

“Green credit loan as environmental policy”

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Abstract

This study explores the effects of social welfare and growth of the loan program for environmental protection. If the government adopts a policy of credit to allocate funds to low-polluting production technology, it may thereby link financing with environmental protection work. Maximum social welfare may be achieved when environmental pollution is improved due to more capital being obtained by low-polluting technology than by high-polluting technology. This policy could increase the rate of economic growth and indeterminacy; it may also hurt the economic growth rate and determinacy.

Keywords: environmental protection, credit loan, endogenous growth.

JEL Classification: G32, O40, Q56.

Introduction

People around the world have started to be aware of the importance of environmental protection in recent years, so they have become actively involved in international cooperation and signing international agreements to restrict any activity which does harm to the environment on the Earth. For example, these agreements include the Montreal Protocol on substances that deplete the ozone layer signed in 1987, and Kyoto Protocol in 1997. It will be impossible to improve the environment and make human life sustainable unless these agreements can enforce every country's establishment of corresponding laws and policies. In addition, some international banks which participate by the financial organizations have also taken environmental action – the Equator Principles (EPs), to promise funding in environmental issues and to assist enterprises to take action on these matters. The Equator Principles (EPs) are a voluntary set of standards for determining, assessing and managing social and environmental risk in project financing. Project financing, a method of funding in which the lender looks primarily to the revenues generated by a single project both as the source of repayment and as security for the exposure, plays an important role in financing development throughout the world. For instance, Bank of America proposed USD20 billion in 2007 to assist enterprises to go through reform of environmental operation in terms of developing new energy technology in order to reduce the use of energy and the emission of green house gases¹. This environmental action has been carried on for six years. The number of participating banks has grown from 10 in 2003 to 67 in 2009, showing that the financial system has realized the importance of environmental protection and regards the EP as new criteria to assess borrowing². This is a significant contribution to envi-

ronmental protection, since the financial organization plays a role not only in connecting demand and supply in the market of loanable funds but also in requesting borrowers to take responsibility for environmental protection. Therefore, this can reduce the level of deterioration of the environment and trigger a spontaneous improvement on investment resulting from the fact that the line of credit needed by enterprises is decided by the financial organizations. This is to say that on the one hand, they can collect capital from individual investors, and on the other hand, the borrowers have to comply with the requirements to take action for the environment. This will improve in terms of the level of environmental deterioration, and possibly generate a spontaneous environment that improves investment.

With the rise of environmental protection awareness, the influence of environmental policies on the economic growth has been a heated issue recently. It used to be thought from the traditional point of view that the environment is owned by everyone so the cost of environmental pollution should be undertaken by the public, not by the individual polluters, even if environmental pollution or environmental deterioration has a negative externality. It can cause too much pollution as a result. In other words, the fruit of environmental protection can be shared by the public but it would be a huge cost to be involved in the action. Whenever people feel like acting as free-riders, they would never have active participation. Based on past literature, economists previously thought that the solution to restraining the public from being free-riders depends on Pigouvian taxes, subsidies, pollution restrictions, and public abatement policies to achieve the first optimal environmental protection. While according to Keeler, Spence, Zeckhauser (1971), Tahvonon, and Kuluvaainen (1991), they added environmental pollution externality to the neo-classical growth model and found that restriction on pollution attributed to considering environmental quality and pursuing social welfare as the ultimate goal would usually limit

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¹ Please refer to <http://e-info.org.tw/node/20411> for relevant news reports.

² The full content of Equator Principles you can find at <http://www.equator-principles.com>.

economic growth, and reduce consumption and production per capita. However, the rate of economic growth in their theory is exogenous given, which fails to display the influence of environmental protection policies on the rate of economic growth.

The endogenous growth model proposed by Lucas (1988) and Romer (1986, 1990) shows the relationship between government policies and the rate of economic growth to include the issue of the influence of environmental protection on the rate of economic growth in discussion. Furthermore, Huang and Cai (1994), and Lighthart and van Ploeg (1994) emphasize the reason why the removal of pollution can give humans comfort. They set environmental quality in utility function to establish an endogenous growth model of pollution externality and AK mode to prove that the increased tax rate would improve environmental quality but decrease the rate of economic growth if the government uses income tax in financing pollution prevention expenses when executing environmental protection policies. However, this claim does not match the reality. Porter and van der Linde (1995) have taken Germany and Japan as examples. Both countries retain high productivity even though they have set up stricter criteria on environmental restriction. While Bovenberg and Smulders (1996) also indicated that environmental policies would drive companies to become involved in pollution prevention and in producing technical innovation. From this point of view, Bovenberg and Smulders (1995, 1996), Smulders and Gradus (1996), and Mohtadi (1996) and Byrne (1997) stress that increased environmental quality has positive externality on production which proves that environmental policies can improve not only environmental quality but technology to increase the rate of economic growth. In addition, Bovenberg and Smulders (1996), and Bovenberg and de Mooij (1997) further prove that environmental policies can increase not only the rate of economic growth but also social welfare as long as the externality of environmental productivity is strong enough, which brings society a double dividend effect.

