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Resource flows and the decomposition of regional inequality in Beijing-Tianjin-Hebei Metropolitan Region, 1990-2004

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Abstract: The paper introduces a new way of decomposing regional inequality. Decomposition analysis is made by three resource agglomeration patterns: urban, peri-urban and periphery areas. These three patterns are indentified by assessing urban-rural linkages at the regional level in a three five-year periods. These patterns are indicating differences of economic conditions within the region in each period. Regional inequality of Beijing-Tianjin-Hebei Metropolitan Region is decomposed into inter-class, intra-class and overlapped components. The inter-class inequality contributes to the major part of regional inequality from 1993 to 2004 while inequality between urban and peri-urban areas is the major component of the inter-class inequality.

Keywords: urban-rural linkages, regional inequality, decomposition, principal component analysis, Gini coefficient

Introduction

The examination of regional inequality has been an important research aspect in the empirical studies of which the decomposition of regional inequality in terms of different methods such as Gini coefficient and Theil index has been widely used. The attribute of the decomposition analysis is that it can decompose inequality into different components. Basically, most empirical studies make the decomposition by population classifications. They start by dividing the region according to the administrative divisions such as urban and rural, and then calculate inequalities within and between the population components. This approach is a useful tool for both descriptive and quantitative analysis but still has the limitations.

First, the results differentiate when the classifications of population in a certain region or country were made in different ways. Take the empirical studies of China's regional inequality for instance, Xue (1997) and Chang (2002) argues that rural-urban inequality is the major component of regional inequality in China. However, Liu (2006) classifies China into east, central and west, and finds that inter- and intra-region inequalities contribute differently to the rural regional inequality. Second, such decomposition analysis only considers "isolated effect": contributions of within- and between population components while there is no "mixed effect" caused by the interaction of the population divisions. In this sense, decomposition in terms of administrations omits the mutual linkages and interdependencies among the administrative divisions. Third, decomposition by administrative divisions is made from a static perspective. Due to the economic development, villages of strong economy possess the ability and attribute of being granted the status of "towns" which belong to the urban system (large cities, medium and

small cities and towns). However, administrative adjustment is usually lagging behind the development and these villages still belong to rural. This case is often seen in Southern China where strong industrialization and economy exist in the countryside.

Generally, regional inequality is basically determined by the locations of the sources and the economic activities such as firms and households. Firms choose to settle in the places where they can maximize profits while households do so to maximize job market outcomes and utility (Kim, 2008). Then, inequality emerges when there is the net result of balance of forces of concentration and dispersion. In this sense, the examination of regional inequality could be made in terms of the resource flows and agglomerations which can imply the economic conditions in a certain area. Besides, the resource agglomerations which are relied on the centripetal and centrifugal forces are located beyond the urban or rural administrative boundaries.

The paper aims to decompose regional inequality based on the population groups which are made in terms of resource flows and agglomeration instead of administrative divisions. The paper chooses Beijing-Tianjin-Hebei Metropolitan Region (Jing-Jin-Ji region for short. Jing, Jin and Ji are the abbreviations of Beijing, Tianjin and Hebei province) as the study area. Ma et al. (2007) use per capita GDP as the index and find regional inequality of Jing-Jin-Ji region presenting a “U” tendency in the period of 1993-2003 (decrease from 1993 to 1997 while increase from 1998 to 2003). Similarly, Ma et al. (2007) conduct the constrigent analysis of per capita GDP at the county level in Jing-Jin-Ji, and point out that this region is still in the “polarization period”¹ from 1992 to 2003 (polarizing effect in Beijing and Tianjin outstrips the diffusing effect from these two cities to other cities in Hebei province). Basically, current studies have not made the decomposition analysis of regional inequality in this region.

The paper is organized as follows: section two makes theoretical analysis of resource flows and agglomeration at the regional level. In section three, the paper introduces the study area and methods that are used in this paper. The fourth section divides Jing-Jin-Ji region and decomposes regional inequality by the divisions in three time periods. The paper concludes through discussing the research findings.

Resource flows and agglomerations: Theoretical perspective

Basically, a larger regional economy that includes urban areas to which the rural part is economically related serves as the base for the understanding of the linkages (resource flows like people, capital, goods, information and technology) between urban and rural areas. These

linkages and the interdependencies are shaping the fortunes of urban and rural areas alike (Davoudi and Stead, 2002). Central place theory (Christaller, 1933) provides an ordering of the economic activities flowing between villages, towns and cities. Cities are the main suppliers of high-order services like medical service and education to the surrounding areas which supply low-order services like food and other resources to the central place. The core-periphery theory (Friedmann, 1966) which is mainly based on the unequal distribution of power in economy, society and polity, is of great scientific relevance concerning the spatial and socio-economic inequalities at the regional and other scales. The core area is the central realm while the surrounding rural periphery is dependent on the central place for the supply of high-order services. Thus, the relationship of dominance-dependency greatly influences the economic structure and exchanges between core and periphery areas. Krugman (1991) and Fujita et al. (1999) also point out that interrelated industry concentrations, reliable infrastructure, accessibility to the market and high returns in production drive a cumulative process that may result in a core-periphery economy. In this sense, resource flows tend to agglomerate to the urban areas while rural areas are tightly dependent on the urban areas. Thus, the uneven development pattern emerged consisting of the high-growth urban cores and an intervening lagging rural periphery.

