COMPLEX SYSTEMS APPROACH TO THE STUDY OF POLITICAL INTEGRATION IN KOREA

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ABSTRACT

The aim of this paper is to suggest a complex systems model for the study of political integration in Korean peninsula. From the theoretical assumptions of modern thermodynamics it is possible to analyze the complex pattern of interactions between two different political entities over time. Based on this model I am going to analyze the complex process of political integration in the Korean peninsula over time.

The past trend of interactions between North and South Korea has shown the characteristics of political interactive dynamics. This dynamic process has reflected in the continuous fluctuations in term of the nonequilibrium thermodynamic state in the Korean Peninsular

INTRODUCTION

The past trend of interactions between North and South Korea shows the characteristics of political interactive dynamics which reflected fluctuations in equilibrium state. This kind of fluctuations can be studied in terms of thermodynamic phenomena. Thermodynamics is that part of physical science that is concerned with the conditions that material systems may assume and the changes in conditions that may occur either spontaneously or as a result of interactive between systems, including interactions such as heat, which cannot be described in terms of mechanics. Throughout the rest of 19th century it developed into a science, now known as classical thermodynamics, concerned primarily with physical systems in or passing through stable equilibrium state. More recently thermodynamics has been extended to include physical system in nonequilibrium states. This theory of thermodynamics, as Prigogine and Jantsch explicitly or implicitly suggested, can be properly applied to the study of social phenomena.

According to physicists, classical thermodynamics deals with equilibrium system or system near equilibrium. "Equilibrium" is a term that refers to processes and ensembles. It can be a macroscopic (local or global) or microscopic condition, but need not be all simultaneously. We have mechanical, thermal, electrical, chemical and other equilibria as separate aspects that require consideration. With respect to any process, local equilibrium requires detailed balance and reversibility. A system can be at equilibrium locally (macroscopically), but be far from equilibrium microscopically. The wide range of velocities of molecules in the macroscopic equilibrium state of an ideal gas, from zero to
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supersonic, is an example; it is the overall distribution of velocities that is unchanging at macroscopic equilibrium.

An isolated system without environment shows a particular type of self organization (or to be precise, self-disorganization). It will evolve in the direction of its equilibrium state and remain there. The more general and realistic case is a partially open system which exhibits similar behavior. This is generally the case for the systems not far from equilibrium. With irreversibility, the notions of process and history enter. Time is to govern a direction from the past into the future. The system evolves through a sequence of thermodynamic states which may be ordered along the scale of a single macroscopic parameter, entropy. In a microscopic view, the system gains the experience of innumerable encounters and exchanges between system components, but in a macroscopic view all that changes is the relation between free energy and entropy in the total system. Within the experience of a system of this kind, the equilibrium state determines the origin of system as well as its death.

From the theoretical assumptions of modern thermodynamics we can analyze the complex pattern of interactions between North and South in Korea over time. According to students of Korean unification, the questions on the whether, when, and how of Korean unification will be determined primarily by the Koreans themselves and secondarily by the concerted efforts of major powers. This means that the dynamic interactions between North and South can be dealt with the complex pattern of fluctuations, which is also closely involved in the complex interactions among the major powers in the Far Eastern international system. It can be assumed that the complexity of the dynamic interactions of North-South and the environmental conditions lead to nonequilibrium thermodynamic processes.

Recently, many systems scientists have discovered the applicability of the principle of "order through fluctuation" for the analysis of social phenomena. Based upon the above equilibrium thermodynamic assumptions suggested by Prigogine and his colleague, we can analyze the interactive dynamics of North and South Korea in terms of equilibrium, nonequilibrium, far-from-equilibrium, dissipative structure and attractor, which may relate with the integration and its subsequent unification process in the future.

Although this approach does not suggest precisely the detailed integration process and its mechanism of Korean unification process, it will be helpful not only to analyze the complex mechanism of interactive dynamics between North and South but also to suggest an alternative solution for unification process. Here I like to address to social scientists and students of Korean unification that we are in proper time to develop new creative systems thinking enable us to analyze the complexity of integration or unification process and other relevant subjects in politics by applying nonequilibrium thermodynamic models (assumptions) or deriving a set of relevant propositions from theory of nonequilibrium thermodynamics.
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THERMODYNAMIC STATE OF NORTH KOREAN POLITICAL SYSTEM

Since 1948 North Korea has been maintaining the relatively stable socialist system for the past four decades even though it has faced the crisis during the Korean war and a series of instabilities. From the systems perspective it can be said that North Korean political system could maintain its stability over time. If we can properly utilize an analytical framework from modern theory of thermodynamics, we can analyze the system functioning of North Korean political system.

