

A Theoretical Analysis for the Supply-Demand Relation of International Public Goods in Uni-Polar and Bi-Polar Systems:

The Interpretation and Problems of the Theory of Neo-Realism by Cournot Equilibrium.

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Abstract

The purpose of this article is the following three. Firstly, it is to examine the form of the international system and the logical relevance with supply and demand relations of the international public goods. Secondly, it is to make the model with “Cournot Equilibrium”. Thirdly, with this model, it is to interpret international political theory of the neo-realism. There is two following recognition in the background of such a critical mind. Mechanism of supply and demand relations of the international public goods to produce the changes of the international system have close connection, and the balance is recognition to have possibilities to stabilize an international system. At first, this article models supply and demand structure of the international public goods in “Uni-Polar System”. And then, this thesis models supply and demand relations of the international public goods in “Bi-Polar System”.

Keywords : International Public Goods, International System, Cournot Equilibrium

キーワード : 国際公共財 国際システム クールノー均衡

1. Whereabouts of the problem

(1) Preface

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the international system have close connection, and the balance is recognition to have possibilities to stabilize an international system. At first, this article models supply and demand structure of the international public goods in “Uni-Polar System”. And then, this thesis models supply and demand relations of the international public goods in “Bi-Polar System”.²⁾

In addition, an argument of this thesis is analysis for a short term as a general rule. And, this article does not discuss a supply standard of the most suitable international public goods (an argument of so-called “Pareto Efficiency”). By the way, the supply activity of the international public goods in international relations is Non-Cooperative Game and Simultaneous Game. Therefore, the balance level strategic ideally is Nash Solution, and it is not Stackelberg Equilibrium. And, it is very likely that the supply and demand-related strategic variable of the international public goods in international relations becomes the supply amount of production, and many nations which are the demand subject are weak bodies relative to the large country which is the supply subject. Therefore, the balance level strategic ideally is not Bertrand Equilibrium.³⁾

(2) An analytical framework

At first, this thesis defines the concept of eight follows as follows to make an argument of this report clear.

(a) The dynamics and the stability of international system.

The international society is constructed by a large number of nations and it is social system performing a change by foreign policy and called this with International System.

(b) International public goods

In international relations, It called a fortune or service having both character of Non-Exclusiveness and Non-Rivalness international public goods.⁴⁾ Generally speaking, resources for the international order that a hegemony country having the preeminence of the resources occupation power such as military affairs, economy, politics, culture, energy, the food supplies for other countries in comparison with other countries are international public goods. A global environment, world peace, a fair trade relationship, the international transportation network are international public goods to be concrete. Because as for the goods and the service that the advantage is enjoyed by the whole world or plural countries is because is it. Therefore, the international public goods are not only simple material or human resources. The frame of the system of international law, international organization, development policy,

financial support, trade relationship, international security, Regime of the international collaboration are included in international public goods.⁵⁾

(c) Supply of the international public goods

Because so-called “equilateral externality” (plus externality) beyond the profit of the specific supply country is big, the international public goods is easy to be undersupplied when I can leave it to a market system.⁶⁾ In addition, the country having the strong strength of a nation that can supply international public goods is limited. Therefore, the supply activity by the large country having intention and ability for the supply is necessary. In addition, a supply country decides the international public goods supply and quantity of request of the loyalty degree (later description). It is equivalent to Products of the international public goods if it says economically.

(d) Demand of the international public goods

It called the degree that a demand for international public goods country supports a supply country by a foreign policy Degree of Loyalty. If it says economically, it is Price which is necessary to get 1 international public goods unit. Based on the request of the demand country, the large country which can supply international public goods is decided whether I can get the support of many countries, and the supply country calls for how much loyalty degree again.

(e) Uni-polar system

The international system that international public goods are supplied by a single superpower is called a monopole system. If this is the same as the hegemony system, and it is said economically at the same time if it says for international political science, this is the same as Monopoly Market.

