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Infrastructure Investment and Sustainable Development in Coastal Areas in China

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ABSTRACT

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In order to study the influence of infrastructure investment to economy in the interior of China and the coastal areas, this paper uses qualitative analysis and empirical analysis to demonstrate the both the relationship between infrastructure investment and regional economic development in China and the divergence between coastal and inland areas. Compared with other regions, China's coastal zone economy is highly extroverted and open. Coastal zone plays an important role in national sustainable economic development strategy. Based on qualitative analysis, this paper firstly establishes a cooperative game model to qualitatively and horizontally analyze the differences and complementarities between central and local governments in regional infrastructure investment. Empirical analysis is adopted to discuss various kinds of infrastructure construction investment at the national level. In the conclusion, preliminary policy recommendations are put forward.

ADDITIONAL INDEX WORDS: *Infrastructure construction, regional economy, cooperative game, balanced growth path, PCA (principal component analysis), coastal areas.*

INTRODUCTION

Since 1979, China's economy turned into Local Government Leading Model from Central Government Leading Model, which means the local governments of each region can develop economy according their own comparative advantages (Guo, 2017). Since the 21st century, China's marine economy with double-digit annual growth rate of rapid development (Li et al., 2018). The factors which influence sustainability in coastal management span social, economic, institutional, biophysical and legal conditions (House et al., 2011). Sustainable Development is defined as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs" and coastal research is addressing these issues through sustainable coastal zone management (Brommer et al., 2010). Integrated coastal and marine management provides a framework and context for examining the interaction between complex issues and interests (Magdalena, 2002). Infrastructure is the base of regional sustainable economic development. From a horizontal perspective, a blind increasing of the infrastructure construction investment scale will negatively affect the "inverted U" economic growth in a long-term due to the opportunity cost. Government investment in infrastructure cannot be used for other production activities, while excessive investment will crowd out potential benefits that could be obtained if invested in other fields. From a vertical perspective, the state and the local investment in infrastructure construction focus on different aspects. In the 1980s, a phenomenon of economic construction in China has attracted the attention of many economists, that is, local governments are keen on industrial investment in the sacrifice of infrastructure investment.

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DISCUSSION

One striking phenomenon in China's economic construction is that local governments are keen to invest in industry whileneglecting investments in infrastructure. But in the 1990s, local governments began to invest heavily in infrastructure. This phenomenon can be solved by game model.

Game Between the Central and Local Government Model Setup

In the following equation, C and L are defined as central and local government, E and I stand for infrastructure investment and other investment. To simplify the analysis, the central and local government revenue functions are respectively derived from the following Cobb-Douglas forms:

Central government utility $R_c = (E_c + E_l)^{\gamma}(I_c + I_l)^{\beta}$
Local government utility $R_l = (E_c + E_l)^{\alpha}(I_c + I_l)^{\beta}$

Dynamic Interaction Between the Central and the Local

In this game, the strategy of the central and the local governments is to choose their own investment allocation. For one party, it is assumed that the other party's investment allocation is given. In the following function, B_c and B_l are respectively used to represent the total budget that the central and the local governments can allocate. It is assumed that both the central and the local governments maximize their own revenue functions based on their budgetary constraints.

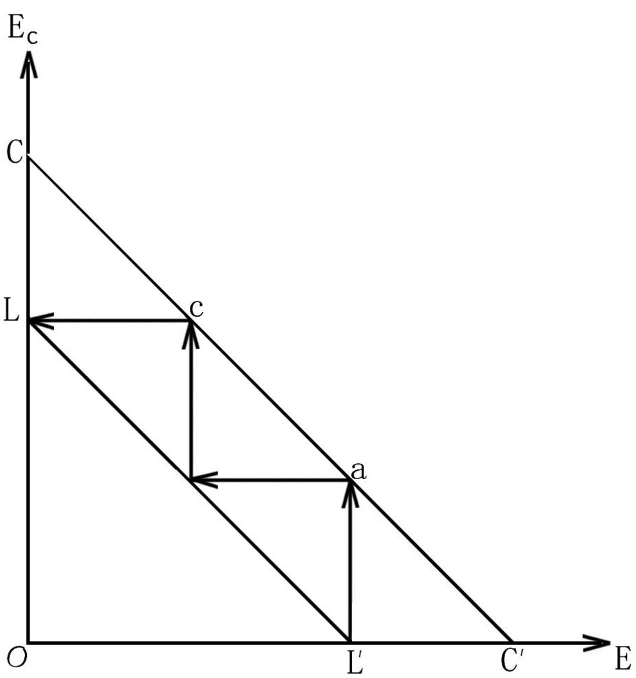

Figure 1. Game between Central and Local government.