The environmental policies discussed in the above-mentioned literature are mainly limited to taxes or public abatement policies, where in the smaller part of them considers inducing the public to get involved in environmental protection by the influence of the financial organization or market on the allocation of loanable capital. Enlightened by the Equator Principles, authorities can use the allocation of credit loans as its policy tool to induce the public to participate in environmental protection through the money market. This article modifies the current model of endogenous growth of the environment to

analyze the influence of linking allocation of credit loans with environmental policies as the theoretical basis for the relationship between green credit policy and economic growth. This article presumes the existence of two types of technology, in which one is high-polluting and the other is non-polluting. High-polluting technology will receive reduced financing after the green credit policy comes into force, and therefore, the accumulation of capital and productivity of this type of technology will decrease. The other type of technology will receive increased financing so its accumulation of capital and productivity will increase correspondingly. This brings the result that pollution will definitely be reduced, environmental quality will be increased, and the rate of economic growth will be influenced, thereby demonstrating the influence of the green credit policy on economic growth.

The second contribution made by this article is the analysis of the policy effect on whether or not welfare is increased or the first best optimal growth is achieved. The ultimate goal in pursuit of economic growth is to pursue the maximum welfare for human beings. However, in terms of the influence of economic activities on environmental pollution, pursuit of economic growth is not necessarily matching the pursuit of the best welfare of human beings. As a result, this article focuses on the influence of the green credit policy on the rate of economic growth as well as on social welfare. We presume that pollution brings negative externality and technology with high productivity will receive more financing as a result of the market allocation mechanism. However, this does not guarantee the technology is low-pollution. The best welfare will, therefore, not be achievable if the focus remains on productivity that causes too much pollution instead of the first optimal pollution result. The quality of environment improves and social welfare increases only when the green credit policy reverses the allocation of market mechanism enabling low-polluting technology to receive more financing.

Although endogenous growth provides a solution to the shortcoming of neo-classical growth, the early literature regarding endogenous growth mainly focused on the influence of policies on equilibrium growth on a long-term basis whereas short-term transitional dynamics was less discussed. The lack of discussion of transitional dynamics has led more researchers, such as Benhabib and Farmer (1994), Xie (1994), Mino (2001), Weder (2001), Jha, Wang and Yip (2002), Itaya and Mino (2003), and Suen and Yip (2005), to dedicate to the study of relevant issues in which they have found that transitional dynamics could cause multiple transitional routes

and different rates of growth. This phenomenon is called dynamic determinacy. This discovery can explain the economic phenomenon observed by Lucas (1993) where a great disparity in future growth achievements happens to countries which set off from a similar starting point (e.g., South Korea and the Philippines), and that if the existence of dynamic indeterminacy has been referred to in policy selection due to the difficulty in policy evaluation caused by this situation. The third contribution made by this article is analyzing if transitional dynamics caused by the green credit policy are featured with dynamic indeterminacy. It has been found that dynamic indeterminacy is likely to happen in circumstances where relative coefficient of risk aversion is more than 1 along with higher flexibility in pollution production, a representative individual aversion to pollution, and attribution to polluting technology made by capitalism.

The article is structured as follows. Section 1 is about the basic set-up of models specifying the set-up of models as well as the comparison between the social planner (efficient) solution and the decentralized (equilibrium) solution and analyzing whether green credit policy can raise the welfare standard of the decentralized solution to the same level as that of the social planner solution. Section 2 is regarding the influence of green credit policy on economic growth and the nature of transitional dynamics, in which the influence of green credit policy on the rate of economic growth and the nature of transitional dynamics is analyzed. The final Section concludes.