(f) Bi-polar system

It called the international system that two superpowers supply international public goods Bi-polar system. If this is the same as Cold War System, and it is said economically again if it says for international political science, this is a kind of Oligopoly Market and it is the same as Duopoly Market.

Similarly, it sets three following suppositions.

(i) The international system is constructed by two kinds of countries, and primarily it is the large country where it is single or few having ability to supply the other countries with international public goods, and second it is a lot of countries which cannot produce international public goods.

(ii) The demand for international public goods country shows a loyalty degree through the foreign policy depending on a supply for a supply country. The demand country acts to get maximum international public goods at a minimum loyalty degree. In addition, the supply country decides a supply of the international public goods depending on a loyalty degree of the demand country. The supply country acts to get a maximum loyalty degree with a minimum supply.

(iii) When supply and demand relations of the international public goods are balanced, the international system is stable and becomes unstable if it becomes unequal.

2. A Dynamics and the stability of the Uni-polar system

It is the international relations by so-called hegemon, and, in other words, the Uni-polar system is the hegemony system. Here, the international public goods is supplied by a single superpower. In addition, in the other countries, it is supplied international public goods by the superpower, and the demand country gives the hegemon concerned the support in the foreign policy instead and shows loyalty.

Therefore, the superpower supplies international public goods until a loyalty degree of the other countries which are profit of the self becomes greatest. Therefore, the point where supply accords with demand becomes the degree of the most suitable loyalty (it is a balance level in the monopoly market if it says by a term of the microeconomics).

In addition, judging from a viewpoint of the international political theory, It can classify these in kind of the argument of neo-realism or International Political Economy. It falls under Hegemonic Stability Theory represented by Robert Gilpin; ⁷⁾.

(1) The formulation by the mathematics model

This thesis formulates the above-mentioned logic to expect accuracy. It transcribes a supply of the international public goods into S , a loyalty degree of a necessary demand country into L to get 1 international public goods unit, a total cost into C , gross earnings into R , a profit into I , therefore, it gets the following function and inverse function.

$$S = S(L)$$

$$L = L(S)$$

In addition, the profit deducted a total cost from gross earnings.

$$SL - C(S) = I$$

Because of $SL = R(S)$ or $L(S)S$

$$R(S) - C(S) = I$$

Thus, it is provided when the maximization condition of I differentiates the above about S .

$$\frac{dI}{dS} = \frac{dR}{dS} - \frac{dC}{dS} = 0 \quad (2-1)$$

Thus, it transcribes dR/dS into marginal revenue MR , dC/dS into marginal cost MC , the expression becomes $MR-MC = 0$ (2-1) and gets follows.

$$MR = MC \quad (2-2)$$

In addition, a marginal cost is quantity of the loyalty that is necessary to let a supply of the international public goods rise 1 unit. In other words, if there are few supplies, the marginal cost grows big and shrinks if a supply is big (Scale Merit). Therefore, a marginal cost curve is a supply curve. In other words, where the profit maximization condition of the hegemony country in the monopole system becomes the point (a point of intersection) that a marginal revenue curve and a marginal cost curve are equal. In addition, a method in search of a marginal revenue curve is to differentiate gross earnings function $R = L(S)S$ about S .

$$\frac{dR}{dS} = L(S) + \frac{dL}{dS} \cdot S = MR \quad (2-3)$$

Here, it is $dL/dS < 0$ and $L(S) < 0$. Therefore, the above becomes the decrease function about S . By trade off relations of the S and L , it is recognized that it is a curve of the right inferiority.

