

THE ECONOMIC IMPACT OF SPATIAL ORGANIZATIONAL STRUCTURES ON THE PROVINCIAL BORDER-REGIONS OF CHINA ^①

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ABSTRACT: Based on the spatial organizational structures of the provincial border-regions (a border-region is one which borders two or more independent administrative regions), we build a spatial economic model for N-provincial border-regions (a N-p border-region is one which is under the jurisdiction of N provincial governments) and find that, for a given region with same geographical condition and resources endowment, the largest output of a N-p border-regional system will not exceed that of a (N-1)-p border-regional system, i.e., $F_1^* > F_2^* \cdots > F_{N-1}^* > F_N^*$. Using the model in this paper, we present a quantitative method to calculate the economic impacts of "provincial borders" and apply it to the border-region of Shanxi, Hebei, Shangdong, and Henan provinces. The result shows that the economic potential in the border-region has not been efficiently exploited and that the annual gross agricultural products have decreased by 10.4% due to the 4-p borders.

KEY WORDS: province, border-region, spatial organization, chinese economy

I. INTRODUCTION

As one of the largest countries in the world, China is divided into 31 provinces (autonomous regions or municipalities) and has 849 counties or cities located in 52000 km of provincial border lines, which account for 39% of the total counties or cities in country^[1].

① Financial supports from China National Science Foundation and National Social Science Foundation are gratefully acknowledged.

Due to the spatial separations among Chinese provinces, the provincial border-regions have not been efficiently developed in spite of their plentiful natural resources.^①For example, in the border-region of Shanxi, Hebei, Shandong and Henan Provinces in Central China, Changzhi and Jincheng of Shanxi Province are rich in coal resource, while Xinxiang of Henan Province teems with wheat and rice. They should have exchanged and complemented each other according to the comparative principle of economics. However, because of the inter-provincial separations, it has a saw that "Henanese swear not to use Shanxi's coal even if they die of frost and Shanxian never import Henan's grain until they starve", which artificially makes low utilizations of resources and hence restricts the economic development in the border-regions.^②

From the angle of spatial organizational structure, we may classify the provincial border-regions into 2, 3, ... and N-provincial border-regions which are those being under the jurisdiction of 2, 3, and N provincial governments respectively.

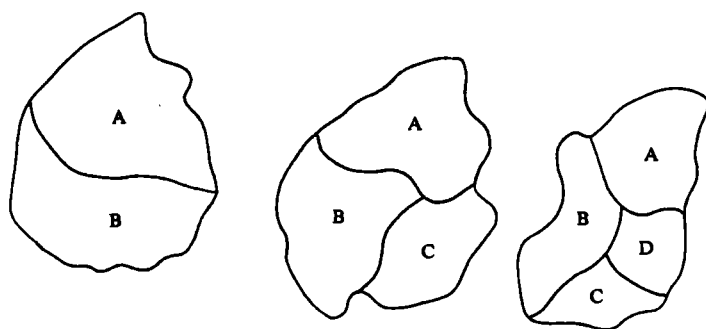


Fig.1 Basic spatial structures of the provincial border-regions

(a) 2-p Border-region (b) 3-p Border-region (c) 4-p Border-region

Obviously, given a region with same geographical condition and resources endowment, a N-p border-region will lower the productivity of spatial economic operation than a (N-1)-p border-region, etc. To demonstrate the above point of view, Section II will present a N-p model of spatial economies which can be used to derive the preferential rank for the largest outputs of i-p border-regional systems (i=1, 2, ..., N). Section III is a case study of the agricultural production in the region bordering Shanxi, Hebei, Shangdong and Henan Provinces in Central China, followed by conclusions.

① For more evidence, see Guo Rongxing (1993, pp.96-117 and pp.184-188).

② Source: 晋冀鲁豫接壤地区资料汇编, 联合发展之计, 邯郸市, 1987.