Recently, small and medium urban centers are seen as playing important role in urban-rural linkages given the strong link with their rural hinterland (Baker and Claeson, 1990). Situating between urban and rural areas, these centers are serving as the interface for urban-rural linkages. McGee (1991) uses the concept of 'desakota' in the Asian context, describing the symbiosis of urban and rural areas which resulted from the transformation into a dispersed metropolis. Gering et al. (1998) label the urban-rural interface and find it a zone where social, economic and political factors interact in complex ways. Browder (2002) considers urban-rural interface as an array of networks connecting urban agents and rural producers. STEPS center (2008) uses peri-urban interface and considers it a transition zone where urban and rural activities and institutions co-exist. Basically, all the manifestations emphasized the transitional and dynamic features of urban-rural interface which acts as a frontier where rural areas are under transition to urban areas. Due to the typical location, urban-rural interface is attractive destination for rural migrants, offering employment, education and other services to the rural areas. The role of urban-rural interface has also been recognized when there are the out-migration and industrial transfer from downtown to the outskirts because of the congestion problems in the urban areas. Krugman and

Elizondo (1996) points out that resource relocating in the urban-rural interface is attributed to the “centrifugal” forces which tend to break the agglomerations in the urban areas. These centrifugal forces include pure external diseconomies like congestion and pollution, urban land price increase, transportation cost increase, and the preferences of moving away from highly competitive urban areas to less competitive rural locations (Tabuchi, 1998).

The above analysis suggests three resource agglomeration patterns at the regional level: urban, rural and urban-rural interface (named peri-urban in the paper). Resources tend to agglomerate to the urban areas while it reaches the rural periphery areas to a limited extent. Resource agglomeration in the peri-urban areas stays at a medium level. Basically, these three patterns are beyond the traditionally classified urban and rural administrations, and are indicating the economic conditions among the patterns. Thus, decomposition of regional inequality can be made in terms of these three patterns.

Study area and methodology

Study area

Jing-Jin-Ji region (183,000 km²) includes Beijing (capital of China, centrally-governed city), Tianjin (centrally-governed city) and eight prefecture-level cities in Hebei province (Figure 1). This region has been experiencing fast economic growth and urbanization development in the post-reform era. Per capita GDP in this region had increased from 5785 ¥/person in 1990 to 22252 ¥/person in 2005 while urbanization level had increased from 28.2% to 46.5% in the same period (National Bureau of Statistics of China, 1991 and 2006). Such development has seen dramatic resource flows and agglomerations within the region. Recently, this region is considered as “the third engine” in China after Yangtze River Delta (Shanghai as the central city), Chu Chiang Delta (Guangzhou as the central city) and believed to promote China’s economy further in the 21st century. In 2008, there were 78.6 million people in this region producing 9.9% of the GDP in China (National Bureau of Statistics of China, 2009).

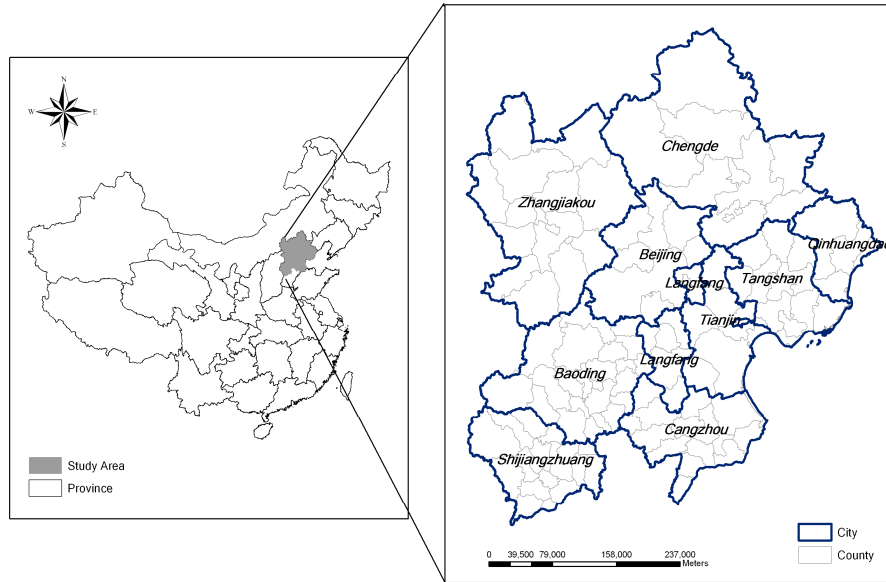


Figure1. Ten cities and the counties in Jing-Jin-Ji region

Assessing urban-rural resource flows by principal component analysis

The paper attempts to assess urban-rural resource flows and divides Jing-Jin-Ji region according to the assessment. Generally, it is not that easy to monitor and record the resource flows which are in a rather complicated and complex process. Lin (2001) identifies the spatial form of urban-rural linkages in Pearl River Delta of China by assessing this concept through introducing several variables (population, employment and land use intensity). However, these variables are not adequate to show urban-rural linkages since mutual linkages include many aspects in terms of people, capital, materials, information and technology. Basically, the consequence of these flows will induce the changes of population and economy in both urban and rural areas. Thus, the paper selects six variables in the demographic and economic aspects and indirectly assesses urban-rural linkages at the county level in Jing-Jin-Ji region.