(2) The formulation by the figure

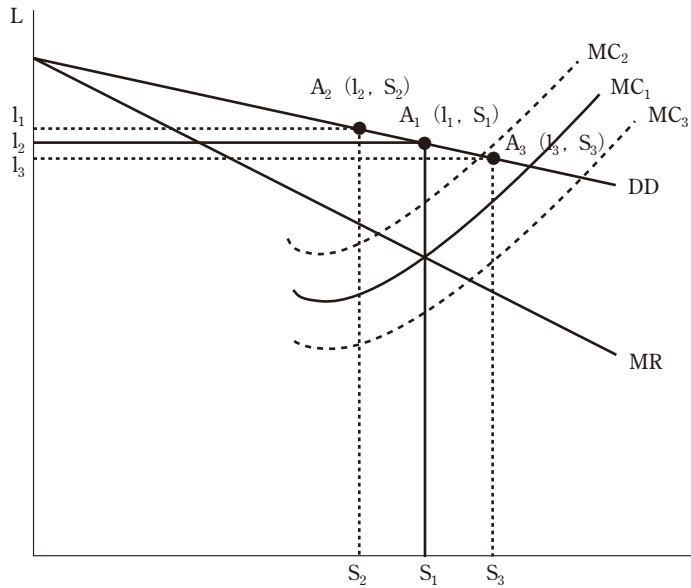


Figure 1 : supply and demand relations of the international public goods in the Uni-polar system.

The vertical axis of figure 1 is loyalty degree L of the profit maximum that is necessary for the acquisition per 1 international public goods unit. The horizontal axle is supply S of the profit maximum. Demand curve DD , marginal cost curve MC , marginal revenue curve MR are drawn. The point where MR intersects MC is point A_1 on DD (l_1, s_1). This point is the supply that a hegemony country lets you maximize a profit. In addition, this point expresses the loyalty degree that a hegemony country requests each country for (so-called “Cournot’s Point”). The above is composition of the monopoly market which we can look at with a standard economic text well.

When marginal cost curve MC_1 shifts to MC_2 (increase) or MC_3 (decrease) here, point A_1 mentioned above moves to A_2 or A_3 each. In addition, in s_1, l_1 changes to it to l_2 or l_3 to s_2 or s_3 , too. The loyalty degrees increase in the former, and the supplies decrease. This increases the profit of the supply country and, however, it becomes disadvantageous to the demand country and increase the dissatisfaction. In addition, in the case of the latter, the loyalty degrees decrease, and, however, the supplies increase. This increases the profit of the demand country adversely and, however, it becomes disadvantageous to the supply country and increase the dissatisfaction. In other words, it is with an element increasing the dissatisfaction of the supply and demand two countries, and both increase and decrease of

MC want to do it and invite the destabilization of the system. Therefore, the Uni-polar system is the international system that is more unstable than Bi-polar system (cf. following chapter).

In addition, it transforms the (2-3) expression mentioned above at the following.

$$MR = L \left(1 + \frac{dL}{dS} \cdot \frac{S}{L} \right)$$

And, it transforms the (2-3) expression mentioned above at the following. Then, it substitutes $e = -dS/dL / S/L$ as flexibility of the loyalty degree as above and assume it $MR = L (1-1/e)$. Furthermore, it is as follows when it substitutes $MR = MC$ and arrange it about $1/e$.

$$\frac{1}{e} = L - \frac{MC}{L} \tag{2-4}$$

It means that international system rule degrees of the hegemony country increase so that this value is big (reciprocal number = of the price elasticity of demand so-called "Lerner's Degree of Monopoly").

In addition, as for the supply activity of the international public goods, Initial Cost is serious, and and it is very likely that Sunk Cost grows big and wants to do it, and an entry wall is high, and, in the reason, global community, it is easy to be in the Natural Monopoly = hegemony system. But it is very likely that the loyalty degree called for is maintained to suitable quantity, and this is so-called Contestability if it is relaxed a situation by diplomatic relations or the world opinion of the hegemon. In addition, even if the burden puts pressure on profit, It may continue the supply of the international public goods by the hegemon in the Uni-polar system in the real international relations, this is rigorousness by so-called "Concord Effect."⁸⁾ Because the reason why it stop supply of the international public goods is that a hegemon will accept "failure" formally and Logic of Politics beyond Logic of Economy is strong as a policy decision element and acts there (possibility of the activity that is Non-Rational or Non-Marketable).