For the Central $\max_{\{E_c, I_c\}} R_c = (E_c + E_l)^{\gamma}(I_c + I_l)^{\beta}$

s.t. $E_c + I_c \le B_c,\ E_c,\ I_c \ge 0$

For the Local $\max_{\{E_l, I_l\}} R_l = (E_c + E_l)^{\alpha}(I_c + I_l)^{\beta}$

s.t. $E_l + I_l \le B_l,\ E_l,\ I_l \ge 0.$

Because investment produces positive benefits, it is regarded as a normal good in this model. According to the Local Unsaturation Theorem[1], the equation of budget constraint is assumed to hold.

Response function of central government

$$E_c^* = \max\left\{\frac{\gamma}{\gamma+\beta}(B_c + B_l) - E_l, 0\right\}$$

Response function of local government

$$E_l^* = \max\left\{\frac{\alpha}{\alpha+\beta}(B_c + B_l) - E_c, 0\right\}$$

The optimal level of investment in infrastructure construction at national level should be higher than that of local government due to the latter shows no externality:

$$E_c^* + E_l = \frac{\gamma}{\gamma+\beta}(B_c + B_l) > \frac{\alpha}{\alpha+\beta}(B_c + B_l) = E_l^* + E_c$$

The above inequation means that at the equilibrium point, the optimal solution of at least one party is corner solution.

[1] Local Unsaturation Theorem: For normal products in utility functions, local unsaturation means that the decision-maker (consumer) must consume all budget constraints to maximize utility.

From the figure 1, the two parallel lines CC' and LL' represent the response curves of the central and local governments respectively. OL $= \frac{\alpha}{\alpha+\beta}(B_c + B_l)$; OC $= \frac{\gamma}{\gamma+\beta}(B_c + B_l)$. Assuming $\frac{\gamma}{\gamma+\beta}(B_c + B_l) \le B_c$, namely, the total budget of the central government for investment is greater than the ideal amount of investment of the central government in infrastructure. Using Reiterated Elimination of Inferior Strategy, it is obtained that C is the only Nash equilibrium point.

Different Possible Outcomes

Situation A

If $\frac{\gamma}{\gamma+\beta}(B_c + B_l) \le B_c$, the Nash Equilibrium will be

$$E_l^* = 0;\ I_l^* = B_l;\ E_c^* = \frac{\gamma}{\gamma+\beta}(B_c + B_l);\ I_c^* = B_c - \frac{\gamma}{\gamma+\beta}(B_c + B_l)$$

In this case, the local government prefers to invest its entire budget to the fields other than infrastructure, the central government compensates the investment of local government in infrastructure and invests the rest of the money to industry and other fields.

Situation B

If $\frac{\gamma}{\gamma+\beta}(B_c + B_l) > B_c \ge \frac{\alpha}{\alpha+\beta}(B_c + B_l)$, the budget funds of the central government are smaller than the optimal investment scale of the ideal amount of the central government on infrastructure but larger than the optimal scale of the local government.

$$E_l^* = 0,\ I_l^* = B_l,\ E_c^* = B_c,\ I_c^* = 0$$

The local government will invest all its capital in industry and other fields, and the central government will invest all its capital in infrastructure.

Situation C

If $B_c \le \frac{\alpha}{\alpha+\beta}(B_c + B_l)$, the Nash Equilibrium will be,

$$E_l^* = \frac{\alpha}{\alpha+\beta}(B_c + B_l) - B_c = \frac{\alpha}{\alpha+\beta}B_l - \frac{\beta}{\alpha+\beta}B_c > 0$$

$$I_l^* = B_l - E_l^* = \frac{\alpha}{\alpha+\beta}(B_c + B_l) > 0$$

$$E_c^* = B_c,\ I_c^* = 0$$

The central government invests all its money in infrastructure construction, and the local government makes up for the investment shortage of the central government until it has reached to the ideal level of the local government. The rest of the money of the local government is invested to industrial development. Moreover, the investment of local government in infrastructure increases while the investment from the central government decreases.

