surplus, depreciation of fixed assets, and net tax on production.
Another noteworthy feature of this strain of research is that most of these studies are based on provincial data, though there are a few exceptions, for example, Sakamoto and Fan (2010) examine the transitional dynamics of 75 cities and counties in the Yangtze River delta. In fact, except the works of a few researchers (Cheong & Wu, 2013, 2014a, 2014b), most of the present county-level distribution dynamics studies are limited to the county-level units in a few provinces of the eastern economic zone (Liao & Wei, 2012; Wei & Ye, 2009), whereas the other studies include only the county-level cities without taking the counties into consideration (Ho & Li, 2010; Wang & Zhu, 2013; Zhou & Zou, 2010). It should be noted that none of these distribution dynamics studies is based on industrial output. Regrettably, because of the unavailability of literature, distribution dynamics of industrial output at the county-level remains virtually unknown to academic communities. Thus, the aim of this paper is to study the evolution and convergence of industrial output in China by using a county-level database compiled from provinces situated in all the economic zones.

3. Data

The municipality of Chongqing was separated from Sichuan in 1997 and since then the data of Chongqing and Sichuan have been made available individually. Therefore, 1997 is selected as the beginning year of the database. The data used in this study are population and gross regional product (GRP) in the secondary industry sector of the counties and county-level cities from 1997 to 2010. The county-level database was compiled from the Provincial Statistical Yearbook of each province (State Statistical Bureau, 1998 - 2011a), but because of inconsistency and incompleteness of the county-level data, the China Statistical Yearbook for Regional Economy (State Statistical Bureau, 2004 - 2008) was then used for data checking and verification. In the case of an inconsistency being found between the data of the Provincial Statistical Yearbook of each province and those from the China Statistical Yearbook for Regional Economy, then the Provincial Yearbook for each province (State Statistical Bureau, 1998 - 2011b) was checked to determine which data is correct. More than 400 yearbooks were employed in the data preparation process. Optical recognition techniques and spreadsheet programming were then employed to transform voluminous amounts of data in the printed publications into electronic data. To the best of the authors’ knowledge, this is the most complete database ever constructed for the investigation of distribution dynamics of GRP at the county-level.

Relative secondary industry GRP per capita (SGRPPC) can be computed by the GRP in the secondary industry sector of a county-level unit divided by its population and the regional mean. All the values were deflated by the provincial secondary industry deflator so as to convert the value to 1997 constant prices. However, since the deflator index for each individual county-level unit is not available, so the provincial deflator was used in the process.
It is worth noting that the county-level units in China can be categorized into districts, counties and county-level units. Unfortunately, individual data for each district is not available from the publications for many provinces, especially at the beginning of our study period, so districts are not included in the analysis. Accordingly, the municipalities of Beijing, Tianjin, Shanghai and Chongqing are not included because most of the county-level units within these municipalities are districts. The provinces included in this study are:

a) Eastern zone: Hebei, Jiangsu, Zhejiang, Fujian, Guangdong and Hainan. The province of Shandong is not included because of unavailability of data.
b) Central zone: Anhui, Jiangxi, Henan, and Hunan. The provinces of Shanxi and Hubei are not included because of unavailability of data.
c) Western zone: Inner Mongolia, Guangxi, Sichuan, Guizhou, Yunnan, Gansu, Qinghai, Ningxia and Xinjiang. The provinces of Shaanxi and Tibet are not included because of unavailability of data.
d) North-eastern zone: Liaoning, Jilin and Heilongjiang.

However, there is one thorny problem in the compilation of this database, namely the change in administrative divisions at the county-level. Whenever there was a boundary change which involved two county-level units, these units were aggregated. This approach was first suggested by Fan (1995). The data are comparable across time after adjustment, and thus the analysis can better reveal the distribution dynamics. Interested reader can refer to Cheong and Wu (2014b) for details of compilation of the county-level database.

4. A New Analytical Framework

There are many different approaches used in convergence analysis. Some of the previous studies are based on time series techniques such as cointegration tests and unit root tests (Bernard & Durlauf, 1995, 1996; Hobijn & Franses, 2000; Lim & McAleer, 2004; Oxley & Greasley, 1995; Pesaran, 2007). Some follow the concepts of $\sigma$-convergence and $\beta$-convergence (Barro & Sala-I-Martin, 1991, 1992), while others employ the distribution dynamics approach. Although $\beta$-convergence is frequently employed in the study of convergence, this method is subjected to many criticisms. For example, Quah (1993b) shows that these cross-section tests are misleading by drawing an analogy of the cross-section regression tests of the convergence hypothesis with those of the classical Galton’s fallacy. Li (2003) claims that, even if the coefficient on the initial level of income is negative, it is perfectly consistent with the absence of convergence. The fact of the coefficient being negative is a necessary but not sufficient condition for convergence. Cheshire and Magrini (2000) suggest that the $\beta$-convergence approach is a poor test of the hypothesis in neoclassical growth models. In fact, the studies of $\sigma$- and $\beta$-convergence can only provide a summary of statistics for the evolution of distribution but not the details of mobility, and hence identical summary statistics
can be derived from two distributions with entirely different mobility. For that reason, the
distribution dynamics approach is gaining popularity because it has a number of advantages over
other approaches. Distribution dynamics analysis takes transitional dynamics into consideration and
can show the mobility probability of the county-level units. Moreover, it can provide a forecast of
future distribution based on historical data.

The distribution dynamics approach can be further divided into the traditional Markov transition
matrix analysis and the stochastic kernel approach, although one controversial issue of the Markov
transition matrix approach is the demarcation of states associated with the selection of grid value in
that process being somewhat arbitrary. The stochastic kernel approach can circumvent the problem
demarcation, as it can be viewed as an extension of the traditional Markov transition matrix
approach with a continuous infinity of states. Therefore, the stochastic kernel approach is used in
this study.

The bivariate kernel estimator is an extension of the univariate estimator, and it is defined as
follows:

\[
\hat{f}(x, y) = \frac{1}{n h_1 h_2} \sum_{i=1}^{n} K \left( \frac{x - X_i}{h_1}, \frac{y - Y_i}{h_2} \right)
\]

(1)

where \( K \) is the Epanechnikov kernel function, \( h_1 \) and \( h_2 \) are the bandwidths, \( n \) is the number of
observations, \( X_i \) is an observed value of relative SGRPPC of a county-level unit at time \( t \), and \( Y_i \) is
the observed value of that county-level unit at time \( t+1 \).