(1) *Change of percentage of urban population to the total population.* This variable is selected to describe the urbanization development, especially the population mobility from rural to urban areas.

(2) *Change of percentage of non-agricultural employees to the total employees.* This variable is to show the employment structure in the primary, secondary and tertiary industries. Sectoral linkages have advanced non-agricultural industries in rural areas and accommodated many rural residents in the off-farm industries.

(3) *Change of non-agricultural production refers to the development of non-agricultural industries.* This variable is chosen to show economic structure changes both in cities and countryside. Particularly, the development of non-agricultural industries in rural areas has induced changes of rural economic structure in China.

(4) *Change of rural household per capita net income.* This variable is to show the change of rural household income due to the sectoral linkages which have diversified rural economy and rural households' income.

(5) *Change of per capita GDP.* This variable describes the economic growth both in urban and rural areas.

(6) *Change of rural electricity consumption (kwh).* This variable is selected to indirectly show the development of rural economy, especially the non-agricultural industries.

Considering the possible correlation of the variables, the paper uses Principal Component Analysis (PCA) to transform these correlated variables into a smaller number of uncorrelated variables. PCA can reduce data dimensionality through covariance analysis between factors. Data matrix will finally be compressed into fewer orthogonal components that are uncorrelated. Suppose there are m variables X_1, X_2, \dots, X_m and m new variables can be generated through PCA, known as the principal components (PC), PC_1, PC_2, \dots, PC_m which can be expressed as follows:

$$PC_1 = a_{11}X_1 + \dots + a_{1m}X_m = Xa_1 \quad (1)$$

.

$$PC_m = a_{m1}X_1 + \dots + a_{mm}X_m = Xa_m \quad (2)$$

Where a_i are the coefficients for PC, and each column of a contains the coefficients for one PC. Here PC_1 and PC_2 which have the first and second largest variance are chosen on the condition that they are uncorrelated. If we consider that the sample variance-covariance matrix of the original variables X is N_x , then, the coefficient vector a_i can be computed through the equation:

$$|N_x - \lambda I|a = 0 \quad (3)$$

Where λ is the vector of characteristic roots and a is a matrix comprising of the characteristic vectors corresponding to each characteristic root. It is noted that PC_1 is computed by using the characteristic vector corresponding to the largest characteristic root λ_1 while PC_2 is computed by using the characteristic vector corresponding to the largest characteristic root λ_2 , and so on (Harris, 2001).

This assessment aims to indirectly show the urban-rural linkages. Since urban-rural linkages indicate a dynamic process, the paper computes the linkages in three periods: 1990-1994, 1995-1999 and 2000-2004². After the computation, the paper classifies Jing-Jin-Ji region through cluster analysis in terms of the assessment results of the counties (urban districts). Cluster analysis assigns the group memberships to all the units according to their loading on the exacted components.

Gini coefficient and the decomposition of regional inequality

Gini coefficient is commonly used for measuring income or other attributes inequalities between individuals. It ranges from 0 to 1 which represents two extremes of income distribution in a country or region. $G=0$ means each person receives the same percentage of the total income and no inequality exists, while $G=1$ means just the opposite. Gini coefficient can be decomposed into three components if the population is divided into a certain number of classes. Yao (1999) made detailed introduction of the decomposition of Gini coefficient by population classes, and tested it by using household survey data in Sichuan province, China. Thus, the computation of Gini coefficient in the paper follows his demonstration.

Suppose the total population in the region can be divided into n classes, G , w_i and p_i represent the Gini coefficient, income share and population share in the i -th class. Then, Gini coefficient can be written as:

$$G = 1 - \sum_{i=1}^n p_i (2Q_i - w_i), \quad (4)$$

$$Q_i = \sum_{j=1}^i w_j, \quad p_i = \frac{n_i}{\sum_{i=1}^n n_i} \quad (i=1, 2, \dots, n)$$

Where Q_i is the cumulative income share.

Then, G can be decomposed into three components when the population was divided into three classes: inter-class, intra-class and the overlapped part.

$$G = G_b + G_w + G_o \quad (5)$$

G_b is the inter-class component and G_w is the intra-class component. G_o is the overlapped component of G . If the richest people in any low income class is not better off than the poorest people in any high income class, then $G_o = 0$.

$$G_b = 1 - \sum_{j=1}^n P_j (2Q_j - W_j) \quad (6)$$

P_j and W_j denote the population share and income share in the j -th population class ($j=1,2,\dots,n$).

$$G_w = \sum_{j=1}^n W_j P_j G_j \quad (7)$$

Where G_j denotes the Gini coefficient for the j -th population group. G_o then can be derived from the equation 5.

The paper divides Jing-Jin-Ji region into three classes in terms of the resource flows and agglomeration: urban, peri-urban and periphery areas. The logic of the decomposition of regional inequality is shown in Figure 2.

