2006 - 2015 108 DEA

Malmquist ESDA

V

- -

430074

430074

T

DEA CCR BCC Malmquist

ESDA

1.

30 2014

11 108

2011 108

2006-2015

2.

1 DEA Malmquist

DEA

DMU CCR

DMU BCC CCR

1 λ=1

CCR BCC

n DMU DMU m s x_j y_j $X_j=(x_{1j},x_{2j}, \quad x_{mj})^T,Y_j=(y_{1j},y_{2j}, \quad y_{sj})^T$ x_{ij} j DMU j y_{rj} j DMU r i=1,2, 3,⋯,s λ_j n DMU x_{j0} y_{j0} j_0 DMU S^- S^+ $S^-=(s_1^-,s_2^-, \quad s_m^-)T$ $S^+=(s_1^+,s_2^+, \quad s_m^+)^T$ D $V_D=1$ j0 DMU DEA D $V_D=1$ λ^* s^{*-},s^{*+},θ^*, $s^{*-}=0$ $s^{*+}=0$ j_0 DMU DEA

$$D \quad \begin{array}{l} = \\ . . \sum_{=1} \quad + \ ^- = \quad _0 \\ \sum_{=1} \quad - \quad + = \quad _0 \\ \geqslant 0, \ = 1,2,\cdots, \end{array} \qquad D' \quad \begin{array}{l} \max \ = \ ' \\ . . \sum_{=1} \quad + \ ^- = \quad _0 \\ \sum_{=1} \quad - \ ^+ = \quad _0 \\ \geqslant 0, \ = 1,2,\cdots, \end{array}$$

CCR BCC

Malmquist t t t+1 t+1

t t+1 TEPCH

$$M \ x_i \ y_i \ x_{t+1} \ y_{t+1} = \frac{^{+1}(\ _{+1} \ _{+1})}{(\quad)} \times [\frac{(\ _{+1} \ _{+1})}{^{+1}(\ _{+1} \ _{+1})} \times \frac{(\quad)}{^{+1}(\quad)}]^{1/2} = EFFCH \times TECH$$

D^t D^{t+1} t t+1 M

1 t t+1 M 1 1

EFF PE SE

$$M \ x_i \ y_i \ x_{t+1} \ y_{t+1} = TFPCH = EFFCH \times TECH = PECH \times SECH \times TECH$$

EFFCH t t+1

TECH t t+1

TECH 1

2 ESDA

a.

Moran s I

$$I=n\sum_{=1}\sum_{=1} - {}^{-} \quad - {}^{-} / \sum_{=1}\sum_{=1} \quad \sum_{=1} \quad - {}^{-2}$$

x_i x_j $^{-}$ n W_{ij}

Moran s I −1 1 Moran s I

0 Moran s I 0

Moran sI 0

Z

$$Z=\frac{-\ (\ )}{\sqrt{\quad (\ )}}$$

Z>0 Z<0

Z=0

b.

Getis-Ord Gi^*

$$Gi^*=\sum_{=1}(\quad)/\sum_{=1}$$

$Gi^*>0$ $Gi^*<0$

$Gi^*=0$

3

DEA

20

GDP GDP

1.

1

DEA-CCR DEA-BCC DEA solver

pro5.0 2015

3 1

4 1

DEA

0.561

1

1 2015

	0.435	0.751	0.579		1	1	1
	0.492	0.570	0.863		0.650	0.678	0.958
	0.447	0.523	0.854		0.569	0.636	0.894
	0.500	0.704	0.710				
	0.403	0.492	0.819		0.468	0.637	0.751
	0.569	0.644	0.883		0.493	0.573	0.858
	0.485	0.576	0.842		0.722	0.771	0.933
	0.517	0.582	0.888		0.561	0.660	0.847