The bandwidths are chosen optimally according to the procedures proposed by Silverman (1986). It
should be noted that Quah (2001) suggests using annual transitions in convergence analysis because
in that way, the sample size can be larger and thus the estimation results will be more reliable.
Therefore, the analysis in the next section is based on the data of annual transition of relative
SGRPPC of all the county-level units.

However, the estimation of the stochastic kernel density can be seriously affected if the distribution
has a long tail because under-smoothing may appear in areas with only a few observations, while
over-smoothing may occur in areas with many observations. This is a critical issue because the
distributions of many socioeconomic indicators tend to have a long tail. In order to solve this
problem, kernels of variable bandwidth should be used to take sparseness of data into consideration.
Therefore, the adaptive kernel method with flexible bandwidth is employed in this research. This
method involves two steps: first, a pilot estimate is computed to determine the density, and then the
bandwidth is rescaled by a factor that reflects the density at that point (for details, please refer to
Silverman, 1986).
Suppose that the evolution of the distribution is first order, time invariant, and further assume that the distribution at time \( t + \tau \) depends on \( t \) only and not on any previous distribution, then the relationship between the distributions of relative SGRPPC at time \( t \) and time \( t + \tau \) can be represented as:

\[
 f_{t + \tau}(z) = \int_0^\infty g_\tau(z|x)f_t(x)\,dx
\]  

(2)

where \( f_t(x) \) is the density function of the distribution of relative SGRPPC at time \( t \), and \( g_\tau(z|x) \) is the transition probability kernel which maps the distribution from time \( t \) to \( t + \tau \), and \( f_{t + \tau}(z) \) is the \( \tau \)-period-ahead density function of \( z \) conditional on \( x \). (see Johnson, 2000; Johnson, 2005; and Juessen, 2009 for details).

The ergodic density is the long-run steady state that emerges when \( \tau \) is infinite. Based on formula (2), the ergodic density function, given that it exists, can be found by:

\[
 f_\infty(z) = \int_0^\infty g_\tau(z|x)f_\infty(x)\,dx
\]  

(3)

where \( f_\infty(z) \) is the ergodic density function.

For the stochastic kernel approach, the probability values of the transitions are not available for further examination. Therefore, the estimation result is usually presented in contour map form or as a three-dimensional plot. Both of them show the conditional density of the county-level unit's probability of transition (displayed by its height with the notion that the greater the height, the higher the probability) from a particular value of relative SGRPPC towards other values. It should be noted that because the values used in the analysis are all measured relative to the mean, if a county-level unit has a relative SGRPPC value larger than one, it implies that this county-level unit's SGRPPC is higher than the average, while if the relative SGRPPC value is smaller than one, then that county-level unit's SGRPPC is lower than the average. Given that the diagonal line of the contour map and three-dimensional plot lies on the same values of relative SGRPPC before transition and after transition, it follows that if most of the probability mass lies above the diagonal for a particular value of relative SGRPPC, then those county-level units should have a higher probability of moving up in the distribution. On the contrary, if most of the probability mass lies below the diagonal, then these county-level units should have a higher probability of moving down. Therefore, generally speaking, convergence to the mean SGRPPC is more likely to happen when a large portion of the probability mass of the below-average SGRPPC county-level units (those relative SGRPPC smaller than one) lies above the diagonal, and a major portion of the probability mass of the above-average SGRPPC county-level units (those relative SGRPPC greater than one) lies below the diagonal. In that way, the above-average county-level units will tend to move downwards in the distribution, whereas the below-average ones will tend to move upwards, thereby making possible convergence to the mean SGRPPC.

However, sometimes it is very difficult to determine where most of the probability mass lies by
observing the contour map and the three-dimensional plot by eye. Therefore, Hyndman (1996) and Hyndman, et al. (1996) put forward a new density estimator and two visualization tools, namely the stacked conditional density plots and the highest density region (HDR) plots, in an attempt to make interpretation easier. Although the use of HDR plot alleviates the problem of visualization to some extent, it cannot improve interpretation under a number of circumstances. For example, if there are two peaks in the conditional density strip and if one lies on one side of the diagonal whereas another lies on the other side of the diagonal. Another case is when the peaks are not obvious, but there are long strips of high conditional density that lie on both sides of the diagonal. In these examples, it is very hard to interpret where the largest portion of the probability mass lies even if the HDR plot is employed.

It is also pertinent that all the general display tools of the stochastic kernel approach, namely the contour map, the three-dimensional plot, the HDR plot and the stacked conditional density plot, cannot present comparison results clearly in a combined figure. If one would like to compare the transitional dynamics of two or more periods, it is always useful to superimpose the plots of different periods into one figure so as to make comparison easier. However, the three-dimensional nature of the stacked conditional density plot and the three-dimensional plot just do not allow superimposing because the one situated at the front will always block the view of the one situated at the back. Similarly, superimposing HDR plots for different periods within one figure is unfeasible, as the one on top will always hide the one underneath from view. Therefore, a contour map (which is made up of lines) is the only possible candidate for superimposing. Even so, it is impossible to present two contour maps in one figure clearly because the combined figure will have too many contour lines after superimposing, which makes comparison extremely difficult. One may argue that by reducing the number of contour lines in each map, it will be possible to combine several maps into one figure; however, it means that some data points will have to be deleted. Basically, the use of this approach cannot be done without loss of information, and it cannot be applied if one wants to superimpose several contour maps simultaneously.

Yet another improvement, suggested by Foster and Rothbaum (2012), is the use of a mobility curve based on a population-weighted measure of mobility across cutoff values. However, because of the nature of population-weighting, it is difficult to observe the mobility of the entities which are few in number, especially for those entities located at the far end of the distribution. This problem is more pronounced for China, as the distribution of the relative SGRPPC usually has a very long right tail with only a few entities at the far end.

