Research of Renewable Resources Market based on Logistic Model of Different Property Right System

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ABSTRACT: This paper uses Logistic model for renewable energy markets under different ownership systems were studied. Logistic model is one of the core theoretical ecology Population Growth Model. According to the market characteristics of renewable energy, our coverage under different ownership system of renewable resources is into the oligopoly market. Through the establishment of a linear dynamic system, the Logistic model was added thereto, analyzed under different ownership systems dynamic Nash equilibrium, and numerical simulation test. Conclusion: (1) Under private ownership, while alive fixation rate of natural increase, the equilibrium point (0,0); endogenous natural growth rate is variable: the overall image offset occurs. In the numerical simulation, changes from 0 to 0.8333, changes from 0 to 1.3333, indicating that in a changing market, the impact of the dynamics of the natural growth rate of renewable resources market equilibrium can not be ignored, and the increase in the number of manufacturer resources sustainable use of both the potential positive effects, may bring negative effects. (2) Under public ownership, within the natural growth rate of raw fixed discount rate of two intersection (2.5,3.1); changes and is declining. In the numerical simulation, from the intersection of (2.5,3.1) down to (1.2,0.7), indicating an increase in the number of manufacturers will give sustainable use of resources brought about negative effects, and when it reaches a certain number, the ecological disaster will be inevitable.

Introduction

Renewable resources are the driving force behind the sustainable development of human society, but also economists, biologists, environmental scientists have been the focus of attention. 50s of last century, the emergence is a lot of research fishery optimal fishing output and the Economist ((Gordon, 1954), (Schaefer, 1957)). Balanced development from a static to a dynamic situation, a growing number of mathematical tools used in these, McInerney, 1976,1978; Smith, 1977; DasguptaandHeal, 1979; Morey, 1980; Fisher, 1981; Hanleyetat.1997; Munro and Scott, 1985; Reed, 1986; Cohen, 1987; Charles, 1988; Williams, 1989; Plourde, 1970; Mendels-sohn and Sobel (1980); Clark (1985) and the like.

Logistic model is a classic ecological growth curve model, first proposed in 1838 by the Belgian Mathematical Biology PFVerhulst, after the widely used simulation breeding ecology growth and economic and social development, etc. (Li Jia Zhu, 2009). In renewable energy research, and well adapted to improve the model.

In Ecological Disaster, Government Regulation and Dynamic Equilibrium with Renewable Resource Input (Sun Peng, 2015) in the proposed industrial organization from the perspective of scrutiny of renewable resources market equilibrium problem, it will be assumed before scholars "relaxed", and added on Some assumed new product market, with great innovations. However, "the number of firms under different property right system for renewable resources market equilibrium impact studies", the natural growth rate is assumed unchanged. In fact, growth in the ecological and socio-economic development, particularly renewable energy, its growth and Logistic Growth retardation variation model has a high degree of similarity and the fit.

Therefore, this paper based on renewable resources Logistic Model Different Property Right System under the market research and improvement of the natural rate of growth is change, and comply with Logistic growth model block. This article follows the Ecological Disaster, Government Regulation and the basic assumptions Dynamic Equilibrium with Renewable Resource Input of. Assumptions are as follows: i) the price of endogenous. This article assumes that prices are no longer exogenous, but the amount of resource acquisition function ii) does not limit the number of vendors in any. iii) renewable resources is not the final output products, but intermediate inputs. iv) balanced the different property System.

The Improvement of Private Property System under Oligopoly Market Model

First, we assume that the two producers have a duopoly industry, their product is generated by a renewable resource as the only input, and each vendor has its own renewable resource reserves. We also assume that each vendor has its own largest renewable energy reserves. On the one hand, when renewable resources are relatively abundant, each firm can obtain low cost renewable energy and processed into the final product sales. On the other hand, when the renewable energy is too much when it acquired while reserves continue to decline, the cost of acquisition will continue to rise, thereby increasing the unit cost of the product manufacturers. We can build a renewable resource inputs as the only dynamic duopoly competitive market model. We define two firms A and B, and the natural growth rate in line with changes of logistic block k growth model.