3. A Dynamics and the stability of the Bi-polar system.

The Bi-polar system is unification of the international relations by two superpowers, and, in other words, it is the Cold War System. Here, two superpowers supply international public goods. In addition, it is supplied international public goods by one superpower, and the

demand country gives a superpower the support in the foreign policy instead and shows loyalty. Therefore, two superpowers supply international public goods until a loyalty degree of the demand country becomes biggest, and and it is with the degree of the loyalty that the point where it agrees with the demand for other countries is most suitable (it is a balance level in “the Duopoly Market” if it says by a term of the Microeconomics). In other words, in the case of an uncooperative game, it is the argument of the bipolar system of neo-realism or Structural Realism by words of the international political theory (e.g., Kenneth N. Waltz). In addition, in the case of a cooperative cooperative game, it is the argument of International Cooperation of Neo-Liberalism or Neo-Liberal Institutionalism (e.g., Robert O. Keohane).⁹⁾ Needless to say, this thesis discusses analogy with the former because it assumes non-cooperative games here.

(I) The formulation by the mathematics model

It formulates the above-mentioned argument to expect accuracy. Here, it takes the Cold War System = duopoly that is an uncooperative system into consideration and theorize it. At first, let us assume it, the market demand curve $D = B - A(S_1 + S_2)$, expense curve $C = AS_1$ of Country A, expense curve $C = BS_2$ of Country B, the market. Therefore, it could be write the profit of the two countries as follows.

$$\text{Profit of the country A : } I_1 = (B - A(S_1 + S_2)) S_1 - AS_1$$

$$\text{Profit of the country B : } I_2 = (B - A(S_1 + S_2)) S_2 - AS_2$$

But as for the balance analysis that S_1 and S_2 are the fixed number of each expression here, because this does not add the element of the strategy to is because is it.

$$\frac{dS_1}{dS_2} = 0$$

$$\frac{dS_2}{dS_1} = 0$$

But as for the balance analysis that S_1 and S_2 are the fixed number of each expression here, because this does not add the element of the strategy to is because is it. In other words, Country A supposes Country B not to increase a supply, and Country B supposes that Country A does not increase it (so-called “Cournot’s Assumption”). Therefore, the maximization condition differentiates I_1 in S_1 and is provided by differentiating I_2 in S_2 .

$$\frac{dl_1}{dS_1} = (B - A) - A (2S_1 + S_2) = 0 \quad (3-1)$$

$$\frac{dl_2}{dS_2} = (B - A) - A (S_1 + 2S_2) = 0 \quad (3-2)$$

When it pays off above (3-1) and (3-2) and find a reaction function, it is as follows. This is a maximization condition of the each Country A and Country B.

$$2S_1 + S_2 = \frac{B}{A} - 1$$

$$S_1 + 2S_2 = \frac{B}{A} - 1$$

Then, it decipheres the simultaneous equation mentioned above.

$$S_1 = \frac{1}{3} \left(\frac{B}{A} - 1 \right) \quad (3-3)$$

$$S_2 = \frac{1}{3} \left(\frac{B}{A} - 1 \right) \quad (3-4)$$

It is as follows when it substitutes the above for $L = B - A (S_1 + S_2)$.

$$\begin{aligned} L &= B - A \left(\frac{1}{3} \left(\frac{B}{A} - 1 \right) + 1 \left(\frac{B}{A} - \frac{1}{3} \right) \right) \\ &= B - \frac{3}{2} A (B - A) \end{aligned} \quad (3-5)$$

This (3-3) (3-4) (3-5) is a balance condition (so-called Cournot Solution). In other words, it is the profit maximization condition of the superpower in the international relations of the Bi-polar system type like the hegemon in the Uni-polar system, and it is with a point (point of intersection) where after all marginal revenue (curve) and a marginal cost (curve) agree.