A new framework is therefore proposed for analyzing transitional dynamics. Basically, it is an extension of the approach adopted by Cheong (2012) and Cheong and Wu (2012b, 2013) who calculated the net probabilities of moving upwards in the distribution for different states while they performed the traditional Markov transition matrix analyses. The net probability of moving upwards
is based on the difference between the sum of probability values of moving up and the sum of probability values of moving down for each state in the transition matrix. Therefore, for the stochastic kernel approach, the sum of upward mobility probabilities, \( p_u(x) \), at \( x \) can be calculated as:

\[
p_u(x) = \int_x^\infty g_\tau(z|x)dz
\]  

(4)

It is worth noting that \( p_u(x) \) is also the sum of probabilities above the diagonal for a particular value of \( x \). The sum of downward mobility probabilities, \( p_d(x) \), can be computed as:

\[
p_d(x) = \int_0^x g_\tau(z|x)dz
\]  

(5)

Similarly, \( p_d(x) \) is the sum of probabilities below the diagonal for a particular value of \( x \). Therefore the net upward mobility probability, \( p(x) \), at \( x \) is:

\[
p(x) = p_u(x) - p_d(x)
\]  

(6)

The mobility probability plot (MPP) is thus defined as

\[
p(x) = \int_x^\infty g_\tau(z|x)dz - \int_0^x g_\tau(z|x)dz
\]  

(7)

The MPP plots the net upward mobility probability against relative SGRPPC. The value of net upward mobility probability is expressed in percentage (%), and it ranges from -100 to 100. A positive value means that the units have a net probability of moving upwards, while a negative value means that the units have a net probability of moving downwards. The MPP can thus show the distribution of the probability mass. A value larger than zero means most of the probability mass lies above the diagonal, while a value smaller than zero means most of the probability mass lies under the diagonal.

This new framework has many advantages over the common display tools. First, it can provide a more direct and better visual representation of the net upward mobility. Second, it can offer precise information on the distribution of the probability mass. As mentioned previously, the traditional display tools cannot pinpoint clearly where the largest portion of the probability mass locates, while MPP can indicate whether most of the probability mass lies above the diagonal or not. Third, since the MPP is a curve, many MPPs can be superimposed together in the same figure. This can make the comparison of transitional dynamics in different periods a much easier process. Fourth, the mobility probability of a particular group of county-level units can be identified by examining the MPP. The new framework can pinpoint which group has a higher probability of moving up and which group has a higher probability of moving down, thus providing critical information for developing policy for the county-level units.
In summary, MPP is a very powerful tool in presenting distribution dynamics analysis results. Not only can it offer valuable information, which is not directly visible from the traditional contour map and the three-dimensional plot, but it can also greatly improve visual presentation, thereby facilitating interpretation of the transitional dynamics. The new framework is employed with other display tools in the following section that serves as an illustration of how the MPP can be applied to enhance the traditional distribution dynamics analysis.

5. Results and Discussions

The transitional dynamics of the county-level units across 1997-2010 is shown in Figure 1 as a three-dimensional plot and Figure 2 as a contour map. The contour map is basically an overhead view of the three-dimensional plot. These two types of display tools are the most common in the stochastic kernel analysis literature. According to Figure 1, the width of the transition probability kernel is very narrow and the density mass is concentrated along the 45-degree diagonal line, implying considerable persistence in the relative SGRPPC distribution. This fact can be observed more clearly in Figure 2, which shows the contour map of the stochastic transition probability kernel of relative SGRPPC across the range 0 to 2. It should be noted that the convergence process will be very slow when there is a high concentration of probability mass along the diagonal, while faster rates of convergence can be achieved if most of the probability mass is concentrated parallel to the axis of relative SGRPPC before transition (that is the horizontal axis which is labeled as \( t \)). It is thus apparent from Figure 1 and Figure 2 that convergence in China is a slow process and will take a long time to achieve.

Figure 3 shows that a uni-modal distribution can be achieved in the long run. However, the county-level units will converge to a value around 0.2 in relative SGRPPC, which is far below the mean. This signifies that even though convergence is possible, many entities will congregate around the lower part of the distribution.

In order to gain an understanding of the transitional dynamics, one can examine the distribution of the probability mass in the three-dimensional plot and the contour map. Since the SGRPPC values are calculated relative to the regional mean (the value of the mean is one), if most of the probability mass lies above the diagonal in the below-average portion (that is the portion with range 0 to 1), while most of the probability mass lies below the diagonal for the above-average portion (that is the portion with values greater than one), then it can be expected that the probability of convergence to the mean SGRPPC is high. However, because the persistence is so strong and since most of the probability mass is concentrated along the diagonal, it is very hard to determine where the greatest portion of the probability mass lies by observing Figure 1 and Figure 2 by eye. The new framework of MPP can tackle this problem effectively and offer a direct interpretation of the probability mass.
Therefore, the database is divided into three small datasets according to time. MPP is then used to study the transitional dynamics in different periods so as to provide an understanding of the impacts of time on the evolution of distribution dynamics.

Three datasets are constructed for that purpose; they are based on the transitions in three periods, namely 1997-2000, 2000-2005 and 2005-2010. The first dataset has three transition episodes (that is 1997 to 1998, 1998 to 1999, and 1999 to 2000), whilst each of the other datasets has five transition episodes. Stochastic kernel analyses are performed for each of these datasets individually so as to compute the transitional dynamics of each period. The comparison can be made much easier if it is possible to superimpose the contour maps or the three-dimensional plots of the different periods together in one figure; however, as mentioned in a previous section, doing that is not feasible. Therefore, MPP is used and Figure 4 shows the MPPs of the three periods. It can be observed that the MPP of the period 1997-2000 is above zero for only the entities with relative SGRPPC values from 0 to 0.3 and around the value of 0.8, implying that in the first period, many county-level units had a net probability of moving downwards in the distribution and thus a decrease in their relative SGRPPC. In the second period (2000-2005), the MPP follows the movement of the MPP of the first period but with much larger fluctuations. The MPP of the last period (2005-2010) shows that only the entities with relative SGRPPC values lower than 0.16 had a net probability of moving upwards in the distribution, while those with relative SGRPPC values higher than 0.16 had a tendency to move down. The MPP of the last period lies below the MPPs of the first period and the second period (with an exception around the value of 0.5); thereby implying the entities in the third period exhibited a higher tendency of moving downwards in the distribution than the other periods.