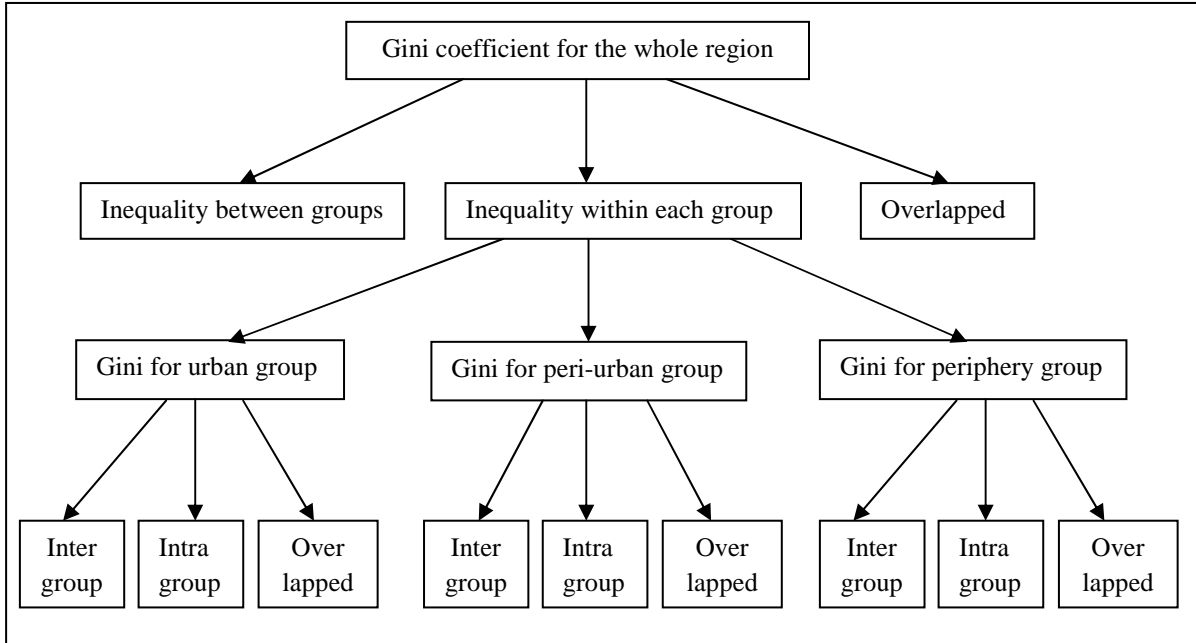


Figure2. Structure of decomposition of regional inequality

The paper uses per capita GDP to compute Gini coefficient at the county level in Jing-Jin-Ji region in three periods: 1990-1994, 1995-1999 and 2000-2004. The economic and demographic data refers to the Hebei Economic Yearbook, Beijing Statistical Yearbook and Tianjin Statistical Yearbook in the same calendar year of 1991, 1995, 1996, 2000, 2001 and 2005. Besides, considering the administrative adjustments, the administrations of Jing-Jin-Ji region in the research period have been adjusted consisting of 109 counties and 10 urban districts. Thus, the economic and demographic data for all the units also follows this division.

Empirical results and interpretation

The classification of Jing-Jin-Ji region by PCA

Two eigenvectors were generated by PCA in the period of 1990-1994 accounting for 82.1% (Table1). The first component which explains 52% of the variance is the most important component while the second component explains 30.1% of the variance.

Table1. Rotated component matrix of the period 1990-1994

Selected variables	Factor loadings	
	Factor 1	Factor 2
Increase of percentage of urban population to the total population	0.140	-0.701
Increase of percentage of non-agricultural employees to the total employees	0.465	0.459
Increase of non-agricultural production	0.076	0.649
Increase of rural household per capita net income	0.692	0.069
Increase of per capita GDP	0.763	-0.302
Increase of rural electricity consumption	0.774	0.024
Initial Eigenvalues	1.903	1.219
% of Variance	52.03	30.10

Then, the equations for the two PCA components in the period of 1990-1994 are made according to the component coefficients as follows:

$$F_1 = -0.635X_1 + 0.416X_2 + 0.588X_3 + 0.063X_4 - 0.274X_5 + 0.022X_6 \quad (8)$$

$$F_2 = -0.701X_1 + 0.459X_2 + 0.649X_3 + 0.069X_4 - 0.302X_5 + 0.024X_6 \quad (9)$$

The factor loadings of the counties (urban districts) in Jing-Jin-Ji region are computed by equation 8, 9. Then, cluster analysis of the factor loadings for each county or urban district is

made in each urban administration of this region³. Similar computation and cluster analysis are conducted for the other two periods. Figure 3 presents the three classifications in Jing-Jin-Ji region and Table 2 contains the demographic and economic changes as well as the number of units in these classifications in the three time periods.

