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Boating Against the Current: Cases, Concepts, Models and Development Power

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Abstract. Generalizing from many of actual problems, this paper puts forward the game: boating against the current, discusses the related assumptions and analyzes the related characters of it. Further more, the author gives the dispersed and continuous models for boating against the current Based on the Partial Distribution[14]-[17]. It is worth to say that the game of boating against the current is a representative example of Development Power problems [18]-[21]. So we should see that the theories of Development Power is proved to have a wide realistic background, and studying Development Power is important for human to interpret and to analyze the macro-laws and macro-characters of economy and society developing.

Key words. boating against the current, Development Power (DP), Partial Distribution, society and economy, analytic model

1 Introduction

As to economic theory, we have now the business cycle theory (Lucas, 1981), real business cycle theory (Prescott, 1982), new growth theory (Romer, 1986), prospect theory (Kahneman, 1979), Real Business Cycles (Plosser, 1983), etc. These theories are excellent and has availably propeled forward the progress in economic theory. But in this paper, we try to introduce an another economic theory based on model of boating against the current, called the theory of development power (DP) [20-21].

By means of DP theory, we could analyze the economic cycle, economic growth and recession in another way, and can analyze the economic states and the developing energy of economy. So DP theory may be of significant value and of worth to be discussed.

2 The Description of Boating Against the Current

There is a rapidly flowing water in a river, someone boating against the current in the river. boating against the current needs to make many times of effort as drifting with the current.

2.1 The regulations. We have the following regulations in the game of boating against the current:

1) There are a series of rest stations in the river.
2) The attendee boats against the current to next station, than he can have a break on the station for a time of T, and acquire the bonus B^+. He must go aboard at the end of the rest time T.
3) If drifting with the current to to next station, the attendee can have a break on the station for a time of T, and must pay a fine B^-. He must go aboard at the end of the rest time T.
4) If not going forward and not retreating, and going back to the original station, the attendee must pay a fine B^0, and goes aboard immediately.
5) The attendees have some of charge at the beginning of his game.
6) The attendee will bowl out if having no the dint to pay a fine.

If someone attends this game, how can he do? There will be what kind of result? What is the best way to go?

Note: if suppose that attendee can not go back to the original station when leaving it, we could take out the 4) listed in above regulations.

2.2 The assumptions. Here we suppose that

1) The difficulty of boating is different at the different districts of the river, and the person of boating can't know the difficulty in advance.

2) Attendee will make an effort to fight for the bonus in order to live and to acquire the self-respect.
3) Any of attendees hopes to get the largest sum of bonus in a shorter time.
4) Any of attendees would be tired in his boating.
5) Attendees would have no any of fees when he bowls out, including his original charge.

2.3 The characters. The attendee in the game of boating against the current has the following characters:
1) There is a motivity for attendee to live and to develop, and this motivity, though it is large at some time or small at another time, impels attendee to get more bonuses all the time.
2) A better rest (accumulating the physical force effectively) would make attendee have full of physical force to decide boating against the current to get more return in bonus; the better boating against the current (releasing the physical force) would increase the sum of his bonus.
3) The more the physical force is paid and the more the difficulties is overcome, such as the water current pounding at, waterway variety, complicated natural environment, the more bonuses can be acquired.
4) Any of attendees prefers to decide boating against the current to get the bonus, or has to decide drifting with the current when he is too tired and has still the charge.
5) Only unremitting and keeping on working hard would make quantity of attendee's bonus increase continuously.
6) Some opportunities would be lost if attendee can not hold them on time.
7) If no enterprising and not going forward, the attendee would be bowled out finally.
8) Attendee would lose his capital if slackening a little bit.
9) The attendees would become less and less along with the games progressing.

3 Other Cases Related to Boating Against the Current

Here, we give some cases related to game of boating against the current.

3.1 Studying knowledge. In modern society, everybody is always facing many kinds of pressure because there are many problems in the environment in which he or she lived. In order to live and to acquire achievement, a person needs to study many of necessary knowledge constantly. If abandoning effort and stopping studying new knowledge, he would not overcome the new difficulties, would fall behind gradually, and would be thrown off. Studying new knowledge continuously and making use of them, one can acquire and keep the advantages to exist.

3.2 Constituting laws. In the process of society progressing and economy developing, many kinds of problems always occur, humankind need to constitute and use all kinds of laws continuously, in order to keep society and economy in order. Many of social and economic problems would come forth and Society and economy would come into confusion if new laws stop being constituted and coming on at some time. So it is necessary for humankind to constitute and use all kinds of laws continuously.