1. Models

This article is based on endogenous growth AK mode model combined with others set forth by Bovenberg and Smulders (1995, 1996), Bretschger and Smulders (2007), Chen, Lai and Shieh (2003), and Gradus and Smulders (1993). As the roles set in the economic growth models by this literature, this article establishes an environmental endogenous growth model in an attempt to study again the relationship between environmental policies and economic growth. The difference between the model in this article and the currently existing one is that there are two types of production technology presumed in the economic system by this article. One of them produces pollution while the other does not. Therefore, the function of the total social production is:

$$y = A\bar{k}^{(1-\alpha)}(uk)^\alpha + B\bar{k}^{(1-\varphi)}[(1-u)k]^\varphi, \quad (1)$$

$\alpha, \varphi \in [0, 1]$,

where y stands for production output, $A > 0$ for the technical efficiency parameter of non-polluting technology, $B > 0$ for the technical efficiency parameter of polluting technology, \bar{k} for the social average capital per capita, k for capital owned by the representative individual, and $u \in [0, 1]$ for the proportion of capital used in non-polluting technology. The design of equation (1) is to present that the total social production is generated by two types of technology in which part of the production is from non-polluting technology $A\bar{k}^{(1-\alpha)}(uk)^\alpha$, while the other from polluting technology $B\bar{k}^{(1-\varphi)}[(1-u)k]^\varphi$. \bar{k} is set according to the viewpoint of Romer (1986) who thinks that investment has externality. Then, pollution is related to the polluting technology which is set in this article as:

$$p = \{B\bar{k}^{(1-\varphi)}[(1-u)k]^\varphi\}^\gamma, \quad (2)$$

where $p > 0$ stands for the amount of pollution, and $\gamma > 0$ for the output flexibility. The output flexibility γ is defined as the percentage change in pollution divided by the percentage change in output from polluting technology which is a measure of the sensitivity (or responsiveness) of the amount of pollution.

It is presumed that a representative individual with dual identity as a consumer and producer exists in the society and he will set out a plan for his lifetime economic activities in which the first optimal behavior can be represented as

$$\max W = \int_0^\infty U(c, p)e^{-\rho t} dt, \quad \rho > 0, \quad (3)$$

$$\text{s.t. } \dot{k} = A\bar{k}^{(1-\alpha)}(uk)^\alpha + B\bar{k}^{(1-\varphi)}[(1-u)k]^\varphi - c, \quad (4)$$

where W is the lifetime utility of the representative individual that is the discounted sum of instantaneous utility function. The function $U(c, p)$ is known as the instantaneous utility function which is non-negative, and a concave increasing function of the consumption, c , and a convex decreasing function of the pollution, p . The parameter ρ is the rate of time preference rate, and t is time, and we define $\dot{k} = dk / dt$.

In the model, the instantaneous utility function is set to the constant relative risk aversion utility function:

$$U(c, p) \begin{cases} = \left[(cp^{-\theta})^{1-\sigma} - 1 \right] / (1-\sigma), & \text{for } \theta \text{ and } \sigma > 0, \sigma \neq 1, \\ = \ln c - \theta \ln p, & \text{for } \sigma = 1, \end{cases}$$

where θ for the parameter of the level influenced by pollution on the utility of the representative individual, σ for the coefficient of relative risk aversion which is defined as:

$$\sigma = -(\partial^2 U / \partial c^2) c / (\partial U / \partial c).$$

It means the willingness of the representative individual to shift consumption across time or shows the curvature of the instantaneous utility function. The smaller the coefficient of relative risk or the smaller the degree of diminishing marginal utility of consumption, the more consumption increases across time in response to economic shock.

According to the points of view adopted by the above-mentioned relevant literature, the power of the representative individual is far too small to control the amount of pollution decided on by the whole society. Therefore, the power will neither drive any participation in environmental protection nor influence the first optimal behavior of the representative individual. In terms of another viewpoint, if there is a kindhearted social planner who has the ability to control the pollution of the whole society, the pursuit of maximized social welfare will synchronize with the representative individuals' pursuit of maximized welfare, in which the first optimal behavior and the first optimal behavior of the representative individual should be different. Mohtadi (1996) proves that the policy made by the social planner can achieve the maximum social welfare so the difference between the first optimal decision made by the social planner and the representative individual can be obtained by comparison.