(2) The formulation by the illustration

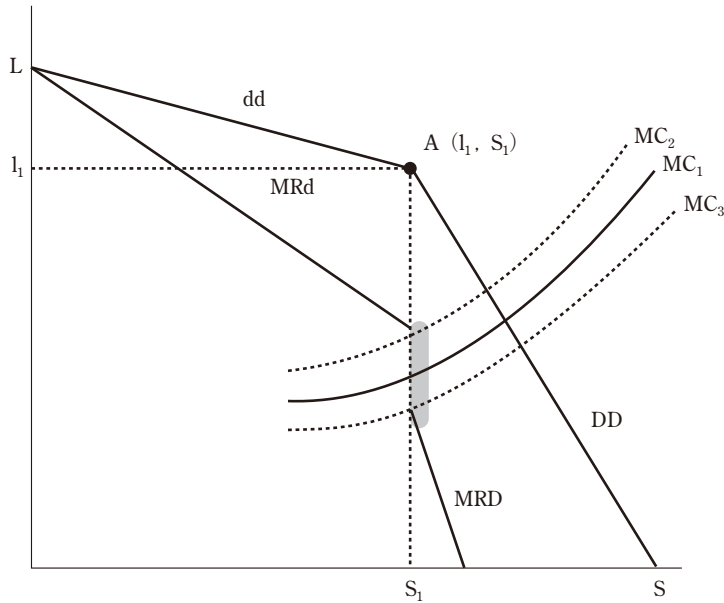


Figure2 : Supply and Demand Relation of the International Public Goods in the Bi-polar System.

Figure 2 is loyalty degree L of the profit maximum that a vertical axis is necessary for the acquisition per 1 international public goods unit, and a cross axle is supply S of the international public goods again. Demand curve dd where Country B is no reaction for the change of the loyalty degree that Country A calls for, Demand curve DD where Country B reacts to for the change of the loyalty degree that Country A calls for, Marginal cost curve MC , marginal revenue curve MR are written. This is composition of the familiar oligopolistic market with a text of standard microeconomics like figure 1.

Demand curve dd of the left side of the A point shows that other superpower do not follow a loyalty degree request of a certain superpower. Demand curve DD of the right side of the A point shows that other superpower follow a loyalty degree request of a certain superpower. The reaction of the demand is big in the left side (a degree of leaning is small) and is small again on the right side (a degree of leaning is big).

This refraction demand curve expresses that differential calculus is impossible in point A (I_1, S_1) deciding L and S . Therefore, the derived function is discontinuous because differential coefficients are different. In addition, it is marginal revenue curve MR (MRd of the figure and MRD) = $L + dL/dS / S$. It is maintained in the equivalent L and S as far as marginal cost curve MC goes along this discontinuous part and becomes like stiffening. In other words,

demand curve is refracted here. In addition, the marginal revenue curve MR is discontinuous. Therefore, both loyalty degrees that is necessary for a supply of the international public goods and the acquisition are maintained as the present conditions.

Even if MC_1 curve changes to MC_2 (increase) or MC_3 (decrease) if it says in detail, stiffening becomes like L_1 and S_1 without influence together because there is refraction demand curve. Therefore, quantity of the dissatisfaction for the system does not have the change and stabilizes both of both supply and demand international public goods. In this respect, it is thought that the Bi-polar system is an international system having stability more comparative than the Uni-polar system mentioned above.