Demand side. For $i \in \{A, B\}$, when the time P_t^i is enterprise instant prices. Q_t^i Enterprise is the instantaneous output at the time of the definition $P_t = (P_t^A, P_t^B)$ and $Q_t = (Q_t^A, Q_t^B)$ timing utility function t:

$$u_t(p_t, Q_t) = \alpha(Q_t^A + Q_t^B) - 1/2[(Q_t^A)^2 + (Q_t^B)^2] - P_t^A Q_t^A - P_t^B Q_t^B - \gamma Q_t^A Q_t^B$$

Which $\alpha > 0$ represents market size $\gamma \in [0,1]$; replacement level two manufacturers of products. (. Liu, et al 2011) and the inverse demand function gives Sacco and Schmutzler (2011) the same, namely (1) the partial derivative obtained:

$$P_t^i = \alpha - Q_t^i - \gamma Q_t^j, \; i, j \in \{A, B\} \text{ and } i \neq j.$$

This article assumes that producers unique investment product manufacturers is a typical renewable resources, throughout the text the following symbols:: Period of renewable resources total reserves.

S_t: t: Period manufacturers have renewable resource reserves.

S_t^i : t All vendors period renewable resources withdrawals $i \in \{A, B\}$.

R_t : t Period manufacturers of renewable resources withdrawals.

r_t^i : t Period manufacturers have the largest reserves of renewable resources $i \in \{A, B\}$.

M_t^i : t The representative of the exploitation of renewable resources unit cos $i \in \{A, B\}$ t, which $c_t^i(S_t^i)$ is a decreasing function of reserves S_t^i, the greater S_t^i the lower the unit cost of mining for the analysis of convenience, we assume a linear form:

$$c_t^i(S_t^i) = \beta - cS_t^i, \quad i \in \{A, B\}$$

Only manufacturers as the only renewable resources into its products S_t^i, the production function as a simple linear form:

$$Q_t^i = \theta_i r_t^i, \quad i \in \{A, B\}$$

Which $\theta_i \in (0, +\infty)$ represents a constant marginal enterprise products $i \in \{A, B\}$. We assume that two companies each have exclusive reserves, ie, the initial private property. Here, we introduce the logistic model for each vendor in terms of:

$$\frac{\partial S_t^i}{\partial t} = \dot{S}_t^i = kS_t^i(1 - \frac{S_t^i}{M_t^i}) - r_t^i, i \in \{A, B\}.$$

Each vendor at time t instantaneous profit function can be expressed as:

$$\pi_t^i = p_t^i Q_t^i - c_t^i(S_t^i) r_t^i, \quad i \in \{A, B\}$$

And the corresponding development of profit unlimited period function:

$$\pi_i = \int_0^{+\infty} e^{-\delta t}[p_t^i Q_t^i - c_t^i(S_t^i) r_t^i] dt, \quad i \in \{A, B\}$$

Which $\delta > 0$ is the discount rate, assuming that the two companies of the same discount rate.

By the formulas (1) - (7), the model is the most typical dynamic problem solving. Reconstructing:

$$\begin{cases} \max\limits_{r_t^i} \pi_i = \int_0^{+\infty} e^{-\delta t}(\alpha\theta_i - \beta + cS_t^i - \theta_i^2 r_t^i - \gamma\theta_i\theta_j r_t^j) r_t^i dt \\ S.t. \quad (5) \end{cases}$$

Among them, $(i, j) \in \{A, B\}$, and $i \neq j$ according to Pontryagin optimal control theory (1962), and is determined by the balance r_t^i S_t^i of the Hamilton function:

$$H_i = (\alpha\theta_i - \beta + cS_t^i - \theta_i^2 r_t^i - \gamma\theta_i\theta_j r_t^j) r_t^i + \lambda_t^i(kS_t^i - r_t^i)$$

λ_t^i is the Lagrange multiplier. Why in the balance by the first-order conditions (10), Euler equation (11), the equations of motion (12) portrayed:

$$\frac{\partial H_i}{\partial r_t^i} = \alpha\theta_i - \beta + cS_t^i - (2\theta_i^2 r_t^i + \gamma\theta_i\theta_j r_t^i) - \lambda_t^i = 0$$

$$\dot{\lambda}_t^i = -\frac{\partial H_i}{\partial S_t^i} + \delta\lambda_t^i = -cr_t^i + (\delta - k)\lambda_t^i$$

$$\dot{S}_t^i = kS_t^i(1 - \frac{S_t^i}{M_t^i}) - r_t^i$$

Pair (10) on the partial derivative obtained:

$$\dot{\lambda}_t^i = c\,\dot{S}_t^i - (2\theta_i^2\,\dot{r}_t^i + \gamma\theta_i\theta_j\,\dot{r}_t^i)$$