The simplified model does capture the transformation characteristics of China in the investment pattern to infrastructure construction investment since the Reform and Opening up. In the early stage, the central government had relatively large budgetary funds available for investment, the situation is roughly between the Situation A and Situation B, while the local governments had no incentive to invest in infrastructure construction. At this stage, the investment in infrastructure of the local government was considered inadequate by the central government. With reduction of the central budget funds, Situation C appeared. Although the central government used all its budget for infrastructure investment, the result can hardly meet the local needs, so the local governments had to make their own infrastructure investment. After the 1990s, for example, the central government could hardly afford to the investment in infrastructure projects that concerned by local governments, therefore, the local infrastructure investment increased substantially.

METHODS

It is assumed that the level of infrastructure investment increases the capital level an effect similar to technological progress, thus promoting the level of output. Technological progress will eventually materialize into capital as a factor of production.

Model Setup

However, due to the opportunity cost of investment in infrastructure construction, excessive investment will lead to crowding-out effect. On this basis, a model is established as follows:[2]

$$\mathrm{Y(t)} = \mathrm{J(t)}^{\alpha}\mathrm{L(t)}^{1-\alpha}\left[\frac{W(t)-B(t)}{W(t)}\right]^{\beta} \beta > 0 \tag{1}$$

J (t) satisfy the dynamic condition described below,

$$\dot{J}(t) = sA(t)Y(t) - \delta J(t) \tag{2}$$

Suppose that investment budget constraints grow over time at a fixed growth rate and is exogenously given.

Particularly in this model, it is assumed that investment in innovation or technological improvement in infrastructure investment will also lead to technological progress, so real technological progress depends on two factors, the exogenous rate of progress g and the technology renovation of production lines caused by investment in infrastructure construction.

$$\frac{\dot{A}(t)}{A(t)} = g + \mu\frac{\dot{B}(t)}{B(t)} = g + \mu g_B \tag{3}$$

Model Solution

In order to analyze the balanced growth path of the economy, the problem of over-investment in infrastructure construction is neglected at first, and the current investment level is tacitly approved in sustention. The crowding-out effect of infrastructure construction investment is not obvious at this stage, so the crowding-out term in the production function can be ignored. After deducing the balanced growth balance, further exploration is carried out on how the government should determine the reasonable growth rate of investment in order to avoid excessive investment in infrastructure construction. Thus the model can be simplified as below.

$$\mathrm{Y(t)} = \mathrm{J(t)}^{\alpha}\mathrm{L(t)}^{1-\alpha} \tag{4}$$

Denote $\mathrm{Q(t)} = \frac{\mathrm{J(t)}}{\mathrm{A(t)}}$ and substitute it into the equation (4),

$$\mathrm{Y(t)} = [\mathrm{A(t)Q(t)}]^{\alpha}\mathrm{L(t)}^{1-\alpha} = \mathrm{Q(t)}^{\alpha}[A(t)^{\frac{\alpha}{1-\alpha}}\mathrm{L(t)}]^{1-\alpha} \tag{5}$$

Divide both sides of equation (5) by $[A(t)^{\frac{\alpha}{1-\alpha}}\mathrm{L(t)}]$,

$$\frac{\mathrm{Y(t)}}{[A(t)^{\frac{\alpha}{1-\alpha}}\mathrm{L(t)}]} = \left[\frac{\mathrm{Q(t)}^{\alpha}[A(t)^{\frac{\alpha}{1-\alpha}}\mathrm{L(t)}]^{1-\alpha}}{A(t)^{\frac{\alpha}{1-\alpha}}\mathrm{L(t)}}\right]$$

$$= \left[\frac{Q(t)}{A(t)^{\frac{\alpha}{1-\alpha}}\mathrm{L(t)}}\right]^{\alpha} = q(t)^{\alpha} \tag{6}$$