In addition, after all a burden on the activity has rigorousness than the case of the Uni-polar system for a certain period of time after having been in a condition to put considerable pressure on the profit that the two countries acquire virtually, and, in the real international relations, as for the supply of the international public goods by two superpowers in the Bi-polar system, it is thought that they tend to continue it at the risk of a loss. The reason is because it means "the defeat" for the rival country by supply of the international public goods one country stop or to decrease, and it is with the policy decision element which is more important "the logic of the politics" beyond "the logic of the economy" than the case of the Uni-polar system crucially here.¹⁰⁾

4. Conclusion

This report examined on a balance condition for an international system of Uni-polar and Bi-polar to stabilize it based on the recognition that was the element that smooth supply of the international public goods stabilized international relations.

First, in the Uni-polar system, It lectured on the stabilization condition of the system which a single hegemon supplied international public goods, and acquired the loyalty of the countries. Second, in the Bi-polar system, It discussed the stabilization condition of the system which two superpowers supplied international public goods, and got the loyalty of the countries. Finally, It schematized the above-mentioned model and comparative analysed them. There is refraction demand curve in Bi-polar system; that is why a loyalty degree and the rigorousness of the supply exist. Therefore, supply of the international public goods may be carried out relatively than a monopole system stably.

In addition, the problem of this report is following two. First, it is to make the interlocking movement-related logic of monopole system and the sokyoku system dynamics. In other words, it is to get the argument about the process of the decline of the hegemony

country and the prosperity of the challenge country ready. Second, it is to formulate supply and demand relations of the international public goods in the cooperative game, and, in other words, it is to formulate the logic of the principle of neo-liberalism or principle of neo-liberal system = international coordination using a similar concept. Such an argument will formulate an argument of so-called Neo-Realism Synthesis closely.¹¹⁾

〈Notes〉

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No. 48, pp.266-79, 1966; A lot of countries which can supply international public goods exist, and there is a demand country a lot, but each supply country has a block unifying plural demand countries (having original demand curve) and can call the system which cannot move to other blocks even if therefore a loyalty degree called for by the supply country changes into the demand country with Block System. It is Monopolistic Competition Market, and “the logic of the politics” is stronger than “the logic of the economy”, and even here acts if it say by a term of the Microeconomics.

- 11) R. O. Keohane, *International Institutions and State Power*. Essays in International Relations Theory, Westview Press, 1989; R. O. Keohane, *Power and Governance in A Partially Globalized World*, Routledge, 2002; The international system that plural large countries supply international public goods is Multi-Polar system. It is the same as Balance of Power or the international coordination system if it says for international political science. It is the same as an oligopolistic market if it says economically. Because this system is non-cooperative games, it is a system having a property same as a duopoly system. In the multi-polar system, plural large countries supply the international public goods. In addition, the demand country shows the loyalty in the foreign policy for a supply country of the international public goods. Therefore, the supply country supplies international public goods until a loyalty degree of other countries becomes biggest. The point where supply accords with demand, a profit is the biggest point, and it is the degree of the most suitable loyalty again (it is a balance level in the oligopolistic market if it says by a term of the Microeconomics). It becomes the classical realism or balance of power when it thinks from the viewpoint of international political theory if it is an uncooperative multi-polar system. In addition, It falls under liberal or neo-liberal international coordination if it is a cooperative multi-polar system. When supply of the international public goods in the multi-electrode system is carried out by the cooperative international coordination between large countries, the expense burden by negotiations may be performed. The reason is because so-called Lindahl Mechanism functions. However, it is impossible to completely prevent the outbreak of a free ride country showing false information.

In addition, at the place such as the United Nations, an evaluation of the world opinion for the international public goods may be chosen by decision by majority. When it quotes the argument of so-called “public choice theory” and consider it, based on the logic of Medium Voter Hypothesis in Bowen’s Model of Voting, the supply may become socially appropriate. However, in the international relations that each country investigates national interest, the guarantee becoming desirable does not necessarily have the result. However, relatively smooth “withdrawal” or “the stop of the new entry” is carried out if the expense of the supply country comes to exceed advantage in the supply of the international public goods in the multi-electrode system. Because “the logic of the economy” appears on the front in comparison with “the logic of the politics” there.

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