In fact, MPP not only can indicate the exact value of relative SGRPPC, but the information derived from MPP can also reveal important information on the ergodic distribution. According to Figure 4, all the MPPs intersect the horizontal axis with relative SGRPPC values from 0.16 to 0.3. It should be noted that the county-level units which are on the left hand side of these intersection points have a high tendency to move upwards, whereas those on the right hand side of these intersection points have a net probability of moving downwards. Therefore, a lot of the county-level units will migrate and congregate around the intersection points. The peak of the ergodic distribution is situated at the value of 0.2 which lies within the range of intersections of the MPPs. Thus, the shape of the ergodic distribution is determined by the transitional dynamics as shown by the MPPs.

It should be noted that the biased regional development policy in China has attracted heavy criticism (Cheng & Zhang, 1998; Fan, 1997; Tang & Lu, 1996; Zhao & Gu, 1995). The central government has recognized this problem and initiated several campaigns in an attempt to reduce the gap between the inland and coastal regions. In 1999, the ‘Campaign to Open up the West’ was launched to stimulate economic development in the western provinces (for details of the campaign and its impacts, see Golley, 2007; Goodman, 2004). In 2003, the State Council of China issued the
document *On Implementing the Strategy of Revitalizing the Northeast Old Industrial Base and Other Areas*, which marked the commencement of the ‘Revitalize Northeast China’ campaign targeting the north-eastern provinces (Zhang, 2008). Finally, the ‘Rise of Central China’ campaign was initiated in 2004 to target the central provinces (Lai, 2007). These campaigns were launched to foster development in the western, north-eastern and central economic zones so as to reduce the disparity between them and the eastern zone. It is thus of interest to examine the transitional dynamics of different economic zones so as to provide an understanding of the impacts of these campaigns on distribution dynamics of the county-level units. For this purpose, the whole dataset is divided into four datasets, namely the eastern, central, western and north-eastern economic zonal datasets. Stochastic kernel analyses are then performed for each of these datasets individually.

MPPs and the ergodic distributions of the four economic zones are shown in Figure 5 and Figure 6 respectively. It can be observed from Figure 5 that the MPP of the north-eastern zone stays above the horizontal axis for most of the regions with values from 0.5 to 2, while the MPPs of the other zones stayed below the horizontal axis. It implies that the government in the north-eastern zone had done a much better job than the other zones in promoting industrial growth for the low industrialized regions with relative SGRPPC values from 0.5 to 1. Figure 5 also indicates that it is very difficult for the units of the central and western zones to move upwards in the distribution. It can be observed that except for the units with very low relative SGRPPC, many of the units in these zones tended to register a decline in the relative SGRPPC. Therefore, many units in these zones would move downwards in the distribution and congregate around a value much lower than the average. It can thus be expected that the peaks should lie somewhere below 0.5 in the ergodic distributions. This can be confirmed in Figure 6. In contrast, the MPP of the north-eastern zone stays a little bit above the horizontal axis for the values of relative SGRPPC in the range 0.6-1.5. Hence, it can be expected that the ergodic distribution of the north-eastern economic zone should be more dispersed than the central and western zones, while the peak of the north-eastern zone's ergodic distribution should not be as apparent as the ones of the central and western zones. Actually, the shapes of the ergodic distributions and the locations of the peaks, which can be observed from Figure 6, are all in line with the expectations drawn from the interpretation of MPP. The peak of the ergodic distribution of the western zone, as shown in Panel (c) of Figure 6, has a height of 3.68, whereas the peak of the central zone has a height of 1.65. These two peaks are much higher than the other zones implying these peaks are more pronounced than the others. In contrast, Panel (d) shows the height of the peak of the north-eastern zone which is only 0.82, while the distribution is more dispersed.

It can be observed that most of the peaks of the ergodic distributions in Figure 6 lie roughly at the same relative SGRPPC values as where the MPPs and the horizontal axis intersect in Figure 5. All the peaks of the ergodic distribution are situated far under the mean, though the peak of the eastern zone's ergodic distribution is closer to the mean than the other zones. However, since none of the
peaks of the four ergodic distributions lie around the value of one, which is the value of the mean, it implies that convergence to the mean SGRPPC is impossible for all the economic zones.

In order to give a more in-depth analysis of the transitional dynamics, the whole dataset is divided into provincial datasets for further investigation. However, with the aim of facilitating the comparison of provinces within an economic zone, the average used in the provincial analysis is based on the mean of the economic zone in which the province is situated. Figure 7 shows the MPPs of the provinces within the four economic zones. All the MPPs lie above the horizontal axis when the relative SGRPPC is zero, which is a good sign as it means the units with the lowest relative SGRPPC would have a very high tendency to move upwards. However, most of the MPPs cross the horizontal axis with relative SGRPPC values smaller than one, implying that many below-average units had difficulty in moving up to the mean. It can also be observed that the provinces exhibit different characteristics in transitional dynamics. However, in order to save space, this discussion is limited to a few selected provinces which have special features in transitional dynamics, though readers are encouraged to study the MPPs of those provinces they are interested in.

In fact, a great deal of important information can be obtained from observing the movement of MPP. For example, Panel (a) of Figure 7 shows that the MPP of Hainan lies above the horizontal axis in the range of 0-0.10, but then it moves under the axis from 0.10 to 0.36 and reaches a minimum around 0.17. After that, the MPP rises and reaches the maximum at 0.43. Actually, it remains above the horizontal axis till 0.50, but the MPP stays under the horizontal axis after 0.50. The information gathered from the MPP is valuable for formulating county-level policies in industrial development. For instance, the MPP shows that there is a maximum at 0.43, so it means those county-level units, with a relative SGRPPC roughly equal to 0.43, perform quite well as they enjoy high net upward mobility probability. However, attention should be paid to those county-level units with values of relative SGRPPC in the range 0.10-0.36, for which the MPP lies below the horizontal axis, implying that these low industrialized units tend to drop further downwards in the distribution. Another concern for Hainan is the MPP reaches -100 around the region of 1.08. This means that the county-level units in Hainan just could not transit through the threshold of 1.08. It is also noted that whenever the relative SGRPPC value of a county-level unit reached this level, it had a decline in relative SGRPPC which brought it downwards in the distribution. It implies that there might be a development trap in Hainan and policy makers should take this information into consideration and focus specifically on the units with values of relative SGRPPC greater than 0.5. MPP can thus pinpoint precisely the group of county-level units needing special attention, and can thus help the policy makers in formulating a priority list for county-level units.