$$\frac{\dot{q}(t)}{q(t)} = \frac{\left[\dfrac{\dot{Q}(t)}{A(t)^{\frac{\alpha}{1-\alpha}}\mathrm{L(t)}}\right]}{\left[\dfrac{Q(t)}{A(t)^{\frac{\alpha}{1-\alpha}}\mathrm{L(t)}}\right]} = \frac{\dot{Q}(t)}{Q(t)} - \frac{\alpha}{1-\alpha}\frac{\dot{A}(t)}{A(t)} - \frac{\dot{L}(t)}{L(t)}$$

$$= \frac{\dot{J}(t)}{J(t)} - \frac{\dot{A}(t)}{A(t)} - \frac{\alpha}{1-\alpha}\frac{\dot{A}(t)}{A(t)} - \frac{\dot{L}(t)}{L(t)} \tag{7}$$

$$\frac{\dot{q}(t)}{q(t)} = \frac{\dot{J}(t)}{J(t)} - \frac{1}{1-\alpha}(\mathrm{g} + \mu g_B) - \mathrm{n} \tag{8}$$

Substitute (2) into (8),

$$\dot{\mathrm{q}}(\mathrm{t}) = \mathrm{s}q(t)^{\alpha} - \left[n + \delta + \frac{1}{1-\alpha}(g + \mu g_B)\right]\mathrm{q(t)}$$

$$= \mathrm{sy} - \left[n + \delta + \frac{1}{1-\alpha}(g + \mu g_B)\right]q(t) \tag{11}$$

In the balanced growth path, $(\mathrm{q(t)})^{\cdot}=0$, thus the output per effective labor will be

$$\mathrm{y} = \frac{\left[n + \delta + \frac{1}{1-\alpha}(g + \mu g_B)\right]q(t)}{s} \tag{9}$$

Through comparative static analysis, it can be seen that the growth rate of infrastructure construction investment rises, the balanced output level of unit efficiency labor will indeed rise. If the crowding-out effect is not considered, the increase of infrastructure construction investment growth rate g_Bwill indeed increase the output level.

In the static analysis of the equilibrium growth path, the role of the latter part of the production function is neglected. Assuming that investment growth is not excessive, then the crowding-out effect can be neglected accordingly. However, further discussion on the changes might happen in output ought to be carried out if investment is excessive.

$$\frac{W(t)-B(t)}{W(t)} = 1 - \frac{B(t)}{W(t)} = 1 - \frac{B(0)e^{g_B t}}{W(0)e^{wt}} \tag{10}$$

$\mathrm{g_B}$ is the decision variable of government. However, if $\mathrm{g_B}$ is higher than w, i.e. the growth rate of government investment in infrastructure construction is higher than the growth rate of the government's total investment budget. As time goes by,

[2] The dynamics of the effective capital is $\dot{J}(t) = sA(t)Y(t) - \delta J(t)$, which means that technology enters the production factors in the form of materialized capital. In the model, J(t) stands for effective capital, L(t) stands for labor, w(t) denotes the total budget that can be allocated in the investment and B(t) denotes the proportions of the total budget that used in the infrastructure investment.

Table 1. *Local government's capital stock of urban infrastructure investment (in 10,000).*