II. THE CASE STUDY OF THE 4-P BORDER-REGION

Table 1 shows the differences of agricultural productivities in the border-region of Shanxi, Hebei, Shandong and Henan Provinces ($34^{\circ} 31' - 37^{\circ} 41' \text{ N}$, $111^{\circ} 56' - 116^{\circ} 30' \text{ E}$) in Central China.

Table 1 The agricultural productivities of Shanxi-Hebei-Shandong-Henan border-region (unit: kg per ha)

Sub-region		(1) Grains	(2) Cotton	(3) Yegetables	(4) Fruits	Total Cultivated Area (ha)
SHANXI (1)	Changzhi (1)	3274.2	387.0	20400.6	4182.6	299400
	Jincheng (2)	2236.2	221.0	16279.1	3521.1	221900
HEBEI (2)	Xingtai (1)	2646.0	789.5	20828.7	3447.9	901400
	Handan (2)	4973.4	654.9	36145.8	2906.3	1029800
SHANDONG (3)	Liucheng (1)	7204.9	884.5	67377.8	2115.5	533500
	Hezhe (2)	6358.4	789.5	67377.8	5906.3	734700
HENAN (4)	Anyang (1)	3113.6	469.9	29225.6	4145.7	450000
	Xinxiang (2)	3646.5	947.9	45472.2	4145.7	456300
	Jiaohuo (3)	1818.8	755.1	50740.2	4145.7	383600
	Hebi (4)	2286.2	343.7	40209.5	4540.4	60400
	Puyang (5)	3013.7	682.5	17150.6	587.1	763300

Source: Guo Rongxing (1993, Table 3-1)^[2]

Using the approach given in Section II, we will analyse the impact of 4-p spatial organizational structure on the agricultural production of the border-region.

Let variable X_{ijk} stands for the land input in kth agricultural production of jth sub-region of ith province (see Table 2). The 4-p linear programing model for the border-region is built as below.

Table 2 The specification of policy variables X_{ijk} (unit: thousand ha)

Sub-region		(1) Grains	(2) Cotton	(3) Yegetables	(4) Fruits
SHANXI (1)	Changzhi (1)	X_{111}	X_{112}	X_{113}	X_{114}
	Jincheng (2)	X_{121}	X_{122}	X_{123}	X_{124}
HEBEI (2)	Xingtai (1)	X_{211}	X_{212}	X_{213}	X_{214}
	Handan (2)	X_{221}	X_{222}	X_{223}	X_{224}
Liucheng (1)	Hezhe (2)	X_{311}	X_{312}	X_{313}	X_{314}
		X_{321}	X_{322}	X_{323}	X_{324}
HENAN (4)	Anyang (1)	X_{4111}	X_{412}	X_{413}	X_{414}
	Xinxiang (2)	X_{421}	X_{422}	X_{423}	X_{424}
	Jiaohuo (3)	X_{4311}	X_{432}	X_{433}	X_{434}
	Hebi (4)	X_{441}	X_{442}	X_{443}	X_{444}
	Puyang (5)	X_{451}	X_{452}	X_{453}	X_{454}

(1) From the last column of Table 1, the cultivated land restraint for j th sub-region of i th province is

$$\sum_{i=1}^4 X_{ijk} \leq \text{the cultivated area of } j \text{th sub-region of } i \text{th province.} \tag{1}$$

(2) In the 4-p spatial system of border-regional economies, the output restraint for k th agricultural production of i th province is

$$\sum_j C_{ijk} X_{ijk} \geq \text{the previous year's output of } k \text{th agricultural product of } i \text{th province} \tag{2}$$

which is given in Table 3.

Table 3 The previous year's outputs for the border-region (unit: million kg)

Sub-region	(1) Grains	(2) Cotton	(3) Vegetables	(4) Fruits
(1) Shanxi	1334.300	1.087	433.225	92.495
(2) Hebei	2937.200	219.056	1591.480	219.890
(3) Shandong	4849.355	383.835	1226.400	86.331
(4) Henan	5621.985	137.600	1295.000	129.500
Total	15742.840	741.578	4546.115	528.216

Source: Guo Rongxing (1994, Table 3-3)^[2].