It can be observed that the shapes of the MPPs of the provinces are very different, even when the provinces are situated in the same economic zone. However, Panel (b) of Figure 7 shows that the shapes of the MPPs of the provinces within the central zone are quite similar to each other implying
that the county-level units of the central zone had comparable transitional dynamics. Panel (c) shows that various provinces within the western zone require special attention, for example, the MPPs of several provinces lie below the horizontal axis for the values of relative SGRPPC greater than 0.3. It means that many of the units in these provinces would register a decline in their relative SGRPPC. Ningxia is another province deserving attention. The MPP of Ningxia lies below the horizontal axis from 0.26 to 1.23, while it lies above the axis with relative SGRPPC values from 1.23 to 1.85. It means that the low output units tend to move downwards in the distribution, while the high output units tend to move further upwards, thereby implying convergence to the mean is very difficult for that province. In contrast, the transitional dynamics of the Jilin province facilitated convergence greatly as can be observed from Panel (d). The MPP of Jilin lies above the horizontal axis from 0 to 1, and then lies below the horizontal axis with values greater than one (though a small part is above the axis around 1.3). It means the below-average units tend to move upwards in the distribution, whereas the above-average units tend to move downwards, therefore one can expect that convergence to the mean can be achieved in the long run. This fact can be demonstrated by Panel (u) of Figure 8, which shows the ergodic distribution of the Jilin province. It can be observed that the peak of the ergodic distribution situates around one which is the mean; therefore, the shape of the ergodic distribution is in line with expectations derived from the MPP.

Indeed, Jilin is one of the exceptions to the general pattern. Referring to Figure 8, the peaks of most of the provinces' ergodic distributions situate far below the mean, with only two exceptions, namely, Jilin and Liaoning. It means that convergence to the mean is unattainable in many provinces. Another fact which can be observed from Figure 8 is that most of the ergodic distributions have only one peak (uni-modal); however, Hainan, Liaoning, and Zhejiang have two peaks in the ergodic distribution (bi-modal). In fact, the shapes of the ergodic distributions of Inner Mongolia, Hunan, and Yunnan are also bi-modal, though their smaller peaks are not evident. It should be noted that Guangxi has a multi-modal ergodic distribution with three peaks. These findings suggest that convergence clubs have existed in many provinces.

6. Conclusions

Many researchers have argued that it is improper to develop county-level policy by relying on the findings derived from provincial level data. However, due to the difficulty in data preparation, most of the studies are still based on data compiled at the provincial level. The aim of this paper is to examine the transitional dynamics of the county-level units' industrial output by using a new framework of distribution dynamics analysis, namely the Mobility Probability Plot (MPP). This study fills the gap in the literature and provides valuable information on mobility of the county-level units, which can greatly aid the policy making process.

The new framework can address several inadequacies of the traditional display tools in the
distribution dynamics literature. It can also greatly improve visual presentation and facilitate interpretation. For example, it can provide precise information on the distribution of the probability mass and offer a better visual representation of the net upward mobility. The new framework can also indicate the probability of movement for each entity. Moreover, many MPPs can be superimposed together in the same figure, which can make comparison much easier. In fact, the MPP can be incorporated into the traditional distribution dynamics approach easily and enhance the analysis greatly.

In this study, stochastic kernel analyses are performed for the nation, the economic zones and the provinces individually so as to provide an in-depth understanding of the evolution of county-level industrial output. Based on the ergodic distributions computed in previous section, it is found that convergence to the mean is impossible for most of the spatial groupings, with the exception of a few provinces. Cheong and Wu (2014b) and Huang, et al. (2003) find that overall regional inequality in China can be attributed largely to the inequality in industrial output, while this study points out that convergence of industrial output to the mean is impossible for most of the groupings. Therefore, it implies that regional inequality in China will be exacerbated further and China will continue to be plagued by this problem in the years ahead.

The manufacturing firms tend to agglomerate because of the benefits derived from increasing returns to scale, transport costs, knowledge spillovers and the pooling of specialized skills (Marshall, 1920; Redding, 2010). Given that there are many virtues of agglomeration, it is not worthwhile to have government intervention. Actually, if the benefits of industrial agglomeration outweigh the costs, then the government should not impose further constraints on industrial agglomeration but should counteract the effect by formulating policy to boost primary and tertiary outputs in the underdeveloped regions. Promoting the development in the tertiary industry is a good option because many of the tertiary industries have a low setup cost and do not require high skilled labour. Consequently, the backward regions within a province can enter these businesses easily and this can considerably improve the living standards of the people living in these underdeveloped regions. In this way, regional inequality can be alleviated without affecting industrial development.
Figure 1 Three-dimensional plot of transition probability kernel for relative SGRPPC of all counties and county-level cities with annual transitions, 1997-2010
Source: Authors’ calculation.

Figure 2 Contour map of transition probability kernel for relative SGRPPC of all counties and county-level cities with annual transitions, 1997-2010
Source: Authors’ calculation.
Figure 3 Ergodic distribution for relative SGRPPC of all counties and county-level cities with annual transitions, 1997-2010
Source: Authors’ calculation.

Figure 4 Mobility Probability Plot (MPP) for relative SGRPPC of all counties and county-level cities with different periods
Source: Authors’ calculation.
Figure 5 Mobility Probability Plot (MPP) for relative SGRPPC of all counties and county-level cities within different economic zones.

Source: Authors’ calculation.

Figure 6 Ergodic distributions for relative SGRPPC of counties and county-level cities for each economic zone with annual transitions, 1997-2010.

Source: Authors’ calculation.
Figure 7 Mobility Probability Plot (MPP) for relative SGRPPC of all counties and county-level cities within different provinces.