Province\Year	2006	2007	2008	2009	2010
Beijing	3,664,492	5,872,436	6,674,187	8,852,124	10,471,680
Tianjin	622,057	641,091	753,439	939,561	837,179
Hebei	1,126,026	1,633,090	2,307,528	3,042,408	3,659,485
Shanxi	483,290	775,985	964,724	1,166,474	1,293,881
Inner Mongolia	676,003	910,445	1,026,035	1,190,409	1,294,479
Liaoning	2,607,553	3,272,973	4,344,845	4,726,041	4,146,806
Jilin	424,419	523,162	594,063	775,638	712,517
Heilongjiang	727,829	871,044	1,139,199	1,558,405	1,468,678
Shanghai	2,219,627	2,035,958	2,190,568	2,069,847	1,842,796
Jiangsu	4,477,021	5,302,128	5,987,014	6,858,021	6,249,982
Zhejiang	4,167,711	4,836,510	5,581,448	6,399,739	5,733,200
Anhui	825,647	1,067,009	1,410,039	1,614,671	2,050,879
Fujian	1,494,306	2,181,190	2,756,603	3,056,824	2,853,084
Jiangxi	639,842	827,914	1,121,346	1,533,982	2,064,060
Shandong	3,584,003	4,680,234	5,758,865	7,976,189	7,670,086
Henan	821,575	1,263,861	1,563,499	1,966,877	2,021,411
Hubei	841,084	1,091,891	1,343,819	2,455,275	2,163,756
Hunan	953,384	1,174,359	1,466,725	1,933,890	1,840,054
Guangdong	3,140,900	3,947,306	4,245,136	4,961,455	4,342,974
Guangxi	1,159,770	1,231,952	1,384,957	1,503,143	1,535,350
Hainan	116,243	140,531	193,966	258,920	274,256
Chongqing	1,188,836	1,496,351	1,793,243	2,091,126	2,010,488
Sichuan	1,943,092	2,284,036	2,483,933	2,709,771	2,756,996
Guizhou	182,710	255,131	255,962	276,670	309,787
Yunnan	440,650	479,770	533,293	661,625	747,652
Shanxi	682,726	860,878	1,125,856	1,511,423	1,697,106
Gansu	190,204	353,728	444,796	489,948	520,459
Qinghai	42,940	78,774	92,300	111,033	115,495
Ningxia	111,035	126,549	153,893	172,097	177,257
Xinjiang	404,810	527,122	623,551	725,370	741,056

$$\lim_{t\to\infty}\frac{W(t)-B(t)}{W(t)}=\lim_{t\to\infty}1-\frac{B(0)e^{g_B t}}{W(0)e^{wt}}=-\infty \tag{11}$$

Through equation (14), it is found that the crowding-out effect will become negative at the extreme level. Intuitively, when the government budget is insufficient to sustain infrastructure investment, the government is forced to debt to meet the high growth of infrastructure investment, but the real surplus generated by these liabilities is not enough to compensate for the negative effect of liabilities.

ANALYSIS

The principal component analysis method has been applied to the empirical test of the provinces, which can more accurately determine the investment field with the strongest crowding out effect. It could also target provinces and cities with the strongest potential for infrastructure investment.

Calculation of Output Index of Local Government's Urban Infrastructure

Suppose there are m observation objects and q indicators in this study. The q indicators of the first observation object are $X_{i1}, X_{i2}, \ldots, X_{iq}$, then each q indicator with m object each can be expressed in the matrix form,

$$X=\begin{bmatrix} X_{11} & X_{12} & \cdots & X_{1q} \\ X_{21} & X_{21} & \cdots & X_{2q} \\ \cdots & \cdots & \ddots & \cdots \\ X_{m1} & X_{m2} & \cdots & X_{mq}\end{bmatrix} m\times q$$

The data selected in this paper include 30 provincial administrative regions and 13 basic indicators of infrastructure, i.e. m=30, q=13. The above 13 indicators are expressed by X_1 to X_{13}, respectively, as shown in the former index systems.

X_1 = length of gas supply pipeline,
X_2 = length of heating pipeline,
X_3 = road area,
X_4 = number of bridges,
X_5 = public green space. Area,
X_6 = 10,000 people have public toilets,
X_7 = harmless treatment plants,
X_8 = mobile phone exchange capacity,
X_9 = long-distance optical cable line length,
X_{10} = flood embankment length,
X_{11} = length of water supply pipeline,
X_{12} = sewage treatment capacity,
X_{13} = length of drainage pipeline.

Result Summary

From Table 3, it can be seen that the variance contribution rate of the first factor is 63.05%, and the cumulative variance contribution rate of the first three factors accounts for 86.04% of the total variance. The eigenvalues of the first three factors are greater than 1 with large difference, while the eigenvalues of the latter factors are less than 1 with small difference. Therefore, this paper chooses the above tables. The first three factors are the main components.