The (12) brought into (13), we have:

$$\dot{\lambda}_t^i = c\left[kS_t^i(1 - \frac{S_t^i}{M_t^i}) - r_t^i\right] - (2\theta_i^2 r_t^i + \gamma\theta_i\theta_j\,\dot{r}_t^i)$$

Public Property System under the Market Model

The preceding analysis an important assumption is that each vendor has exclusive ownership of renewable resources, which property rights are clear, and if the property is not clear, some of the results will not be satisfied prior to analysis. Under public ownership system, seeking power system will change, so the system steady-state equilibrium conditions will change. This section of public property condition reconstruction theory model, and the model previously established private property rights under the presumptive compared investigate whether property rights a key role in the renewable energy market. When in public property, manufacturers will change the unit cost function, each firm faces the same cost function. The unit cost function as:

$$C_t^i = \beta - cS_t$$

(32) and (3) different, this time showing in public ownership system, all vendors have the same unit cost function. Apparently under a common ownership of the unit cost of each vendor is less than the cost of private property under. We can foresee the amount of renewable resource use public property under the system will increase substantially. Each vendor will also become constraints:

$$\dot{S}_t = kS_t(1 - \frac{S_t}{M_t}) - R_t \text{ ,} (R_t = \sum_i^N r_t^i)$$

After the improvements, the dynamic optimization problem that is seeking:

$$\begin{cases} \max\limits_{r_t^i} \pi_i = \int_0^{+\infty} e^{-\delta t}(\alpha\theta - \beta + cS_i - \theta^2 r_i - \gamma\theta^2 r_j) r_i dt \\ S.t. \qquad\qquad (33) \end{cases}$$

Among them $i, j = 1, 2......N$,($i \neq j$),, (), the same below. of the formula (34) again using optimal control theory $\alpha\theta = \beta$, and to maintain the assumed constant. We get under the Public Property System (R, S) of the power system is:

$$\begin{cases} \dot{R}_t = \dfrac{\theta^2[2+(N-1)\gamma](\delta-k)-(N-1)c}{\theta^2[2+(N-1)\gamma]}R_t + \dfrac{Nc(2k-\delta-\frac{kS_t}{M_t})}{\theta^2[2+(N-1)\gamma]}S_t \\ \dot{S}_t = -R_t + kS_t(1-\dfrac{S_t}{M_t}). \end{cases}$$ (

Order a system (35) of the Jacobian coefficient matrix J :

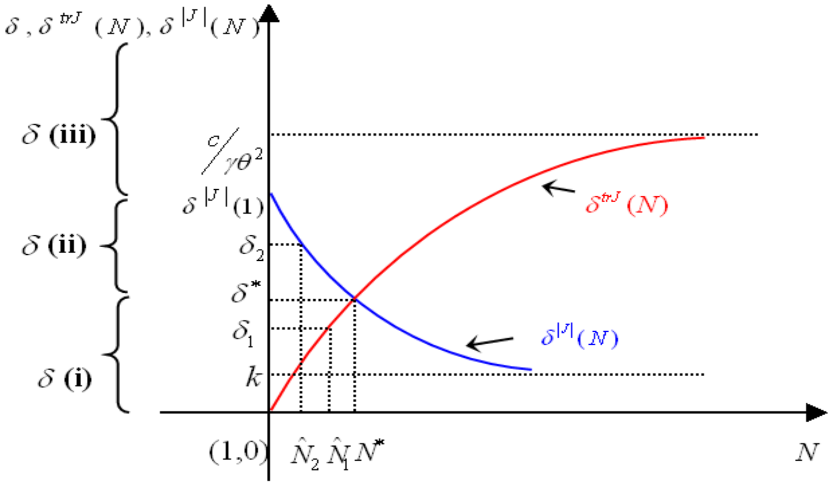
$$J = \begin{bmatrix} (\delta-k)-\dfrac{(N-1)c}{\theta^2[2+(N-1)\gamma]} & \dfrac{Nc(2k-\delta-\frac{kS_t}{M_t})}{\theta^2[2+(N-1)\gamma]} \\ -1 & k(1-\dfrac{S_t}{M_t}) \end{bmatrix}$$