0.561

0.847

0.858 0.847

5 35.04% 29.62

7 211 152

2

Malmquist

DEA Malmquist

Deap 2.1 2

2 2006-2015 1 4

4

2 2006–2015 Malmquist

	EFFCH	TECH	PECH	SECH	TFPCH
	0.981	0.977	0.988	0.993	0.959
	0.988	0.971	0.994	1.003	0.960
	0.984	0.959	0.979	1.005	0.944
	1.015	0.991	1.005	1.010	1.006
	0.981	0.949	0.995	0.986	0.932
	0.993	0.980	0.995	1.036	0.972
	0.928	0.881	0.919	0.926	0.894
	1.006	1.014	1.013	1.036	1.020
	1.037	1.046	1.018	1.018	1.084
	1.001	1.021	0.996	1.003	1.021
	1.004	0.980	1.009	0.994	0.984

3

2006–2015

2006–2015

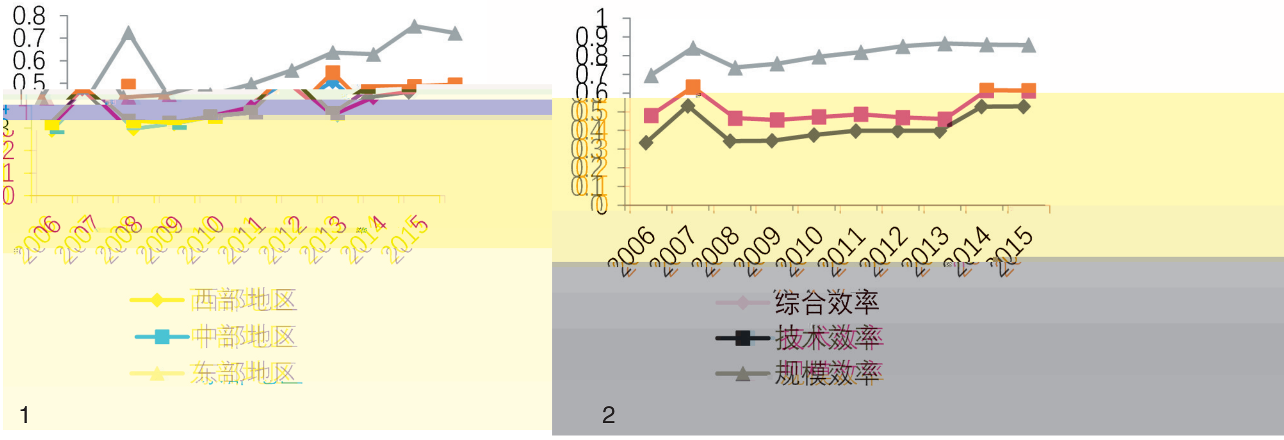
1 2006–2015

2007–2008 2007 2003

2008

2012

2012



2 2006–2015

2.