In this paper, the contribution of the first principal component F1 reached to 63.05%, which is the most important determinant factor. Among these factors, the index X_3, X_{11}, X_{12},

Table 2. *Evaluation index systems.*

First level index	Second level index	Third level index	Dimension
Local infrastructure construction level	Urban energy system	Length of gas supply pipeline	km
		Length of heating pipeline	km
	Urban transport system	Road area	10000 square
		Bridges	number
	Urban environment system	Public green area	Hectare
		Number of public toilets per 10000 people	number
		Harmless treatment plant	number
	Urban communication system	Mobile phone interaction capacity	10000 household
		Length of long distance optical cable line	km
	Disaster resistance system	Length of flood dike	km
	Urban drainage system	Length of water supply pipeline	10000 square
		Sewage treatment capacity	Number per day
		Length of drainage pipe	km

Table 3. *Eigenvalues and contribution of principal components.*

Factors	Eigenvalues	Contribution (%)	Cumulative contribution (%)
F1	8.201	63.05	63.05
F2	1.665	12.77	75.82
F3	1.325	10.22	86.04
F4	0.637	4.90	90.94
F5	0.461	3.53	94.47
F6	0.353	2.72	97.19
F7	0.123	0.95	98.14
F8	0.112	0.86	99.00
F9	0.051	0.39	99.39
F10	0.039	0.30	99.69
F11	0.020	0.16	99.85
F12	0.015	0.12	99.97
F13	0.004	0.03	100.00

Table 4. *Result of principal component analysis.*

Principal component	F1	F2	F3
Contribution	63.05%	12.77%	10.22%
Cumulative Contribution	63.05%	75.82%	86.04%
X1	0.285	0.167	−0.209
X2	0.066	0.649	0.210
X3	0.341	0.059	0.073
X4	0.269	−0.121	−0.509
X5	0.326	−0.101	0.209
X6	0.215	0.512	0.185
X7	0.311	0.093	0.029
X8	0.188	−0.252	0.363
X9	0.184	−0.411	0.499
X10	0.267	−0.113	0.441
X11	0.334	−0.089	−0.022
X12	0.325	−0.043	0.063
X13	0.344	0.010	−0.025

X_{13}, i.e. road area, length of water supply pipeline, sewage treatment capacity and length of drainage pipeline, are relatively large. Therefore, the principal component F1 mainly reflects the efficiency of urban traffic system and the length of drainage pipeline, the capacity of urban water resources and the water supply and drainage system, it is thus not difficult to find that the coastal area with high volume of water transportation capacity are supposed to entail higher externality in infrastructure development, which is consistent with the principle component analysis. The contribution of the second principal component F2 is 12.77%. Among these factors, the index X_1, X_2, X_6, X_7, i.e. the length of gas supply pipeline, heating pipeline, the number of public toilets per ten thousand people and the number of harmless treatment plants, are relatively large. Therefore, the principal component F2 mainly reflects the efficiency of urban energy power system. The contribution of the third principal component F3 is 10.22%. The index X_8, X_9, X_{10}, i.e. mobile telephone switching capacity, long-distance optical cable line length and flood levee length, have larger coefficients. Therefore, the principal component F3 mainly reflects the efficiency of urban communication system and urban disaster prevention system.

By using maximum orthogonal rotation method, the F1, F2 and F3 can be respectively expressed as:

$$F1 = 0.285\ X_1+0.066\ X_2+0.341\ X_3+0.269\ X_4+0.326\ X_5+0.215\ X_6+0.311X_7+0.188\ X_8+0.184\ X_9+0.267\ X_{10}+0.334\ X_{11}+0.325\ X_{12}+0.344\ X_{13}$$

$$F2 = 0.167\ X_1+0.649\ X_2+0.059\ X_3-0.121\ X_4-0.101\ X_5+0.512\ X_6+0.093X_7-0.252\ X_8-0.411\ X_9-0.113\ X_{10}-0.089\ X_{11}-0.043\ X_{12}+0.010\ X_{13}$$

$$F3 = -0.209\ X_1+0.210\ X_2+0.073\ X_3-0.509\ X_4+0.209\ X_5+0.185\ X_6+0.029X_7+0.363\ X_8+0.499\ X_9+0.441\ X_{10}-0.022\ X_{11}+0.063\ X_{12}-0.025\ X_{13}$$