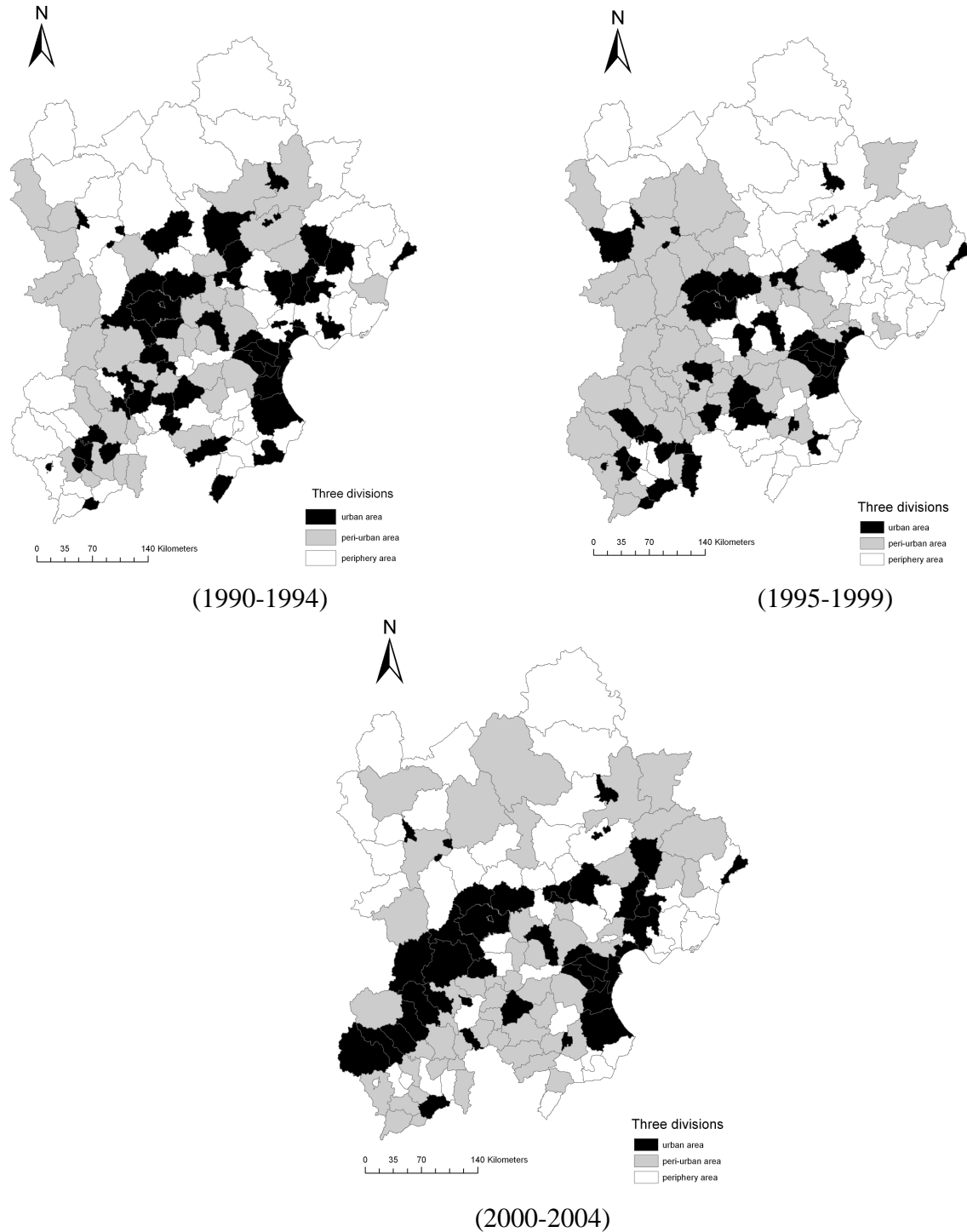


Figure3. Classifications of Jing-Jin-Ji region, 1990-1994, 1995-1999, 2000-2004

Table2. Demographic and economic conditions in the classification

Classification	Items	1990-1994	1995-1999	2000-2004
Urban area	Population change (%)	-1.7	1.7	2.7
	Average per capita GDP (¥/person)	8594	19758	18877
	No. of units	35	26	29
Peri-urban	Population change (%)	2	1.9	1
	Average per capita GDP (¥/person)	3479	9096	9424
	No. of units	37	48	49
Periphery	Population change (%)	2.3	0.5	0.2
	Average per capita GDP (¥/person)	2698	7073	7757
	No. of units	47	45	41

Note: the change of population and per capita GDP refers to the annual average change in each period.

Generally, the urban areas are mainly located in the urban districts of each urban administration and their close counties while the peri-urban areas are those places surrounding the urban areas. In the period of 1990-1994, urban and peri-urban areas are primarily situated in the middle and south parts of the region while these areas tended to concentrated in the west and south parts in the period of 1995-1999. In this ten-year period, the number of peri-urban areas increased greatly from 37 to 48 while the number of urban areas dropped from 35 to 26. In the period of 2000-2004, the locations and numbers of urban and peri-urban areas didn't change much comparing with that in the late 1990s. However, urban areas formed two belts (Tangshan-Tianjin, Beijing-Baoding-Shi Jiazhuang) in this period while they were dispersedly located in this region in the former five years. In the research period, the number of periphery areas didn't change much and they were mainly located in the north and east parts of Jing-Jin-Ji region.

The figures in Table 3 show that urban areas have been experiencing speed-increased population change in the research period while population change in peri-urban and periphery areas increased slowly with the decreased speed. The average per capita GDP in the urban areas stayed at the high level in the research period followed by the peri-urban and periphery areas. Basically, these figures indicate that urban areas are the places of fast population growth and high

economic level while these two indexes in the periphery areas are of lowest level. The demographic and economic situations in the peri-urban areas stay at the medium level.