3.3 Employing employee. The purpose a company employing employees is that the employees could make the contributions for the company. So an employee needs to make his (or her) contributions for the company constantly. Because there is always the competition for personnel in company, an employee will be dismissed if he is no longer to make the contributions for the company, to say nothing of promoting. Therefore, an employee must make contributions constantly in order to insure his (or her) status and get promotion in company.

3.4 Developing transportation. A region (nation or city) can not get away from the transportation facilities, and also face that every kind of transportation tool increase continuously. If a region (nation or city) stops developing original transportation and new transportation facilities at some time, it would not meet the demands for normal running, all kinds of its developments in society and economy would be restricted seriously, and this region would meet with loss in economy. So, it is only the continuous developments in transportation facilities, which can resolve the new problem in transportation expanding and region's economy developing.

3.5 Developing energy sources. The human life and all kinds of productions can not get away from the energies. The energy demand will increase continuously along with that the production level becomes higher and production scale extends continuously, so that the demand and lack of energy becomes obvious more and more. Once the current energies stop producing, not only all kinds of production are hard to keep on, but also the existence of humankind would be threatened seriously. So the current energies must be produced continuously, and the new energy must be developed, in order to maintain the economic production and existence for human.

3.6 Controlling pollutions. The industrial productions bring much pollution inevitably, and these pollutions have been threatening the environments. So human has been taking up with controlling pollutions and protecting environment. Once these efforts stop, the environment will be quickly worsened. For this reason, mankind must overcome every kind of difficulties, and control diligently and reduce effectively the pollutions brought from industry productions and life garbage, to present a good environment for everybody.

In fact, working and leisure, also nature's evolvement is the example of boating against the current. Of course, there are many other examples which we do not list here. So, if we regard the boating against the current as the game between humankind and natural environments, thus, it has a wide background of society and economy.

4 Analysis for the game of Boating against the Current

Based on the game of boating against the current, we denote at the time t

The person 1 in game: river (environments). The set of its states includes the break stations $A=(a_1,\ldots,a_n)$, the corresponding sum of bonus are $F=(\mu_1,\ldots,\mu_n)$, $\mu_{i-1}<\mu_i$, $\mu_i>0$ ($i=1,\ldots,n$), μ_0 is the original charge.

The person 2 in game: boater (humankind). The motivity for boater to choose a_i ($i\in[1,n]$), namely to have the total bonus as μ_i, is the $v_i(i\in[1,n])$. Here the motivity means the desire based on physical force.

If the current position of boater is at $a_i(1<i<n)$, then the difference of his motivity for decision could be described as:

$$\mathbf{\Delta v_i}=\begin{cases}\alpha^{+}(\mu_{i+1}-\mu_i), & \text{current fund is } \mu_i \text{, the goal fund choosed is } \mu_{i+1}\\ -\alpha^{0}\mu_i, & \text{current fund is } \mu_i \text{, and go back to original station}\\ \alpha^{-}(\mu_{i-1}-\mu_i), & \text{current fund is } \mu_i \text{, the goal fund choosed is } \mu_{i-1}\end{cases}, \quad i=2,\ldots,n\text{-}1.$$

where, α^{+} ($\alpha^{+}>0$) is the ratio coefficients of bonus, both α^0 and α^{-} ($\alpha^0,\alpha^{-}>0$) are the ratio coefficients of fine.

Suppose that boater can not go back immediately once he leaves a break station, and $\alpha=\alpha^{+}=|\alpha^{-}|$, thus the differences of motivity to decide which break statione he will reach next and total bonus can be expressed as

$$\Delta v_i=\alpha\Delta\mu_i$$

Three kinds of more complicated situations are as follow:

1) $\Delta v_i=\alpha v_i\Delta\mu_i$, the difference of motivity is in direct ratio to the current motivity and the difference of bonus, i.e. the stronger the current motivity is, the larger the difference of motivity is; and vice versa.

2) $\Delta v_i=\dfrac{\alpha}{\mu_i}\Delta\mu_i$, the difference of motivity is in inverse ratio to the current sum of bonus, i.e. the more the current sum of bonus is, the less the difference of motivity is; and the less the current sum of bonus is, the larger the difference of motivity is.

3) $\Delta v_i=\alpha\dfrac{d_i}{\mu_i}\Delta\mu_i$, both of two situations above happen at the same time.