1

Moran s I ArcGIS 10.1 2006–2015

Moran s I Z

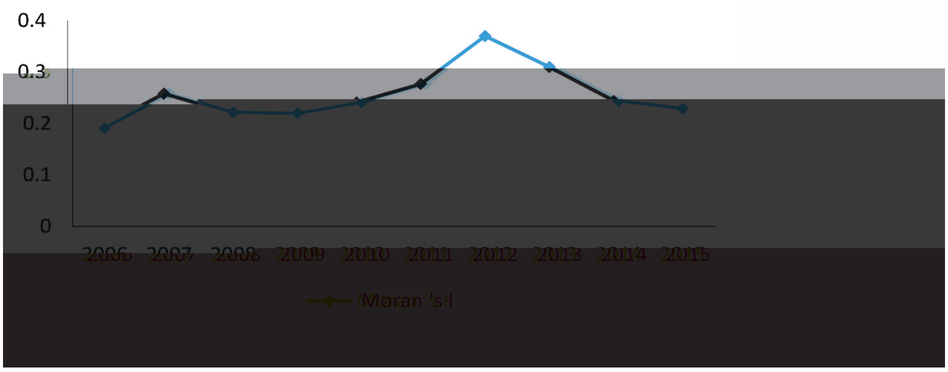
Moran s I Z>1.96 Z<−1.96

Moran s I 2006–2015 Moran s I 0

3 2006–2012 Moran s I

3 2006–2015 Moran' s I

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Moran I	0.191	0.258	0.222	0.220	0.241	0.277	0.370	0.310	0.244	0.229
P	0.0003	0.001	0.0005	0.0002	0.002	0	0	0	0	0
Z	3.542	3.903	3.462	3.348	3.678	5.061	5.628	4.759	3.731	3.538