Regional inequality and decomposition analysis

The Gini coefficients of the whole region and the three population classifications are computed at the county level in Jing-Jin-Ji region in the period of 1990-2004 by equation 4 as shown in Figure 4. Generally, Gini coefficient of the whole region decreased from 1990 to 1994 and maintained around 0.35 for the rest of period. The variation of Gini coefficients in urban, peri-urban and periphery areas followed the similar way to the Gini coefficient of the whole region.

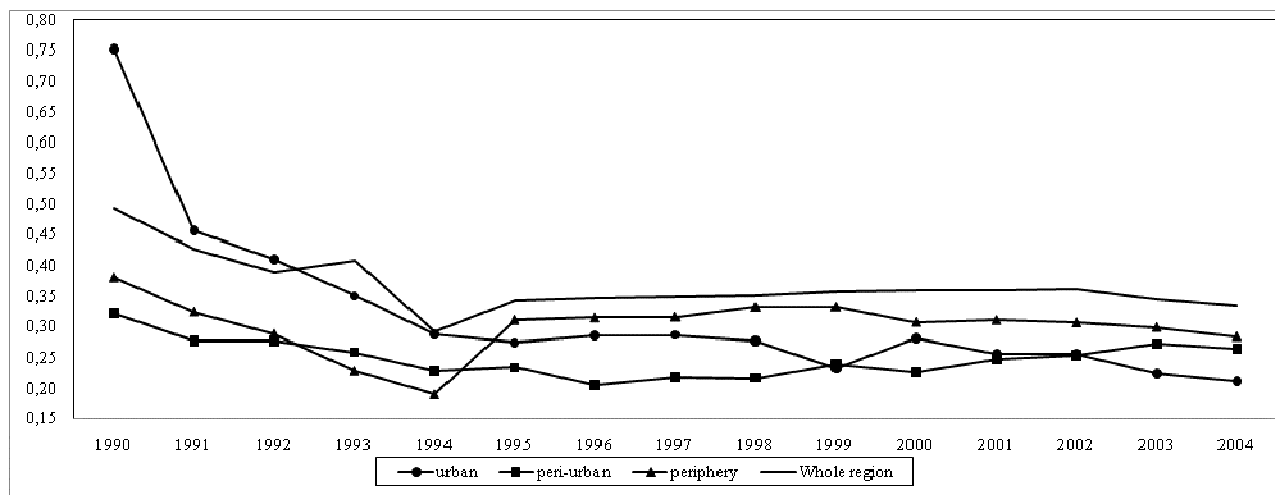


Figure4. Gini coefficients of the whole region and three classifications

In the period of 1990-1994, Gini coefficient of the urban areas started from a very high level and experienced a sharp decrease by 1994. Comparing with urban classification in the next period, nine urban areas were excluded from this classification. Suppose urban classification just consisting of these nine urban areas and the other urban areas in the period of 1990-1994, thus, these nine urban areas were gradually ruled out in this period while leaving the other urban areas of limited differences. In this sense, the first period saw this decreased Gini coefficient in the urban areas.

For the slight decrease of Gini coefficient in the peri-urban areas in the initial period, it shows that some periphery areas and those excluded urban areas added into the peri-urban classification in the following time period. This could be understood that the development of those periphery areas and the decay of those urban areas in the period of 1990-1994 reached the level of being a

peri-urban unit in the next period. Thus, differences among peri-urban areas experienced quite little fluctuation though the number of peri-urban areas increased greatly in these two periods.

Gini coefficient of periphery areas decreased continuously from 0.38 in 1990 to 0.19 in 1994. The explanation to this might be that those areas (west and south parts of Jing-Jin-Ji region) of the potential of developing into peri-urban areas were progressively excluded from the periphery classification by the end of 1994 while the left areas (mainly north parts of the region) are those of the similar economic conditions. Thus, the first five-year period witnessed the sharp decrease of Gini coefficient of the periphery areas.

Inter-class component, intra-class component and the overlapped component are computed by equation 5, 6 and 7. The population classification in each decomposition analysis is in line with the classifications in the three time periods as shown in Figure 3. The computation results are presented in Table 3 and the contributions of inter- and intra-class components to the total inequality are presented in Figure 5.

Table3. Regional inequality and decomposition in Jing-Jin-Ji region, 1990-2004

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Items															
G	0.49	0.43	0.39	0.41	0.29	0.34	0.35	0.35	0.35	0.36	0.36	0.36	0.36	0.35	0.34
G_b	0.18	0.13	0.12	0.24	0.19	0.18	0.18	0.18	0.19	0.22	0.21	0.21	0.20	0.19	0.19
G_w	0.22	0.17	0.15	0.13	0.19	0.10	0.10	0.10	0.10	0.09	0.09	0.10	0.10	0.09	0.09
G_o	0.04	0.13	0.12	0.04	0.002	0.07	0.07	0.07	0.07	0.04	0.07	0.06	0.06	0.06	0.06

Note: G , G_b , G_w and G_o denote the Gini coefficient, inter- class component, and intra- class component and the overlapped component of G .

