



Research Article

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Evolutionary game analysis of monitoring activity of the unreasonable use of transfer payment based on duplicative dynamic

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ABSTRACT

In order to narrow the development gap between east and west, China central government have given a lot of funds to the western underdevelopment province. Unfortunately, this gap is still growing because local governments use the funds unreasonably. Analyzing the strategies 'choice on the interaction between the funds regulators and local government with the evolutionary game theory, a model of asymmetric game between them is set up and the steady state of the monitoring activity under this condition is analyzed, and some suggestions about transfer payment funds supervision are given in this paper.

Keywords: transfer payment; evolutionary game; duplicative dynamic; supervision mechanism

INTRODUCTION

In the past 30 years, the economy in China has achieved a rapid development. But, it also stimulates a number of serious imbalances, including rural urban income gap, Industry income gap, and etc. The widest disparity in these gaps is uneven regional development, that is to say, the eastern region too highly developed while the western region developed relatively slowly. Also, the disturbing thing is the disparity seems hardly have the trend to be decreased.

China's special fiscal system creates the unequal of administrative powers and financial authority between central and local. In terms of fiscal revenue, China implements revenue-sharing model to give tax revenue to the central and the locals in proportional distribution. The proportion maintains about 50% in the latest 15 years. In 2012, the central fiscal revenue accounted for 47.91 percent of the nationwide total fiscal revenue. In terms of administrative powers, local governments undertake the most part of administrative expenses, which generally results the local deficits. Especially in western region, the financial pressure is great because of the pretty low local fiscal revenue and the comparatively high rigid public expenses due to limited economic development. Simultaneously, central government enacts many funds supporting policies to accelerate the development of the western region and narrow the development gap between east and west. These two facts both encourage central government to give western regions large transfer payments. The cumulative amount of which reached nearly 1.43 trillion dollars in the past 15 years.

However, does the massive investment really promote western region' development? According to numerous empirical researches, transfer payment is no positive effects on the growth of development in western region. On the contrary, it weakens western region's growing. What's the reason? Many scholars believed that the transfer payment caused the local fiscal expenditure's flypaper effect , and the overmuch fiscal expenditure generated crowding out effect and extrudes private investment, in addition after adjusting the existing fiscal expenditure structure when the local governments' finance had improved , it deviated the basic public service equalization target of transfer

payments, that is to say, there was a local fiscal expenditure's alternative effect caused obvious structural bias that local public expenses pay more attention to capital construction rather than human capital investment and public service. Ultimately, due to central government's lack of supervision and management about local government using transfer payment, for the purpose of maximizing local officials own interests, local officials spend the funds on pursuing short-term effects or government investment direction of their own interests instead of education and scientific researches which benefit local economic development in the long term for the purpose of maximizing their own interests, make central transfer payments did not play its role. So it's urgent for central government to strengthen supervision of using transfer payments and regulate local fiscal expenditure structure.

This paper analyses the unreasonable use and supervision behaviors, and set up a model of evolutionary game analysis between central government and local government with the evolutionary game theory. Meanwhile, the steady state under the condition of both sides interconnecting and binding each other to make the fair use of the funds is analyzed.

2. Evolutionary Game Analysis

2.1 Asymmetric Game Model

Evolutionary game dynamics is the application of population dynamical methods to game theory. It has been introduced by evolutionary biologists, anticipated in part by classical game theorists [1].

The parties (the central government and local government) both have two kinds of strategies: the central government (it is hereinafter referred to as provider) can take strict or minor supervision strategy, while local government (it is hereinafter referred to as user) choose reasonable use or abuse tactics to the regulation. As neither of them do selection simultaneously, nor their strategic choice and profit are asymmetric, there comes to a asymmetric game[2]. On the basis of non-cooperative repeated game, Table 1 shows the relevant payoff matrix:

Table 1 Asymmetric game model between central and local government

Strategy		Central government (provider)	
		Strict supervision(x)	Minor supervision(1-x)
Local government (user)	Reasonable use (y)	D-B, -A	D-B, 0
	Abuse(1-y)	-E, E-A	0, -G

Table 1 shows the monitoring cost of provider is A. provider can't take an effective supervision for the cost limit, while check the performance at a certain probability "x"; Meanwhile, if the local official have a good sense of long-term development vision, incorruptible and self-disciplined, they choose reasonable use tactics no matter the provider check them or not, which gives rise to loss of some irregular income "B" and acquisition of reputation benefits "D", we define its probability as "y"; If user engage in going after irregular benefits and wealth, we regard the huge fine along with loss of social image as "E" once they were discovered by provider; In addition, if central government make supervision become a mere formality, yet user neglect the risk of liability arising from irregularities as well, all these bring about social cost as "C" and negative returns for provider as "G".