1.1. The social planner (efficient) solution. The first discussion will be the first optimal allocation of the social planner. The goal which the social planner cares about is the same as what the representative individual cares about, but the biggest difference is that the social planner cares about the influence of the level of pollution on utility. Therefore, pollution is one of the variables in policy making and policy making is to select c , p , k , and u in pursuit of the maximum of lifetime utility within the budget limit and pollution production function limit, which is

$$\max_{c,p,k,u} W = \int_0^\infty \{[(cp^{-\theta})^{1-\sigma} - 1]/(1-\sigma)\} e^{-\rho t} dt,$$

$$\text{s.t. } \dot{k} = A\bar{k}^{(1-\alpha)}(uk)^\alpha + B\bar{k}^{(1-\varphi)}[(1-u)k]^\varphi - c$$

$$\text{and } p = \{k^{(1-\varphi)} B[(1-u)k]^\varphi\}^\gamma.$$

For the solution to this question, we firstly set a Lagrange function:

$$L = \left\{ (cp^{-\theta})^{1-\sigma} - 1 \right\} / (1-\sigma) + \lambda_1 \{ A\bar{k}^{(1-\alpha)}(uk)^\alpha + B\bar{k}^{(1-\varphi)}[(1-u)k]^\varphi - c \} + \lambda_2 \left\{ p - \left[k^{(1-\varphi)} B[(1-u)k]^\varphi \right]^\gamma \right\} \quad (5)$$

and in the equation, λ_1 stands for Hamiltonian multiplier which can be regarded as the capital shadow price represented by utility, λ_2 for Lagrange multiplier which can be regarded as the shadow price of an increased unit of pollution. Accordingly, the first order condition in the first optimal selection by the social planner is

$$\frac{p}{\theta c} = \frac{\lambda_1}{\lambda_2}, \quad (6)$$

$$\frac{1-u}{u} = \left\{ 1 - (\lambda_2 / \lambda_1)^\gamma \left[B\bar{k}^{1-\varphi} ((1-u)k)^\varphi \right]^{-1} \right\} \left(\frac{B\bar{k}^{1-\varphi} - \varphi(1-u)^\varphi k^{\varphi-1}}{A\bar{k}^{1-\alpha} \alpha u^\alpha k^{\alpha-1}} \right), \quad (7)$$

$$\frac{\lambda_1}{u} [A\bar{k}^{1-\alpha} \alpha u^\alpha k^{\alpha-1}] = -\dot{\lambda}_1 + \rho \lambda_1. \quad (8)$$

In addition, the first optimal selection of the social planner should match the intertemporal budget balance, which also needs to satisfy the transversality condition $\lim_{t \rightarrow \infty} \lambda_1 k = 0$.

1.2. The decentralized (equilibrium) solution.

Here we move on to discuss the decision of the representative individual. According to Bovenberg and Smulders (1995, 1996), Bretschger and Smulders (2007), Chen, Lai and Shieh (2003), and Gradus and Smulders (1993), it is presumed that the representative individual regards himself as a very small grain of sand in the enormous society without the ability to improve the situation of pollution.

Therefore, he will not actively take any action to prevent pollution with a prerequisite of having no inducement, so p is not a variable in the individual decisionmaking. The representative individuals' decisionmaking is to select c , k , and u to pursue maximum lifetime utility within budget limit, which is:

$$\max_{c,p,k,u} W = \int_0^\infty \{[(cp^{-\theta})^{1-\sigma} - 1]/(1-\sigma)\} e^{-\rho t} dt,$$

$$\text{s.t. } \dot{k} = A\bar{k}^{(1-\alpha)}(uk)^\alpha + B\bar{k}^{(1-\varphi)}[(1-u)k]^\varphi - c, \quad (9)$$

For the solution to the first best conditions in the first optimal selection are:

$$c^{-\sigma} p^{-\theta(1-\sigma)} = \lambda_1, \tag{10}$$

$$\frac{1-u}{u} = \frac{B\bar{k}^{1-\phi} \varphi(1-u)^\phi k^{\phi-1}}{A\bar{k}^{1-\alpha} \alpha u^\alpha (k)^{\alpha-1}}, \tag{11}$$

$$\frac{\lambda_1}{u} (A\bar{k}^{1-\alpha} \alpha u^\alpha k^{\alpha-1}) = -\dot{\lambda}_1 + \rho \lambda_1. \tag{12}$$

Similarly, if we want to make the first optimal selection match intertemporal budget balance, we need to satisfy the transversality condition $\lim_{t \rightarrow \infty} \lambda_1 k = 0$.