System node (0,0). Proposition 1 and proof of a similar, if the system is close to the junction, renewable resources will tend to failure, and when the system is divergent at the junction, will achieve the sustainable use of resources. We make the definition $trJ=0$ at this point discount rate determined threshold (a function on the number of firms N) as follows:

$$\delta^{trJ}(N) = \frac{(N-1)c}{\theta^2[2+(N-1)\gamma]}$$

So again $|J|=0$, we find the threshold point discount rate at this time: (38) and expression in the annex. $\delta^{|J|}(N) = \dfrac{[2+(N-1)\gamma]k^2\theta^2(1-\frac{S_t}{M_t})-(N+1)ck(1-\frac{S_t}{M_t})}{[2+(N-1)\gamma]k\theta^2(1-\frac{S_t}{M_t})-Nc}$

As shown in Figure 1, $\delta^{trJ}(N)$ is an increasing function of the number of manufacturers, and $\delta^{|J|}(N)$ is a decreasing function N. Solving the intersection of the two functions $\delta^{|J|}(N)$ $\delta^{trJ}(N)$ (N^*,δ^*)to obtain the following figure, the expression Appendix:



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Proposition 3: Suppose no matter what the value of N when $k < Nc/[2+(N-1)\gamma]\theta^2$ will meet. (If $N=1$ at that time $k < c/2\theta^2$ to meet the other conditions are satisfied) in public property we have: i) if the discount rate δ_1 in the interval $(0,\delta^*)$, (the decision), the (0,0) made Sanjie point; when the stabilization phase $N > \hat{N}_1$; ii) If the discount rate, when (the decision $\delta^{|J|}(N)$), (0,0) is made Sanjie point $\delta^* < \delta_2 < \delta^{|J|}(1) = k[2k\theta^2(1-\frac{S_t}{M_t})-2c(2-\frac{S_t}{M_t})] \Big/ [2k\theta^2(1-\frac{S_t}{M_t})-c(2-\frac{S_t}{M_t})]$; $N < \hat{N}_2$ for the stable nodal point $\delta^{trJ}(N)$. iii) if the discount rate, no matter what the value of the ecological disaster will inevitably occur.

Conclusion

When the natural growth rate during the lifetime of the variables in the change in the established model of private property, it can be visually seen from the picture, the overall shift occurred, indicating changes in the natural growth rate of δ is influential. According to Proposition 2, when manufacturers more than two people, but the impact of N, the number of vendors to change equalization system depends on the range of discount rates. If δ is small, the number of manufacturers will make more than a certain level of the system tends to the equilibrium point, and thus lead to ecological disaster; the other hand, when δ is large, if the number of firms less than a certain level, it will happen ecological disaster. So moderate δ, to achieve sustainable use of resources.

For public property, balance is more complex. We have seen from the intersection of change and decline, indicating for δ is influential. According to Proposition under public ownership, no matter what the value of the number of firms there are almost no resources to achieve sustainable use possible. Therefore, the ecological disaster will inevitably occur in both cases. All in all, we can not ignore the dynamic changes in the natural growth rate.

The regulatory agency should be based on different discount levels to determine the number of vendors in the market. Under private ownership, lower the discount rate, the initial introduction of smaller firms might be a better way. Under public ownership, long-term cost of each firm reduced to attract more manufacturers to enter, leading to over-exploitation of resources, and thus more likely to lead to an ecological disaster.

In both the above discussion of property rights system, although in private property rights system by increasing or decreasing the number of vendors to achieve the sustainable use of resources, but in practice, more limited private property rights, such as many renewable resources can not be achieved property privatization or high cost of privatization, other policies such as high seas fisheries resources, climate resources, so we need to use the adjustment tools and legal constraints to the constitution and the integrated use of renewable resources to renewable resources may sustainable use.

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