In general, the time t is considered, we suppose that the $V=g(x_1,x_2,x_3,x_4)$ is a continuous function and

$$\Delta v=g(v\Delta\mu,\frac{1}{\mu}\Delta\mu,\frac{v}{\mu}\Delta\mu,\Delta t)$$

$$=g(0,0,0,0)+\frac{\partial G}{\partial x_1}v\Delta\mu+\frac{\partial G}{\partial x_2}\frac{1}{\mu}\Delta\mu+\frac{\partial G}{\partial x_3}\frac{v}{\mu}\Delta\mu+\frac{\partial G}{\partial t}\Delta t+\circ(\Delta\mu)+\circ(\Delta t)+\circ(\Delta t\cdot\Delta\mu)$$

where, $\circ(\Delta\mu)$ is a small quantity to $\Delta\mu$ in a higher rank, $\circ(\Delta t)$ is a small quantity to Δt in a higher rank, and $\circ(\Delta t\cdot\Delta\mu)$ is a quantity to $\Delta t\cdot\Delta\mu$ in a same rank.

Because no differences of bonus and time would bring on no difference of motivity, i.e. $\Delta v=0$ when $\Delta\mu=0$ and $\Delta t=0$, $g(0,0,0,0)=0$. Letting $\Delta\mu\to0$ and $\Delta t\to0$, and overlooking the $\circ(\Delta\mu)$, $\circ(\Delta t)$ and $\circ(\Delta t\cdot\Delta\mu)$, we have

$$dv=\left(\frac{\partial G}{\partial x_1}v+\frac{\partial G}{\partial x_2}\frac{1}{\mu}+\frac{\partial G}{\partial x_3}\frac{v}{\mu}\right)d\mu+\frac{\partial G}{\partial x_4}dt\quad\left(\frac{\partial G}{\partial x_j}=\frac{\partial G(0,0,0,0)}{\partial x_j},j=1,2,3,4\right)$$

If we suppose that the motivity has something to do with the time in implicit way, and let $\frac{\partial G(0,0,0,0)}{\partial x_4}=0$, then we have

$$\frac{dv}{d\mu}=av+b\frac{1}{\mu}+c\frac{v}{\mu} \tag{1}$$

where, $a=\frac{\partial G(0,0,0)}{\partial x_1}$, $b=\frac{\partial G(0,0,0)}{\partial x_2}$, $c=\frac{\partial G(0,0,0)}{\partial x_3}$.

In expression (1), when sum of bonus increases gradually, i.e. μ increases by degrees, then a, b, $c>0$ means that motivity increases in a higher speed, and a, b, $c<0$ means that motivity decreases in a higher speed. If the sum of bonus is decreasing, we can give an opposite discussion.

If not all of a, b and c are positive or negative, a deeper analysis should be made in order to know the changed characteristics of motivity for different decision.

5 The Basic Assumptions and Models for the Games of Boating against the Current

First, we give two assumptions to apply the model of boating against the current.

Assumption 1:

1) Any break stations can be close to its abuted one arbitrarily.
2) The amount of break stations could be large infinitely.
3) The break stations is distributed continuously.
4) The games of boating against the current could keep on until the attendee is bowled out.
5) The rest time T can be overlooked.

Assumption 2 For one of games, denote

μ: the sum of attendee's current bonus at this game, $\mu>0$.

X: the sum of attendee's real bonus after this game, X ($X>0$) is a stochastic variable.

v: the motivity for a decision, could be described and valuated by the volatility of μ, $v>0$.

Because the physical force and capitals (sum of current bonus) are finite and environment around and in the river is complicated, the value of X should be vary near μ, namely the more far X is to μ, the less the probability is. So, we suppose that the stochastic variable X follows the partial distribution, i.e. distribution density of X is

$$f(x)=\begin{cases} e^{\frac{(x-\mu)^2}{2v^2}}\Big/\int_0^{\infty} e^{\frac{(x-\mu)^2}{2v^2}}dx & x\geq 0 \\ 0 & x<0 \end{cases} \tag{2}$$

and is denoted by $X\in P(\mu, v^2)$. The researched conclusions related to the partial distribution could be seen in literatures [14-17].

To the dispersed process $X(t)\in P(\mu(t), [v(t)]^2)$,where $\mu(t_{i+1})=X(t_i)$,$t=t_0, t_1,\cdots$. At this time, assumption 2 can be applied also [18-20].

If both the level of total bonus and the motivity for a decision (the standard variance of μ) are continuous about time t, the games will follow the partial process[17],i.e. $X(t)\in P(\mu(t), [v(t)]^2)$, where, both $\mu(t)$ and $v(t)$ are continuous function on time t, $t\in[0,\infty)$.