Source: Authors’ calculation.
Figure 8 Ergodic distributions for relative SGRPPC of counties and county-level cities for each province with annual transitions, 1997-2010

Source: Authors’ calculation.
Reference


ECONOMICS DISCUSSION PAPERS

2012

<table>
<thead>
<tr>
<th>DP NUMBER</th>
<th>AUTHORS</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.01</td>
<td>Clements, K.W., Gao, G., and Simpson, T.</td>
<td>DISPARITIES IN INCOMES AND PRICES INTERNATIONALLY</td>
</tr>
<tr>
<td>12.02</td>
<td>Tyers, R.</td>
<td>THE RISE AND ROBUSTNESS OF ECONOMIC FREEDOM IN CHINA</td>
</tr>
<tr>
<td>12.03</td>
<td>Golley, J. and Tyers, R.</td>
<td>DEMOGRAPHIC DIVIDENDS, DEPENDENCIES AND ECONOMIC GROWTH IN CHINA AND INDIA</td>
</tr>
<tr>
<td>12.04</td>
<td>Tyers, R.</td>
<td>LOOKING INWARD FOR GROWTH</td>
</tr>
<tr>
<td>12.05</td>
<td>Knight, K. and McLure, M.</td>
<td>THE ELUSIVE ARTHUR PIGOU</td>
</tr>
<tr>
<td>12.06</td>
<td>McLure, M.</td>
<td>ONE HUNDRED YEARS FROM TODAY: A. C. PIGOU’S WEALTH AND WELFARE</td>
</tr>
<tr>
<td>12.07</td>
<td>Khuu, A. and Weber, E.J.</td>
<td>HOW AUSTRALIAN FARMERS DEAL WITH RISK</td>
</tr>
<tr>
<td>12.08</td>
<td>Chen, M. and Clements, K.W.</td>
<td>PATTERNS IN WORLD METALS PRICES</td>
</tr>
<tr>
<td>12.09</td>
<td>Clements, K.W.</td>
<td>UWA ECONOMICS HONOURS</td>
</tr>
<tr>
<td>12.10</td>
<td>Golley, J. and Tyers, R.</td>
<td>CHINA’S GENDER IMBALANCE AND ITS ECONOMIC PERFORMANCE</td>
</tr>
<tr>
<td>12.11</td>
<td>Weber, E.J.</td>
<td>AUSTRALIAN FISCAL POLICY IN THE AFTERMATH OF THE GLOBAL FINANCIAL CRISIS</td>
</tr>
<tr>
<td>12.12</td>
<td>Hartley, P.R. and Medlock III, K.B.</td>
<td>CHANGES IN THE OPERATIONAL EFFICIENCY OF NATIONAL OIL COMPANIES</td>
</tr>
<tr>
<td>12.13</td>
<td>Li, L.</td>
<td>HOW MUCH ARE RESOURCE PROJECTS WORTH? A CAPITAL MARKET PERSPECTIVE</td>
</tr>
<tr>
<td>12.14</td>
<td>Chen, A. and Groenewold, N.</td>
<td>THE REGIONAL ECONOMIC EFFECTS OF A REDUCTION IN CARBON EMISSIONS AND AN EVALUATION OF OFFSETTING POLICIES IN CHINA</td>
</tr>
<tr>
<td>12.15</td>
<td>Collins, J., Baer, B. and Weber, E.J.</td>
<td>SEXUAL SELECTION, CONSPICUOUS CONSUMPTION AND ECONOMIC GROWTH</td>
</tr>
<tr>
<td>DP NUMBER</td>
<td>AUTHORS</td>
<td>TITLE</td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>12.16</td>
<td>Wu, Y.</td>
<td>TRENDS AND PROSPECTS IN CHINA’S R&amp;D SECTOR</td>
</tr>
<tr>
<td>12.17</td>
<td>Cheong, T.S. and Wu, Y.</td>
<td>INTRA-PROVINCIAL INEQUALITY IN CHINA: AN ANALYSIS OF COUNTY-LEVEL DATA</td>
</tr>
<tr>
<td>12.18</td>
<td>Cheong, T.S.</td>
<td>THE PATTERNS OF REGIONAL INEQUALITY IN CHINA</td>
</tr>
<tr>
<td>12.19</td>
<td>Wu, Y.</td>
<td>ELECTRICITY MARKET INTEGRATION: GLOBAL TRENDS AND IMPLICATIONS FOR THE EAS REGION</td>
</tr>
<tr>
<td>12.20</td>
<td>Knight, K.</td>
<td>EXEGESIS OF DIGITAL TEXT FROM THE HISTORY OF ECONOMIC THOUGHT: A COMPARATIVE EXPLORATORY TEST</td>
</tr>
<tr>
<td>12.21</td>
<td>Chatterjee, I.</td>
<td>COSTLY REPORTING, EX-POST MONITORING, AND COMMERCIAL PIRACY: A GAME THEORETIC ANALYSIS</td>
</tr>
<tr>
<td>12.22</td>
<td>Pen, S.E.</td>
<td>QUALITY-CONSTANT ILLICIT DRUG PRICES</td>
</tr>
<tr>
<td>12.23</td>
<td>Cheong, T.S. and Wu, Y.</td>
<td>REGIONAL DISPARITY, TRANSITIONAL DYNAMICS AND CONVERGENCE IN CHINA</td>
</tr>
<tr>
<td>12.24</td>
<td>Ezzati, P.</td>
<td>FINANCIAL MARKETS INTEGRATION OF IRAN WITHIN THE MIDDLE EAST AND WITH THE REST OF THE WORLD</td>
</tr>
<tr>
<td>12.26</td>
<td>Wu, Y.</td>
<td>R&amp;D BEHAVIOUR IN CHINESE FIRMS</td>
</tr>
<tr>
<td>12.27</td>
<td>Tang, S.H.K. and Yung, L.C.W.</td>
<td>MAIDS OR MENTORS? THE EFFECTS OF LIVE-IN FOREIGN DOMESTIC WORKERS ON SCHOOL CHILDREN’S EDUCATIONAL ACHIEVEMENT IN HONG KONG</td>
</tr>
<tr>
<td>12.28</td>
<td>Groenewold, N.</td>
<td>AUSTRALIA AND THE GFC: SAVED BY ASTUTE FISCAL POLICY?</td>
</tr>
<tr>