(3) The output goal function of i th province is

$$F_{ki} = f_{ki}(X_{ki}) = \sum_j \sum_{k=1}^4 P^k C_{ijk} X_{ijk} \quad (i = 1, 2, 3, 4)$$

where C_{ijk} is given in Table 1. P_k is represented by price of k th product ($k = 1, 2, 3, 4$) respectively.^①

Using the linear programming program, we may obtain the optimal solutions given in Table 4, in which the largest output value of the 4-p border-regions is

$$F_4 = \sum_{i=1}^4 F_i = 12433.02 \text{ million yuan}$$

① The average price of the four kind products in 1987 in China are:
 $P_1 = 0.488$ yuan per kg; $P_2 = 2.442$ yuan per kg; $p_3 = 0.068$ yuan per kg; $p_4 = 0.058$ yuan per kg.

Table 4 The optimal comparison of two spatial agricultural systems (unit: thousand ha)

	Sub-region	(1) Grains		(2) Cotton		(3) Vegetables		(4) Fruits		Total output		(million yuan)
		4-p	1-p	4-p	1-p	4-p	1-p	4-p	1-p	4-p	1-p	△
SHANXI	Changzhi	296.5	0	2.8	0	0	0	0	299.4	751.13	1191.69	440.55
	Jincheng	162.5	0	0	0	44.0	0	32.9	215.3			
HEBEI	Xingtai	0	0	241.0	901.4	0	0	660.4	0	4268.64	4236.61	-32.03
	Handan	791.6	1029.8	44.0	0	194.1	0	0	0			
SHANDONG	Liucheng	392.7	533.5	140.8	0	0	0	0	0	4170.72	4884.83	714.11
	Hezhe	0	241.6	328.5	0	391.6	493.2	14.6	0			
HENAN	Anyang	450.1	450.1	0	0	0	0	0	0	3242.53	3562.90	320.36
	Xingxiang	416.1	384.7	0	31.6	0	0	0	0			
	Jiaozuo	144.6	0	162.2	0	25.5	0	31.2	384.7			
	Hebi	61.1	61.1	0	0	0	0	0	0			
	Puyang	763.3	763.3	0	0	0	0	0	0			
	Total	3478.5	3464.1	939.3	933.0	655.2	493.2	739.1	899.4	12433.02	13876.02	1442.99

Note: 4-p = the solution of the border-region separated by four provinces;
1-p = the solution of the border-region as economically united one.

Next, let us analyse the optimal solution of the region if the 4-p economic border is called off.

The 1-p linear programing model can be built after the output restraint (6) for kth agricultural production of the whole region is changed to

$$\sum_{i=1}^4 \sum_j C_{ijk} X_{ijk} \geq \text{the previous year's output of } k \text{th agricultural product}$$

(3)

which is given in the last row of Table 3.

The solution for this model is given in Table 4, in which the largest output value of the 1-p border-region (i.e., the region which is ran by one province) is $F_1 = \sum_{i=1}^4 F_{ii} = 13876.02$ (million yuan)

From the commparison of the 1-P and 4-P solutions in Table 4, we may find that the 4-p border-region of Shanxi, Hebei, SHandong and Henan Provinces has decreased by

10.4% of total output value of agricultural production because of its inter-provincial separation.

III. CONCLUSIONS

Border-regional economics is becoming a new branch in spatial economics and economic geography. In this paper, we build a mathematical model of spatial economic performances for N-border-regions and find that the largest economic output of a border-regional system is negatively related to the number of provinces included in the spatial system, and present a quantitative method to calculate the economic impacts of administrative borders on the border-regional development. We suggest that this approach is a practically valuable tool for border-regional economists and economic geographers to analyse the inter-regional separation and cooperation.

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