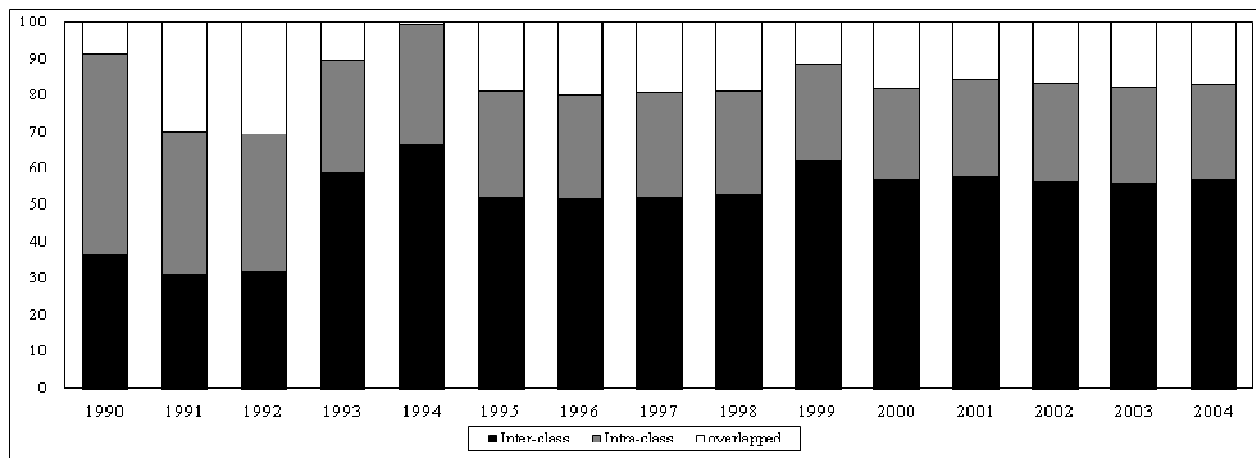


Figure5. Contributions of inter-, intra-class and overlapped components to the total inequality (%)

Generally, intra-class inequality contributed to 54.8% of the regional inequality in 1990 after which its contribution decreased annually until 1993 when inter-class inequality became the main contributor (58.7%). Then, the role of inter-class inequality as the main contributor stayed stably contributing over half of the regional inequality from 1994 to 2004 while intra-class inequality made the contribution of around 25% of regional inequality. To a large extent, this explains why regional inequality in Jing-Jin-Ji region could keep steadily since 1995.

Besides, the stability of inter- and intra-class inequality contributions might be interpreted by the changes of three classifications in the period of 1995-1999 and 2000-2004 as shown in Figure 3. These classifications show that the number of urban, peri-urban and periphery areas didn't have much change in this ten-year period. Specially, new urban areas mainly emerged in the places which used to be peri-urban areas, and some periphery areas developed into the peri-urban areas. Thus, the differences among these three classifications could stay relatively stable. This also contributes to the understanding of the steady Gini coefficients of urban, peri-urban and periphery areas in the period of 1995-2004.

To further analyze the regional inequality, the paper computes Gini coefficients between urban and periphery, urban and peri-urban as well as peri-urban and periphery areas (Figure 6). Inequality between urban and peri-urban areas is the largest followed by inequality between urban and rural areas, and inequality between peri-urban and rural areas. In the first five years, urban-periurban inequality first dropped to 0.11 in 1992 and then climbed to 0.20 in 1993, then fell to 0.18 by 1994. It increased slightly from 0.18 to 0.21 in the second five-year period and decreased slowly to 0.18 by 2004. The change of urban-periphery inequality followed the similar pattern to urban-periurban inequality in the research period. It started from 0.12 and reached the same level in 1995, then, it stayed around 0.12 from 1995 to 1998, jumped to 0.16 in 1999 and maintained around 0.15 for the rest years. Rather small inequality was seen between peri-urban and periphery areas keeping below 0.1 during the whole period.

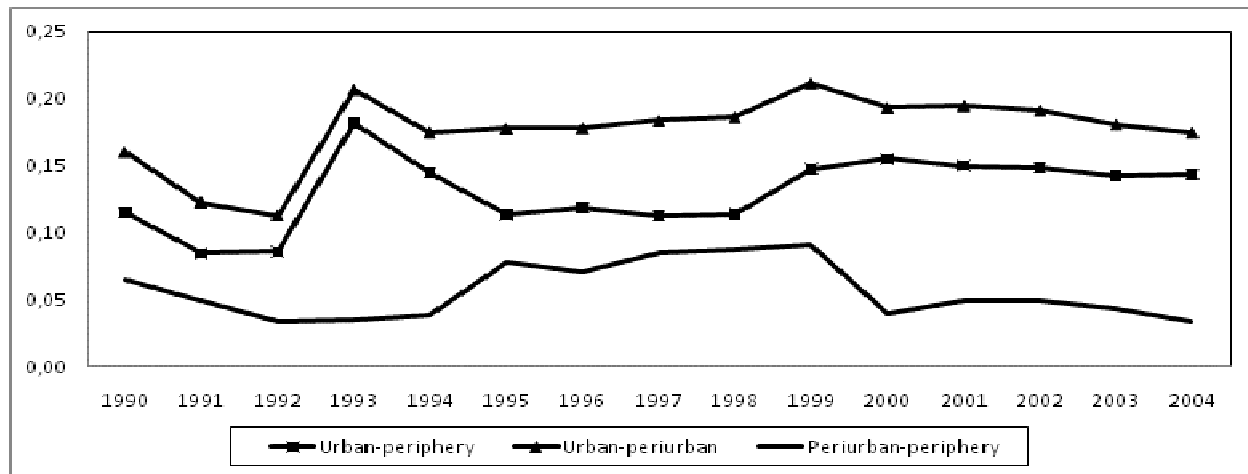


Figure6. Gini coefficients of urban-periphery, urban-periurban, periurban-periphery