<td>DP NUMBER</td>
<td>AUTHORS</td>
<td>TITLE</td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>13.01</td>
<td>Chen, M., Clements, K.W. and Gao, G.</td>
<td>THREE FACTS ABOUT WORLD METAL PRICES</td>
</tr>
<tr>
<td>13.02</td>
<td>Collins, J. and Richards, O.</td>
<td>EVOLUTION, FERTILITY AND THE AGEING POPULATION</td>
</tr>
<tr>
<td>13.04</td>
<td>Robitaille, M.C. and Chatterjee, I.</td>
<td>MOTHERS-IN-LAW AND SON PREFERENCE IN INDIA</td>
</tr>
<tr>
<td>13.05</td>
<td>Clements, K.W. and Izan, I.H.Y.</td>
<td>REPORT ON THE 25TH PHD CONFERENCE IN ECONOMICS AND BUSINESS</td>
</tr>
<tr>
<td>13.06</td>
<td>Walker, A. and Tyers, R.</td>
<td>QUANTIFYING AUSTRALIA’S “THREE SPEED” BOOM</td>
</tr>
<tr>
<td>13.07</td>
<td>Yu, F. and Wu, Y.</td>
<td>PATENT EXAMINATION AND DISGUISED PROTECTION</td>
</tr>
<tr>
<td>13.08</td>
<td>Yu, F. and Wu, Y.</td>
<td>PATENT CITATIONS AND KNOWLEDGE SPILLOVERS: AN ANALYSIS OF CHINESE PATENTS REGISTER IN THE US</td>
</tr>
<tr>
<td>13.09</td>
<td>Chatterjee, I. and Saha, B.</td>
<td>BARGAINING DELEGATION IN MONOPOLY</td>
</tr>
<tr>
<td>13.10</td>
<td>Cheong, T.S. and Wu, Y.</td>
<td>GLOBALIZATION AND REGIONAL INEQUALITY IN CHINA</td>
</tr>
<tr>
<td>13.11</td>
<td>Cheong, T.S. and Wu, Y.</td>
<td>INEQUALITY AND CRIME RATES IN CHINA</td>
</tr>
<tr>
<td>13.12</td>
<td>Robertson, P.E. and Ye, L.</td>
<td>ON THE EXISTENCE OF A MIDDLE INCOME TRAP</td>
</tr>
<tr>
<td>13.13</td>
<td>Robertson, P.E.</td>
<td>THE GLOBAL IMPACT OF CHINA’S GROWTH</td>
</tr>
<tr>
<td>13.14</td>
<td>Hanaki, N., Jacquemet, N., Luchini, S., and Zylbersztejn, A.</td>
<td>BOUNDED RATIONALITY AND STRATEGIC UNCERTAINTY IN A SIMPLE DOMINANCE SOLVABLE GAME</td>
</tr>
<tr>
<td>13.15</td>
<td>Okatch, Z., Siddique, A. and Rammohan, A.</td>
<td>DETERMINANTS OF INCOME INEQUALITY IN BOTSWANA</td>
</tr>
<tr>
<td>13.16</td>
<td>Clements, K.W. and Gao, G.</td>
<td>A MULTI-MARKET APPROACH TO MEASURING THE CYCLE</td>
</tr>
<tr>
<td>13.17</td>
<td>Chatterjee, I. and Ray, R.</td>
<td>THE ROLE OF INSTITUTIONS IN THE INCIDENCE OF CRIME AND CORRUPTION</td>
</tr>
<tr>
<td>13.18</td>
<td>Fu, D. and Wu, Y.</td>
<td>EXPORT SURVIVAL PATTERN AND DETERMINANTS OF CHINESE MANUFACTURING FIRMS</td>
</tr>
<tr>
<td>13.19</td>
<td>Shi, X., Wu, Y. and Zhao, D.</td>
<td>KNOWLEDGE INTENSIVE BUSINESS SERVICES AND THEIR IMPACT ON INNOVATION IN CHINA</td>
</tr>
<tr>
<td>13.20</td>
<td>Tyers, R., Zhang, Y. and Cheong, T.S.</td>
<td>CHINA’S SAVING AND GLOBAL ECONOMIC PERFORMANCE</td>
</tr>
<tr>
<td>DP NUMBER</td>
<td>AUTHORS</td>
<td>TITLE</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>13.22</td>
<td>Hartley, P.R.</td>
<td>THE FUTURE OF LONG-TERM LNG CONTRACTS</td>
</tr>
<tr>
<td>13.23</td>
<td>Tyers, R.</td>
<td>A SIMPLE MODEL TO STUDY GLOBAL MACROECONOMIC INTERDEPENDENCE</td>
</tr>
<tr>
<td>13.24</td>
<td>McLure, M.</td>
<td>REFLECTIONS ON THE QUANTITY THEORY: PIGOU IN 1917 AND PARETO IN 1920-21</td>
</tr>
<tr>
<td>13.27</td>
<td>Li, B. and Zhang, J.</td>
<td>GOVERNMENT DEBT IN AN INTERGENERATIONAL MODEL OF ECONOMIC GROWTH, ENDOGENOUS FERTILITY, AND ELASTIC LABOR WITH AN APPLICATION TO JAPAN</td>
</tr>
<tr>
<td>13.28</td>
<td>Robitaille, M. and Chatterjee, I.</td>
<td>SEX-SELECTIVE ABORTIONS AND INFANT MORTALITY IN INDIA: THE ROLE OF PARENTS’ STATED SON PREFERENCE</td>
</tr>
<tr>
<td>13.29</td>
<td>Ezzati, P.</td>
<td>ANALYSIS OF VOLATILITY SPILLOVER EFFECTS: TWO-_STAGE PROCEDURE BASED ON A MODIFIED GARCH-M</td>
</tr>
<tr>
<td>13.30</td>
<td>Robertson, P. E.</td>
<td>DOES A FREE MARKET ECONOMY MAKE AUSTRALIA MORE OR LESS SECURE IN A GLOBALISED WORLD?</td>
</tr>
<tr>
<td>13.31</td>
<td>Das, S., Ghate, C. and Robertson, P. E.</td>
<td>REMOTENESS AND UNBALANCED GROWTH: UNDERSTANDING DIVERGENCE ACROSS INDIAN DISTRICTS</td>
</tr>
<tr>
<td>13.32</td>
<td>Robertson, P.E. and Sin, A.</td>