From expression (1), we obtain its conclusion as follows:

$$v=v_0\left(\frac{\mu}{\mu_0}\right)^c e^{a(\mu-\mu_0)}+b\mu^c e^{a\mu}\int_{\mu_0}^{\mu}\frac{e^{-au}}{u^{c+1}}du \tag{3}$$

where, μ_0 and v_0 are separately the original values of $\mu(t)$ and $v(t)$.

Uniting $X(t)\in P(\mu(t), [v(t)]^2)$ with expression (3), we have the basic model for game of boating against the current, namely

$$\begin{cases} v(t)=v_0\left(\frac{\mu(t)}{\mu_0}\right)^c e^{a(\mu(t)-\mu_0)}+b(\mu(t))^2 e^{a\mu(t)}\int_{\mu_0}^{\mu(t)}\frac{e^{-au}}{u^{c+1}}du \\ X(t)\in P(\mu(t), v^2(t)),\quad t\in[0,\infty) \\ \mu_0=\mu(0), v_0=v(0),\quad a,\ b \text{ and } c \text{ are all the undecided constants.} \end{cases} \tag{4}$$

Specially,

1) If $a=\gamma$, $b=c=0$, from (4), we have the exponential relation between the total bonus and deciding motivity as

$$v(t) = v_0 e^{\gamma[\mu(t)-\mu_0]} \qquad (5)$$

2) If $b=\gamma$, $a=c=0$, from (4), we have the logarithm relation between the total bonus and deciding motivity as

$$v(t) = v_0 + \gamma \ln\left(\frac{\mu(t)}{\mu_0}\right) \qquad (6)$$

3) $c=\gamma$, $a=b=0$, from (4), we have the power relation between the total bonus and deciding motivity as

$$v = v_0\left(\frac{\mu(t)}{\mu_0}\right)^{\gamma} \qquad (7)$$

where, the constant $\gamma(\neq 0)$ is motivity index.

And further more

4) If $a=0$, $b\neq 0$, $c\neq 0$, we have the synthesized model on combining power law with logarithm law

$$v(t) = \left(\frac{b}{c} + v_0\right)\left[\left(\frac{\mu(t)}{\mu^0}\right)^{c} - 1\right] + v_0$$

5) If $a\neq 0$, $b=0$, $c\neq 0$, we have the synthesized model on combining power law with exponential law

$$v(t) = v_0\left(\frac{\mu(t)}{\mu_0}\right)^{c} e^{a(\mu(t)-\mu_0)}$$

6) $a\neq 0$, $b\neq 0$, $c=0$, we have the synthesized model on combining exponential law with logarithm law

$$v = v_0 e^{a(\mu-\mu_0)} + be^{a\mu}\int_{\mu_0}^{\mu}\frac{e^{-au}}{u}du$$

The exponential model (5) its applications have been discussed in literatures [18-21] and other models will be discussed by authors in other papers.

6 The Basis of Development Power

Based on the description and analysis about the boating against the current, we can see that there is an essential motivity which comes from human's demand of living and developing and the press of environments. This kind of motivity, we call it development power[18-19], occurs in every field of mankind society and economic production and impels human being to work hard and continuously.

Speaking in essential, DP (Development Power) is created and changed from human's demand of living and developing and the press of environments is similar to that the force lurked in the volcano magma is created and changed by the diastrophism continuously.

Now, we give the basic definitions, assumptions and model of *DP*.

6.1 The concepts related to DP.

Definition 1 The development power (DP) is the latent motivity which can impel visible resources to convert to the visible productivity or social and economic products.

The formation and movement of *DP* depend on three essential factors:

- The environments in which human is living change continuously.
- The desire to expect that the society and economy develop in order and that the resources of society and economy are reasonably used.
- The demand to acquire the social services and economic products more and better.

Generally, the capitals, policies, science and technique, information, consciousness, idea, management, culture, law and innovation are all the DP in economy and society.

For example, industrial DP and management DP are the latent motivities to push the industrial productivity and industrial management to progress.

For another example, innovation DP pushes the innovating level to progress. The movement principal and movement structure of innovation DP is shown in figure 1.

There are two basic ways in the movement of DP, namely DP accumulating and releasing. Accumulation of DP means that DP becomes larger and larger in a period of time, and release of DP means that DP becomes smaller and smaller in a period of time.

Definition 2 The derivative process is a completed process of DP movement. It includes an accumulating process of DP and a releasing process of DP, i.e. a releasing process of DP follows an accumulating process of DP, or an accumulating process of DP follows a releasing process of DP.