2012–

2015 Moran s I

3

2006–2015

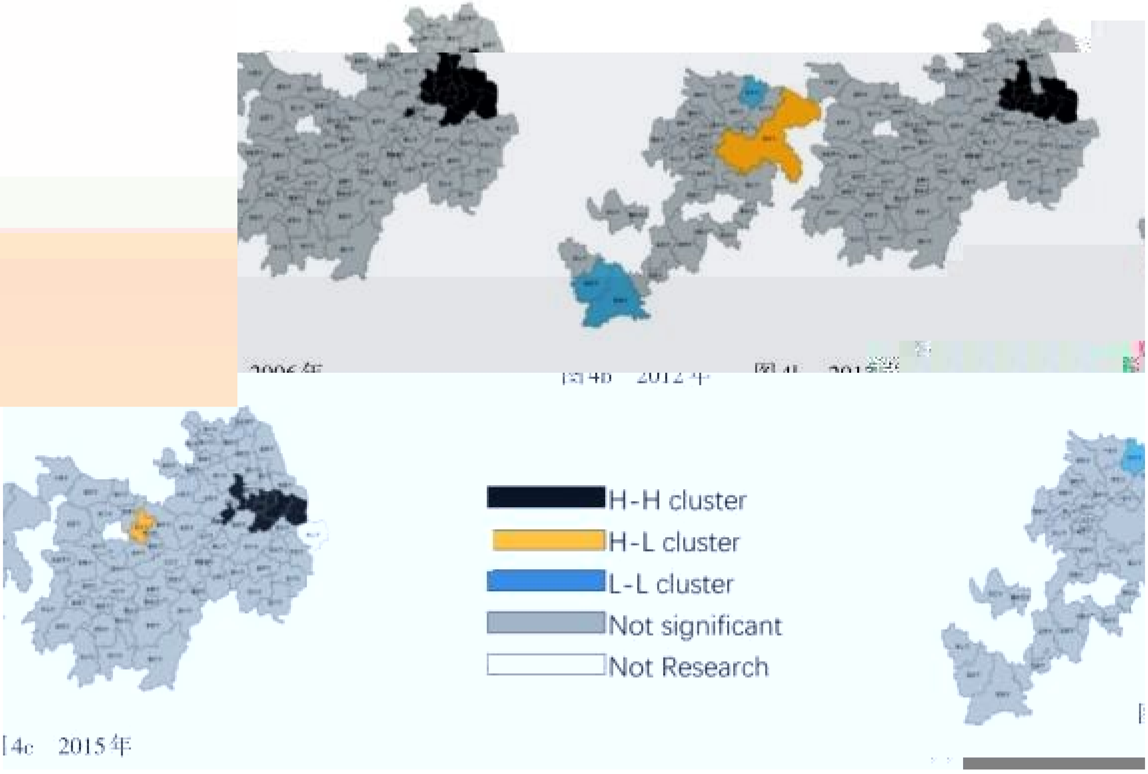
V

2

Moran s I

2006 2012

2015 LISA



4

H–H

L–L

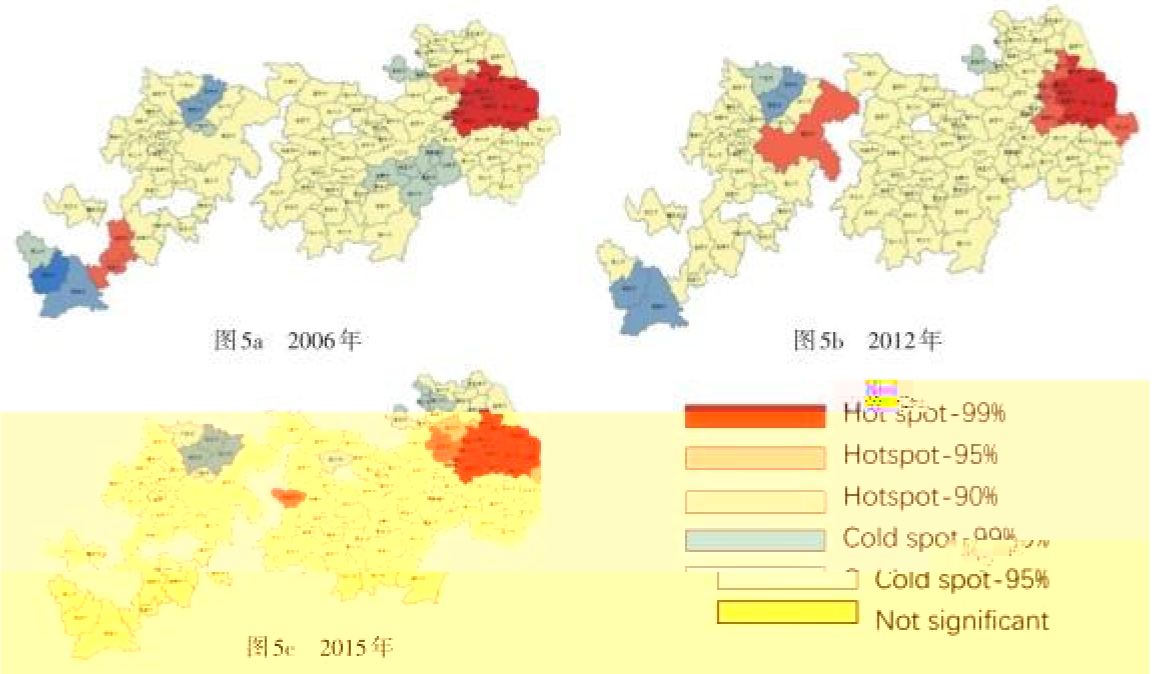


图5a 2006年

图5b 2012年

图5c 2015年

5

2012

2015

– –

108 2006–2015

1

2 V

H–H L–L

– –

1. 2016
21
2. 2016 9
3. 2017 5
4. 2016 18
5. 2017 4
6. 2017 4
7.
2016 4
8. K 2003 7
9. : 1990–2006 DEA Malmquist
2009 3
10. 2016 6

Differences in Urban Innovation Efficiency and Its Features of Spatial Evolution in the Yangtze River Economic Belt

Xiao Ying Deng Hongbing

Abstract: Based on the panel data of 108 cities, the research uses the DEA model and the Malmquist index analysis method to measure the urban innovation efficiency in the Yangtze River Economic Belt during 2006–2015. Combined with ESDA spatial analysis technology, the study probes into the features in spatial evolution of innovation efficiency. The results show that the urban innovation efficiency of the eastern part of the Yangtze River Economic Belt is higher than that of the middle and western cities, both of which rise slowly in periodic fluctuation. The efficiency of innovation is mainly affected by technical efficiency. Innovation efficiency agglomeration shows a trend of an upside-down "V"-shape. The mode of agglomeration reveals a spatial pattern of "high east and low west" and the degree of agglomeration gradually decreases over time. The distribution of innovation efficiency hotspots evolves into a "core-periphery-margin" gradient structure.

Keywords: the Yangtze River Economic Belt; innovation efficiency; spatial evolution