1.3. The first optimal green credit policy. Parameter u can be selected as the variable in decision making by the representative individual to maximize objective function; however, the government can implement environmental policies through credit organization to take environmental factors into consideration in credit assessment conditions when the government adopts the green credit policy, in which u will be controlled to the first optimal standard when more funds (capital) are lent to non-polluting technology. Therefore, u becomes a variable in the policy, which is not controlled by the representative individual but by the government. Comparing the first order condition of the first optimal selection by the social planner and the representative individual, the biggest difference is the selection of pollution. This is because pollution has externality which is regarded by the representative individual as a situation that he is not able to improve. As a result, the individual will not consider how to obtain higher consumption standard only for the sake of reducing pollution (because consumption is the function of social welfare) and will choose efficient production technology without caring about the pollution it produces. The social planner can control pollution and take the welfare of the whole society into consideration to control pollution remaining in the first optimal standard. That means that the social planner will necessarily consider pollution issues in selection of production technology, in which more non-polluting technology will be chosen in production with less favor in choosing the technology which pollutes. This point of view can be perceived by comparing the u 's decided by equation (7) and equation (11). The difference between these two equations is that equation (7) has one more formula:

$$1 - (\lambda_2 / \lambda_1) \gamma [B\bar{k}^{1-\phi} ((1-u)k)^\phi]^{\gamma-1} < 1,$$

and this presents that the u decided by equation (7) is bigger than the u by equation (11). This means that non-polluting technology is adopted in more

proportion of the production of the social planner while the representative individual opts for polluting technology to be more responsible for production. In other words, the decision made by the representative individual will cause more pollution, which requires policies to interfere in order to increase u . Parameter u can be controlled if the green credit policy is able to transfer the capital which was originally lent to polluting technology to the non-polluting one. Social welfare will be able to be raised to the maximum standard if u can be controlled to the first optimal standard selected by the social planner. Therefore, here we can obtain the following:

Proposition 1: The green credit policy can rectify the decentralized (equilibrium) solution featured with pollution externality to become the social planner (efficient) solution of pollution internalization because it can transfer capital from high-polluting technology to the low-polluting one to achieve the first optimal standard u selected by the social planner, and therefore, the green credit policy can increase social welfare.

2. The influence of the green credit policy

2.1. Green credit policy on economic growth. More capital can be allocated to non-polluting technology by the green credit policy if the proportion of the capital used in it, u , is too small, which makes u become the variable in policy control. We can then infer the effect influenced by change of u on the endogenous variable in the model and pay attention to its influence on the rate of economic growth.

We firstly follow the way that Barro and Sala-i-Martin (1995) dealt with variable transformation to define an evaluating variable $x = c/k$ along with the equations of the individual first optimal behavior and social resource limit according to the above to have the following equation of transitional dynamics of economic system as

$$\frac{\dot{x}}{x} = \frac{1}{\sigma} (A\alpha u^{\alpha-1} - \rho) - \frac{\theta\gamma\varphi(1-\sigma) + \sigma}{\sigma} (Au^\alpha + B(1-u)^\phi - x), \tag{13}$$

long-term equilibrium of the system needs to meet $\dot{x} = 0$, and according to this condition, we can have equilibrium x as

$$\hat{x} = Au^\alpha + B(1-u)^\phi - \frac{A\alpha u^{\alpha-1} - \rho}{\theta\gamma\varphi(1-\sigma) + \sigma}, \tag{14}$$

and bring the \hat{x} solved through from the above to \dot{k}/k or \dot{c}/c and here we get an equilibrium growth rate

$$\gamma_k = \frac{A\alpha u^{\alpha-1} - \rho}{\theta\gamma\varphi(1-\sigma) + \sigma}. \quad (15)$$

The influence of the increased u on the equilibrium growth rate is:

$$\frac{\partial \gamma_k}{\partial u} = \frac{A\alpha(\alpha-1)u^{\alpha-2}}{\theta\gamma\varphi(1-\sigma) + \sigma} < 0 \quad (16)$$

if $\theta\gamma\varphi(1-\sigma) + \sigma \geq 0$.

Equation (16) represents that the bigger u not only harms the equilibrium growth rate but also increases balanced growth, and the key point is the sign of $\theta\gamma\varphi(1-\sigma) + \sigma$. The major key $\theta\gamma\varphi(1-\sigma) + \sigma$ is negative if the risk aversion coefficient of consumption σ is more than $\theta\gamma\varphi / (\theta\gamma\varphi - 1)$. This shows that if $\sigma > 1$, the value of $\theta\gamma\varphi$ is big enough, the policy can increase the balanced growth rate. The possible reasons may be that when $\sigma > \theta\gamma\varphi / (\theta\gamma\varphi - 1)$ without credit policies, the representative individual will make intertemporal transfer of future increase in production output to the current consumption. This will make allocated resource to the capital become less and have lower rate of economic growth. When credit policy is adopted to force the transfer of capital from highly productive technology which pollutes to the non-polluting one, it causes loss in production efficiency but it also forces the representative individual to allocate more resources in capital, which increases capital accumulation and leads to a higher rate of economic growth. When σ is less than $\theta\gamma\varphi / (\theta\gamma\varphi - 1)$ and the credit policy is adopted, the loss occurred due to capital transfer from high-polluting technology to non-polluting will do harm to economic growth so we can therefore the following.