There are generally many of derivative processes in the level developing process, like the level of economy developing, the level of mankind society progressing, or the level of nature evolving, etc. Further more, a growth derivative process, a growth process for short, includes a growth process with DP accumulation and a growth process with DP release; and a recession derivative process, a recession process for short, includes a recession process with DP accumulation and a recession process with DP. A complete growth process is similar to a complete recession process in structure, but DP moves in reverse direction. Based on the partial distribution, a process of DP being accumulated and being released in a derivative process are shown in figure 2.

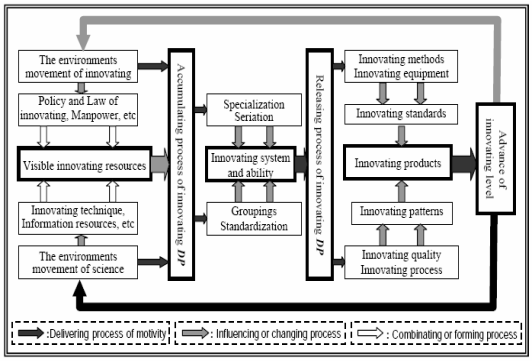

Figure 1 The principle of innovating *DP* Pushing the level of innovation to progress. Innovating systems and innovating abilities will be formed gradually when the innovating DP is being accumulated of. As the innovating systems and innovating abilities, which have been formed, are being applied, innovating DP is being released effectively, then the innovation is in progress.

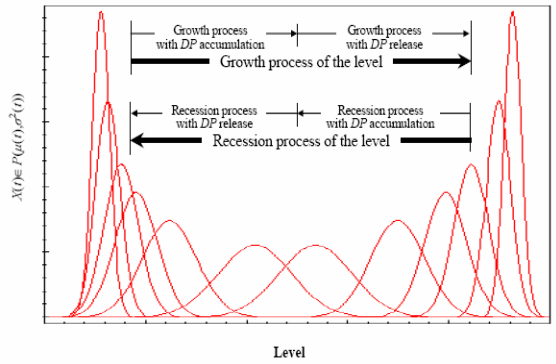

Figure 2 The structure of derivative process based on the partial distribution. A level growth process includes a growth process with DP accumulation and a growth process with DP release, and a complete recession process is similar to a complete growth process in structure, but level is descended, and DP moves in reverse direction.

6.2 The basic models of DP. In the games of boating against the current, if we regard the sum of bonus as a valuation of boater's ability, called the level of development, then the level of development include the basic level (the current level, it is evaluated by the sum of bonus being held) and the real level (the level in next game, it is evaluated by the sum of bonus to be held). If we regard the real level of one game as the basic level of the next game, the basic level will fluctuate, so that the fluctuation ratio of basic level is existent. There are the similar explanations to capitals, policies, science and technique, information, consciousness, idea, management, culture, law, innovation, etc. At this time, we call the bonus, capitals, policies, science and technique, information, consciousness, idea, management, culture, law or innovation the underlying object.

Denoting:

$\mu(t)$: the basic level of the underlying object at time t, $\mu(t)\geq 0$.

$v(t)$: the volatility of the basic level at time t, $v(t)>0$.

$X(t)$: the real level of the underlying object at time t, such as the sum of real bonus after the decision based on $\mu(t)$.

Then $X(t)$ is a stochastic process, $X(t)>0$. At any time t and according to assumption 2, $X(t)$ follow the distribution density

$$f(x)=\begin{cases} e^{-\frac{[x-\mu(t)]^2}{2[v(t)]^2}} \Big/ \int_0^{\infty} e^{-\frac{[x-\mu(t)]^2}{2[v(t)]^2}}\,dx & x\geq 0 \\ 0 & x<0 \end{cases}$$

and generally denoted for $X(t)\in P(\mu(t), v^2(t))$. Of course, we have also the dispersed process $X(t)\in P(\mu(t), [v(t)]^2)$,where $\mu(t_{i+1})=X(t_i), t=t_0, t_1,\cdots$.

Besides the expression (1) and (4), the other research works related to DP can be seen in literatures [17-21].

7 Conclusions and Remarks

In this paper, we have proposed and discussed a problem of boating against the current in the river. As we know, there are many things conformed to boating against the current in economy and society, including economy and society self. so the disscussing about the problem of boating against the current is widely applicable.

If considering the more complex situations in boating against the current, like, there might be two or more branches upper the river, and rocks in river; or boater will face the fog, rain, wind etc., we could obtain the more complex analytic results. And these results could be applied to the more complex DP problems, or might be of worth to analyze economy and society in the different way with the mainstream economics.

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