Local officials in contemporary society are universally short of self-disciplined and pursuit of short-term performance, provider do not implement severe punishment to this behaviour of improper use of funds and this fault is uneasy to find out by the people so that make G smaller. In such circumstances, there always exists $G < A - E$. By now, (Abuse, Minor supervision) reach a Nash equilibrium, and this is the particularly same as current situation. It is important to note that this is what we urgently want to work out and we have to change such a situation. The author suggest that the referred social cost "C" should be born by the provider. Normally, the negative returns caused by social cost "C" is far more than the provider's monitoring cost "A", there exists $C > A > A - E$. Through this method, provider will be promoted to increase monitoring efforts and constraint user's illegal proceeds behaviour with various means. The asymmetric game model between both sides is depicted in the following table:

Table 2 Payoff matrix between regulators and researchers under a asymmetric game model

Strategy		Governmental Regulators (provider)	
		Strict supervision(x)	Minor supervision(1-x)
Local Government (user)	Reasonable use (y)	D-B, -A	D-B, 0
	Abuse(1-y)	-E, E-A	0, -C-G

2.2 Evolutionary Analysis of Behaviour Choices between the central government and local government

Most people always take actions by intuition or imitating other success stories under the bounded rationality condition when they're confronted with complicated problems, which is a continuous process of seeking and studying for the initial strategy may not be the best one. In the process, the proportion of high-profit strategy groups keeps arising until it comes to ESS.

Table 2 shows the expected revenue of local government as follows:

Reasonable use strategy: $E_{11} = (D-B)x + (D-B)(1-x) = D-B$;

Abuse tactic: $E_{12} = (-E)x$;

The average expected revenue of local government:

$$E_1 = E_{11}y + E_{12}(1-y) = y(D-B) + (1-y)(-E)x = y(D-B) - x(1-y)E \tag{1}$$

While, the expected revenue of central government should be:

Strict strategy: $E_{21} = (-A)y + (E-A)(1-y)$;

Minor strategy: $E_{22} = (-C-G)(1-y)$;

Then the average expected revenue of regulators is:

$$E_2 = E_{21}x + E_{22}(1-x) = x[(-A)y + (E-A)(1-y)] + (1-x)(1-y)(-C-G) \tag{2}$$

Consequently, the local government's replicated dynamic equation for the action of misuse funds is

$$F(y) = \frac{dy}{dt} = y(E_1 - E_2) = y[(D-B) - y(D-B) + (1-y)E] - y[(D-B)(1-y) + (1-y)E] = y(1-y)(D-B+E) \tag{3}$$

Make $dy/dt=0$, we get $y_1^* = 0, y_2^* = 1, x^* = \frac{B-D}{E}$.

In accordance with the stability theorem of differential equation and nature of ESS, when there is $F'(y^*) < 0$, y^* is the evolutionary stable strategy. The following chart respectively shows different dynamic tendency in different situations.

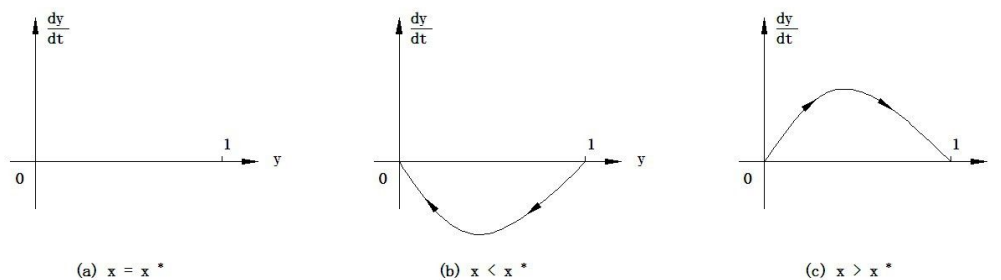


Chart 1 Replicated dynamic phase diagram of researchers in asymmetric game model

When x^* comes to $\frac{B-D}{E}$, $F(y)$ gets to be 0 consistently and we can consider it as this: as soon as provider's supervision arrives at x^* , the initial proportion of the attitudes (proper use or improper use funds) of user is stable.

When $x < x^*$, there always exists $F(y) < 0$ in section $(0, 1)$ and replicated dynamic equation (3) gets two balance points: $y_1^* = 0, y_2^* = 1$, which leads to $F'(0) < 0, F'(1) > 0$. That means when there is $x < x^*$, $y_1^* = 0$ is the single ESS as a whole. It is pointed out that once the provider take weak inspection on the opposite side's behaviour, the legality of using funds keeps descending.

When $x > x^*$, $F(y) > 0$ in section $(0, 1)$ and replicated dynamic equation (3) still gets two balance points: $y_1^* = 0, y_2^* = 1$, contemporaneously $F'(0) > 0, F'(1) < 0$. Then when there is $x > x^*$, $y_2^* = 1$ is the only evolutionary stable strategy (ESS) overall situation. We see it as this: the provider interact well with user and user enhance the reasonable use of scientific funds, which attains Pareto Optimality gradually.