RESULTS

The three provinces of Guangdong, Jiangsu and Shandong have the highest efficiency of urban infrastructure investment, while Gansu, Hainan and Qinghai rank the last. In general, the areas with higher ranks in terms of sustainable development mainly locate in the coastal areas. On the contrary, the areas with lower ranks, Gansu and Qinghai for examples, mainly locate in inland area. Based on the analysis, investment in the principal component F1, i.e. investment in urban road traffic, water resources and water supply and drainage system, can bring higher infrastructure investment efficiency, but this does not necessarily mean that the more close to the water, the higher the efficiency is, this can be seen from the example of Hainan Province, which locate on island with sea all around, are among the most inefficient areas. The numerical variance of the second principal component F2 is relatively large. The F2 values of provinces with higher comprehensive scores are either positive or negative. Even the F2 values of Guangdong and Jiangsu provinces, the top two provinces with highest comprehensive scores, are negative. The F2 values of provinces with lower comprehensive scores are generally negative. As mentioned above, the principal component F2 mainly reflects the urban energy power system and the urban ecological environment system. Therefore, the above data show that local governments generally do not have high investment efficiency in infrastructure in these areas, or these areas have little contribution to the overall infrastructure investment efficiency of local governments. The numerical trend of the third principal component F3 is similar to that of the principal component F1, i.e. provinces with higher comprehensive scores have significantly higher F3 values than the average level, while provinces with lower comprehensive scores have lower F3 values than the average level. The principal component F3 mainly reflects the situation of urban communication system and urban disaster prevention system, so the above figures show that local government investment in communication and disaster prevention systems has a positive contribution to the efficiency of infrastructure investment.

CONCLUSIONS

Through the qualitative and empirical analysis of the infrastructure investment of Chinese government, it can be observed that infrastructure investment has the effect of positive externality on economic growth, and the externality is especially prominent in the coastal areas, which demonstrates the necessity for China to support the coastal development. However, based on the fact that the return to scale is non-increasing, investment in infrastructure construction plays a limited role. Policymakers cannot simply rely on extensive ways of expanding investment scale to develop the economy, the spatial allocation of investment and funds should be carefully examined with regard to inland and coastal areas.

When the economy develops to a certain stage, the government should adopt necessary policy measures to stimulate the development of backward areas and narrow the regional economic disparity (Qin et al., 2018). However, with the strengthening of production specialization and the division of labor, simply expansion of production scale will induce high marginal cost. At this stage, government should turn to the investment in rebuilding production lines, innovating production technology and improving production efficiency. Only by improving production efficiency, can a nation in turn promote long-term economic growth in the highly specialized stage.

LITERATURE CITED

Brommer, M.B. and Bochev-van der Burgh, L.M., 2009. Sustainable coastal zone management: A concept for forecasting long-term and large-scale coastal evolution. *Journal of Coastal Research*, 25, 181–188.

Fang, Z.J., 2011. The relationship between infrastructure investment and economic growth. *Yunnan University of Finance and Economics*, 20–30.

Guo, Q., 2017. Significance of Chinese local governments in China's coastal regional economic development: A comparative study on the nine cities in the Pearl River Delta economic region. *China International Business*, 17, 19–20.

House, C.; Williams, J.; Cullis, M.J., and Phillips, M.R., 2011. Coastal sustainability: a comparative socio-economic lifestyle assessment, South Wales, UK. *Journal of Coastal Research*, 64, 1233–1237.

Jin, T. and Chen, J.J., 2014. Transfer payment, soft constraint and efficiency loss of state-owned enterprises – based on comparative perspective. *Research on Financial and Economic Issues*, 4, 89–96.

Li, B.; Shi, Z.Y., and Tian, C., 2018. Spatio-temporal difference and influencing factors of environmental adaptability measurement of Human-sea economic system in Liaoning coastal area. *Chinese Geographical Science*, 2, 313–324.

Magdalena, A.K.M., 2002. Integrated coastal and marine management in northern regions: Reconciling economic development and conservation. *Journal of Coastal Research*, 36, 522–530.

Qin, Z.Y.; Hu, X.L., and Ding, M.J., 2018. Integration path of coastal leisure tourism resources in Rizhao based on regional economic theory. *Journal of Landscape Research*, 10, 120–122.

Sun, Z.; Yang, G., and Li, K., 2016. Does infrastructure investment contribute to economic growth – empirical evidence from east, central and west. *Economists*, 9, 71–79.