Proposition 2: The influence of green credit policy on the rate of economic growth is indeterminate. When risk aversion coefficient of consumption is less than or equal to 1, green credit policy will cause a fall in the rate of economic growth; while when risk aversion coefficient of consumption is more than 1, the policy is likely to increase the rate of growth.

2.2. The transitional dynamics. According to the literature regarding local indeterminacy of dynamic equilibrium – for example, Benhabib, Schmitt-Grohé, and Uribe (2001a, 2001b), Dopor (2000; 2001), Weder (2001), and Itaya and Mino (2003) – if the number of the positive root of the characteristic root is equal to the number of the jump variable, the only perfect foresight dynamic-equilibrium solution exists. When the number of the positive root of the characteristic root is more than the number of the jump

variable, the only perfect foresight dynamic-equilibrium solution does not exist. When the number of the positive root of the characteristic root is less than the number of the jump variable, the multiple perfect foresight dynamic-equilibrium solutions exist which makes equilibrium local indeterminacy. On the basis of these viewpoints in the literature, there is only one jump variable x in this article. If the perfect foresight dynamic-equilibrium solution exists, the characteristic root of equation (13) needs to be plus. If the multiple perfect foresight dynamic-equilibrium solution exists, the characteristic root is minus. The characteristic root of equation (13), s , is

$$s = \frac{[\theta\gamma\varphi(1-\sigma) + \sigma]x}{\sigma} > 0, \quad (17)$$

if $\theta\gamma\varphi(1-\sigma) + \sigma \geq 0$.

The result from equation (17) can be compared with equation (16) and we find that when σ is more than $\theta\gamma\varphi / (\theta\gamma\varphi - 1)$, the characteristic root of transitional dynamics is less than 0. It means that green credit policy is not only to enhance economic growth but transitional dynamics is also local indeterminacy. Furthermore, the green credit policy will reduce pollution and eliminate pollution externalities, and the representative individual is willing to reduce the current consumption and increase investment leading to improved economic growth. The economic system will have multiple dynamic adjustment path to reach the new equilibrium with the difference from individual expectations. The results show the effect of the policy will be varied from different dynamic adjustment path. On the contrary, when σ is less than $\theta\gamma\varphi / (1 - \theta\gamma\varphi)$, the characteristic root is more than 0 which means a perfect foresight dynamic equilibrium exists in the economic system. This indicated that although the green credit policy to reduce pollution, but the effects of policies cannot increase capital accumulation lead to economic growth is declining, and the only one to reach a new equilibrium dynamic adjustment path. From the results we have the following.

Proposition 3: Local indeterminacy of dynamic balance exists when the green credit policy increases the rate of economic growth. While transitional dynamics in the economic system is determinate when the green credit policy decreases the rate of economic growth.

Conclusion

This article has established an environmental endogenous growth model to explore the possibility

of reducing pollution by implementing the green credit policy as well as to analyze its influence on economic growth. It is firstly proved that from the point of view of having maximum social welfare, this maximum level will be unreachable if the policy made by the representative individual causes excessive pollution. While the maximum level of social welfare can be achieved if the green credit policy is adopted in which the capital is under control to be allocated from the technology which produces pollution to the non-polluting one. We found that green credit policy is as likely to increase economic growth as well as to do harm to it. This depends on the risk aversion coefficient of consumption. It could cause loss in production effectiveness although green credit policy may transfer the capital from highly productive technology which produces much pollution to the low productive one producing no pollution. When

risk aversion coefficient is bigger, the green credit policy will force the public to opt for saving which is beneficial to economic growth because of capital accumulation, and will bring more good than harm to economic growth. When risk aversion coefficient is smaller, the adoption of the green credit policy is likely to cause more productivity loss which is not in favor of economic growth when it enables non-polluting but low-productive technology to receive more capital. Finally, we found that the transitional dynamics are featured with local indeterminacy when the environmental credit loans increase the rate of economic growth. But when the policy decreases the rate of economic growth, the transitional dynamics show determinacy.

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