Then let's deliberate the provider side and their replicated dynamic equation gets to be:

$$G(x) = \frac{dx}{dt} = x(E_{21} - E_2) = x(1-x)[(E+G+C-A)-(E+G+C)y] \tag{4}$$

Make $\frac{dx}{dt} = 0$, we get $x_1^* = 0, x_2^* = 1, y^* = 1 - \frac{A}{C+G+E}$

Still, in line with the stability theorem of differential equation and nature of ESS, when there is $G'(x^*) < 0$, x^* is the evolutionary stable strategy (ESS).

When $y^* = 1 - \frac{A}{C+G+E}$, $G(x)$ always keeps 0. Behaviours of corruption and waste do not exist in local government, which means when seriousness of attention in Table 2 comes up to y^* , it is stable for provider to monitor. To further illustrate this kind of dynamic tendency, there comes Chart 2:

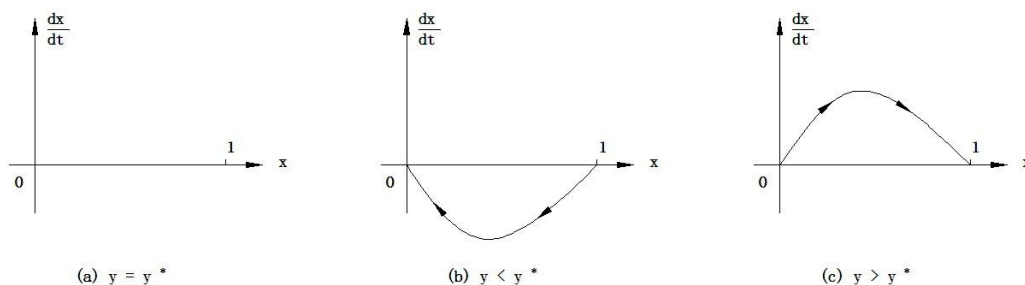


Chart2 Replicated dynamic phase diagram of researchers in asymmetric game model

While $y > y^*$, $G(x) > 0$ in section $(0, 1)$, which arouses equation (4) to get balance points of $x_1^* = 0, x_2^* = 1$, simultaneously $G'(0) > 0, G'(1) < 0$. We can come to the conclusion that under the condition of $y > y^*$, $x_2^* = 1$ gets to be the ESS. It is said that provider will play a great role in supervision under such situation of both parties' carrying on perfectly, which definitely achieves Pareto Optimality gradually.

When $y < y^*$, for the same reason, $x_1^* = 0$ proves to be the ESS. So to speak, user's poor behaviours of waste and unreasonable use of funds, combined with the other side's minor supervision and ignorance of the huge loss, creates an enormous adverse impact on our society.

CONCLUSION

3.1 Conclusions

To central government, if monitoring cost "A" keeps increasing, then y^* decreases. In other words, local government will pursue more expenditure on capital construction and administrative expenses by using the transfer payment[4]; Moreover, if C and G grows, then y^* decreases, as well it can be interpreted as provider endure more with the incremental expectation of the public, which results in the central government enhancing supervision and the opposite side making up their mind in accordance with provider; supposing that $x > x^*$, it is a best choice for local government to reasonable use the fund, which generates $y^* > 0$; Last but not least, in the event of E increasing, y^* magnifies, that is to say in case the punishment on the irregular action of using funds, it is not necessary for local government to run a risk abusing[5].

To local government, with B magnifying D increase and E diminish. Supposing that local official are full of responsibility and self-disciplined, they would never abuse whatever how the central government act. So we can get a bigger reputation benefits D and a lesser irregular income B ($D > B$), which gives rise to a smaller negative effect E.

3.2 Advice

(1) Change current fiscal and tax distribution system and relocate administrative powers and financial authority between central government and western region's local government. Increase the proportion of local government in distribution system and enhance local government's own financial powers[6]. Rationally partition public expenses' sharing ratio. Considering the financial limit of western regions at the same time, suggest central government shoulder basic education, scientific researches and etc[7]. public serving expenditures which benefit China's long term development. Secondly, central should surrender part of the profits to local. Improve western region's revenue in multiple channels, try to achieve its own fiscal balance, reduce the central transfer payments gradually[8]. The good news is third plenary session of 18th CPC central committee has decided to reform fiscal and tax system and administrative power system.

(2) Increase the intensity of supervision and examination on transfer payments. Reinforce the intensity of approving for western regions' transfer payments. Grant often in special funds form and build different assessment indicators and evaluation system of transfer payments to assess social and economic beneficial results of using funds and avoid local government casually and carelessly investing or using. Secondly, strengthen the intensity of investigation on local government's abusing, perfect accountability system, increase cost of illegal behaviors, and make sure that funds be used in right way to help western districts' economic development[9].

(3) Increase the transparency of financial expenses and make the use of transfer payments public. Continuously improve democratic decision-making mechanism and people's interest-expressing mechanism in the process of using transfer payments, such as making government affairs public, sunlight finance. By this way, people have a better understanding about local government using funds' purpose and situation. In a meanwhile, people need more unimpeded and diverse expression channels to increase rationality of transfer payments' usage[10]. Finally, achieve the aim that enhance the space of western regions' development and decrease the developing gap of east and west.

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