<td>MEASURING HARD POWER: CHINA’S ECONOMIC GROWTH AND MILITARY CAPACITY</td>
</tr>
<tr>
<td>13.33</td>
<td>Wu, Y.</td>
<td>TRENDS AND PROSPECTS FOR THE RENEWABLE ENERGY SECTOR IN THE EAS REGION</td>
</tr>
<tr>
<td>13.34</td>
<td>Yang, S., Zhao, D., Wu, Y. and Fan, J.</td>
<td>REGIONAL VARIATION IN CARBON EMISSION AND ITS DRIVING FORCES IN CHINA: AN INDEX DECOMPOSITION ANALYSIS</td>
</tr>
<tr>
<td>DP NUMBER</td>
<td>AUTHORS</td>
<td>TITLE</td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>14.01</td>
<td>Boediono, Vice President of the Republic of Indonesia</td>
<td>THE CHALLENGES OF POLICY MAKING IN A YOUNG DEMOCRACY: THE CASE OF INDONESIA (52ND SHANN MEMORIAL LECTURE, 2013)</td>
</tr>
<tr>
<td>14.02</td>
<td>Metaxas, P.E. and Weber, E.J.</td>
<td>AN AUSTRALIAN CONTRIBUTION TO INTERNATIONAL TRADE THEORY: THE DEPENDENT ECONOMY MODEL</td>
</tr>
<tr>
<td>14.03</td>
<td>Fan, J., Zhao, D., Wu, Y. and Wei, J.</td>
<td>CARBON PRICING AND ELECTRICITY MARKET REFORMS IN CHINA</td>
</tr>
<tr>
<td>14.05</td>
<td>McLure, M.</td>
<td>A.C. PIGOU’S MEMBERSHIP OF THE ‘CHAMBERLAIN-BRADBURY’ COMMITTEE. PART II: ‘TRANSITIONAL’ AND ‘ONGOING’ ISSUES</td>
</tr>
<tr>
<td>14.06</td>
<td>King, J.E. and McLure, M.</td>
<td>HISTORY OF THE CONCEPT OF VALUE</td>
</tr>
<tr>
<td>14.07</td>
<td>Williams, A.</td>
<td>A GLOBAL INDEX OF INFORMATION AND POLITICAL TRANSPARENCY</td>
</tr>
<tr>
<td>14.08</td>
<td>Knight, K.</td>
<td>A.C. PIGOU’S THE THEORY OF UNEMPLOYMENT AND ITS CORRIGENDA: THE LETTERS OF MAURICE ALLEN, ARTHUR L. BOWLEY, RICHARD KAHN AND DENNIS ROBERTSON</td>
</tr>
<tr>
<td>14.09</td>
<td>Cheong, T.S. and Wu, Y.</td>
<td>THE IMPACTS OF STRUCTURAL TRANSFORMATION AND INDUSTRIAL UPGRADING ON REGIONAL INEQUALITY IN CHINA</td>
</tr>
<tr>
<td>14.10</td>
<td>Chowdhury, M.H., Dewan, M.N.A., Quaddus, M., Naude, M. and Siddique, A.</td>
<td>GENDER EQUALITY AND SUSTAINABLE DEVELOPMENT WITH A FOCUS ON THE COASTAL FISHING COMMUNITY OF BANGLADESH</td>
</tr>
<tr>
<td>14.11</td>
<td>Bon, J.</td>
<td>UWA DISCUSSION PAPERS IN ECONOMICS: THE FIRST 750</td>
</tr>
<tr>
<td>14.12</td>
<td>Finlay, K. and Magnusson, L.M.</td>
<td>BOOTSTRAP METHODS FOR INFERENCE WITH CLUSTER-SAMPLE IV MODELS</td>
</tr>
<tr>
<td>14.14</td>
<td>Hartley, P.R. and Medlock III, K.B.</td>
<td>THE VALLEY OF DEATH FOR NEW ENERGY TECHNOLOGIES</td>
</tr>
<tr>
<td>14.15</td>
<td>Hartley, P.R., Medlock III, K.B., Temzelides, T. and Zhang, X.</td>
<td>LOCAL EMPLOYMENT IMPACT FROM COMPETING ENERGY SOURCES: SHALE GAS VERSUS WIND GENERATION IN TEXAS</td>
</tr>
<tr>
<td>14.16</td>
<td>Tyers, R. and Zhang, Y.</td>
<td>SHORT RUN EFFECTS OF THE ECONOMIC REFORM AGENDA</td>
</tr>
<tr>
<td>14.17</td>
<td>Clements, K.W., Si, J. and Simpson, T.</td>
<td>UNDERSTANDING NEW RESOURCE PROJECTS</td>
</tr>
<tr>
<td>DP NUMBER</td>
<td>AUTHORS</td>
<td>TITLE</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>14.18</td>
<td>Tyers, R.</td>
<td>SERVICE OLIGOPOLIES AND AUSTRALIA’S ECONOMY-WIDE PERFORMANCE</td>
</tr>
<tr>
<td>14.19</td>
<td>Tyers, R. and Zhang, Y.</td>
<td>REAL EXCHANGE RATE DETERMINATION AND THE CHINA PUZZLE</td>
</tr>
<tr>
<td>14.20</td>
<td>Ingram, S.R.</td>
<td>COMMODITY PRICE CHANGES ARE CONCENTRATED AT THE END OF THE CYCLE</td>
</tr>
<tr>
<td>14.21</td>
<td>Cheong, T.S. and Wu, Y.</td>
<td>CHINA’S INDUSTRIAL OUTPUT: A COUNTY-LEVEL STUDY USING A NEW FRAMEWORK OF DISTRIBUTION DYNAMICS ANALYSIS</td>
</tr>
<tr>
<td>14.23</td>
<td>Tyers, R.</td>
<td>ASYMMETRY IN BOOM-BUST SHOCKS: AUSTRALIAN PERFORMANCE WITH OLIGOPOLY</td>
</tr>
<tr>
<td>14.25</td>
<td>Tyers, R.</td>
<td>INTERNATIONAL EFFECTS OF CHINA’S RISE AND TRANSITION: NEOCLASSICAL AND KEYNESIAN PERSPECTIVES</td>
</tr>
<tr>
<td>14.27</td>
<td>Clements, K.W. and Li, L.</td>
<td>VALUING RESOURCE INVESTMENTS</td>
</tr>
</tbody>
</table>