Figure 7 shows the contributions of the three inequalities to the inter-class inequality in Jing-Jin-Ji region. Generally, inequality between urban and peri-urban areas is the major component (around 50%) of the inter-class inequality in the research period. The contribution of inequality between urban and rural periphery areas started from 33.8% in 1990 and climbed to 42% in 1993, then it dropped to 32.7% in 1999. This inequality stayed around 40% in the third five-year period. Inequality between peri-urban and periphery areas made less than 20% of contribution from 1990 to 1994, a little over 20% in the second five years, then it contributed around 10% since 2000.

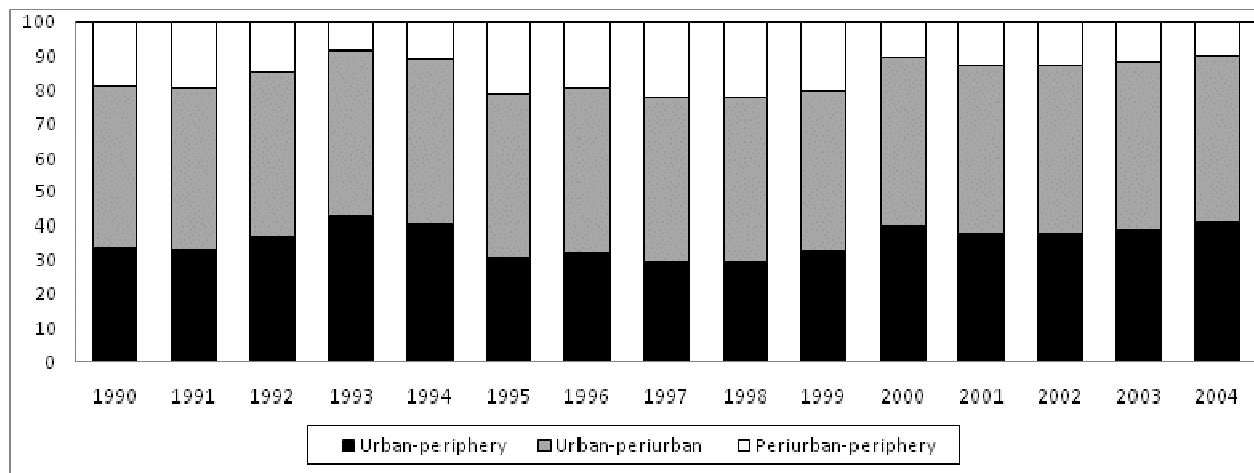


Figure7. Contributions of Gini coefficients of urban-periphery, urban-periurban, periurban-periphery to the inter-class inequality in Jing-Jin-Ji region (%)

Concluding remarks

Unlike current studies which make the decomposition analysis of regional inequality according to the urban/rural administrations, the study of the paper decomposes regional inequality in terms of resource flows and agglomerations. Three resource agglomeration patterns are identified in Jing-Jin-Ji region: urban, peri-urban and periphery areas. Research findings show that regional inequality of the region decreased from 1990 to 1994 and kept around 0.35 in the period of 1995-2004, and that the inequality among the three patterns contributed to an over half of the regional inequality from 1993 to 2004. Further analysis indicates that inequality between urban and peri-urban areas is the major component of the inter-class inequality in the research period.

The attribute of this new decomposition approach lies in that decomposition analysis is made based on the urban-rural linkages instead of the administrative divisions. It brings the decomposition into a dynamic process in which the changes of the three agglomeration patterns in the research period indicates how resource flows and agglomerates within the region. Besides, the differences of economic conditions within the region can also be implied according to the resource agglomeration patterns. Thus, this justifies the applicability of this approach to decompose inequality of the region. Moreover, the approach for the first time brings peri-urban areas which act as the urban-rural interface into the decomposition analysis. A spatial hierarchy of urban, urban-rural interface and rural contributes to the theoretical understanding of the trickle-down (spread) effect or positive externalities from the urban areas to the surrounding areas.

Basically, the research of the paper is made on the basis of urban-rural resource flows and agglomerations at the regional level in the Chinese context. Research results in turn support the three resource agglomeration patterns identified by the theoretical review. However, for the resource flows at the national or international level, there could be new agglomeration patterns in light of the political influences, international migration, trade and other influences related to globalization. Thus, the research approach needs adjustment to be applied in these larger contexts.

Footnotes

1. According to Myrdal's theory (1957), in the early stages of economic development, major economic activity and large amount of production factors tends to concentrate on certain regions due to their higher profit returns than other regions.
2. It is supposed to compute urban-rural linkages of each county or urban district in every two-year period. For the research concern, the paper only computes the linkages in every five-year period. It assumes that such linkages don't change much during each period.
3. Urban administrations refer to the administrations in the ten cities of Jing-Jin-Ji region. Each city consists of one urban district where the urban administration locate and many counties.

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