According to physicists, linear thermodynamics describes the stable, predictable behavior of systems tending toward the minimum level of activity compatible with the fluxes that feed them. The fact that equilibrium thermodynamics may be described in terms of a potential, the entropy production, implies that, both in evolution toward equilibrium and in evolution toward a stationary state, initial conditions are forgotten. Whatever the initial condition, the system will finally reach the state determined by the imposed boundary conditions. As a result, the reaction of such a system to any change in its boundary conditions is entirely predictable.

In the range of linear nonequilibrium entropy production is just such a function: if a system is perturbed, entropy production will increase, but the system reacts by returning to the state at which its entropy production is lowest. However, it is important to recognize that the equilibrium state in isolated system has been stable for certain period of time when corresponding to maximum production of entropy. Based upon this assumption it can be assumed that North Korean political system was in "the state corresponding to thermodynamics equilibrium" or "the steady state corresponding to a minimum entropy production in linear nonequilibrium thermodynamics in the period from early 1960's to late 1970's.

On the other hand, however, if one assumes that North Korean political system was to be in the stationary state of minimum entropy production for given external constraints which prevents system from reaching equilibrium, the functioning of the system might tend to approach as near as possible the equilibrium state, that is the complete degradation. However, it is theoretically impossible to think that North Korean political system could lead to such a state. Here it can be assumed that North Korean system has been functioning under the critically stressful condition due to the difficulty of internal problems and the rapid changing environment in the Far Eastern international system in late 1980's. In other words, the system could maintain its stability by the totalitarian ruling, which might approach the maximum entropy state.

Since North Korean system had to manage cope with the internal stress and to adapt to the irreversible change in the international environment, the state which the system had exhibited was very turbulent. In effect, these factors had mainly reflected in its internal politics and aggressive policies toward South Korea for more than three decades. Here one can say that the-far-from equilibrium thermodynamic state of North Korean political system could be closely related with its characteristic functioning of the most rigid totalitarian system and the complex pattern of interactions between North and South Korea.
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NONEQUILIBRIUM THERMODYNAMIC STATE OF INTERACTIONS BETWEEN NORTH AND SOUTH

The cause of the division on the Korean peninsula was essentially external, having to do with the failure of Allied diplomacy during the World war II and the expansionist aims of the Soviet Union. During the past three decades the mutual hostility and distrust derived from the ideological conflict between North and South Korea has persisted. This ideological struggle has led to the Korean War in 1950. Although there were several attempts of the North-South dialogue, tension has been persisting on the Korean peninsula.

Thus this antagonistic situation may be similar to the Richardson process of mutually increasing hostility. According to the Richardson model, a vicious circle sets in a dyadic competition. When one country is threatened by another, the threatened would undertake a defensive response; such a situation would necessitate a further military build-up on the initially aggressive power. The arms race and its consequent tension would rise in a such situation. This is what was happening in Korea because of North Korea's belligerent policies and behaviors. In this sense the relation between both sides could be characterized by a zero-sum game situation.

As North Korea persists in its policy of unification through violence or tricky tactics, the state of interactions between North and South is a typical "pure conflict game." Pure conflict can be amplified by a war of extermination. The zero-sum notion of mutual antagonism between both sides requires that the interests of one can be advanced only at the expense of those of the others. This survival game of both sides can lead to the mixed motive game (conflict and cooperation) by a dynamic mechanism of the internal and external environment.

But if we look at the external environment of interactions between both sides, the Korean peninsula was in the relatively stable condition in the Far Eastern international environment. In the period from early 1960's to late 1970's it can be observed that multiplicity of relationship among the United States, the Soviet Union, China, and Japan, afforded a greater number of interaction opportunities. The number of possible dyadic relationships in a multipolar system was very great, and it rose in increasing proportion to the number of states(poles). This plentitude of interacting partners means that there was a greatly reduced danger of mutually reinforcing antagonism among the main powers, which had indirectly reduced the war potential on the Korean peninsula. Since world politics would not be a zero-sum game, action by one nation would not require an offsetting response by its single opponent. Instead of the mutual reinforcement of hostility expressed in terms of positive feedback among the major powers, there might be the dissipation of cooperation through negative feedback in the period from early 1960s to late 1970s.

However, the balance of power system among the major powers is intrinsically unstable unless an effective balancer must be both self-restrained and quick in imposing vigorous
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restraints on others. As Liska points out, uncertainty marks the entire system. The dynamics of equilibrium is by its very nature unstable and precarious. 3) The operation of the balance of power as a principle of policy is unpredictable. The changes in conditions that may make the balance of power international system unstable are: the existence of an essential national actor who does not play according to the rules of the game. Consequently, instability may result although the major powers have no intention of altering the balance of power system. 4)

In terms of systems dynamics, any stimulus may induce the deviation amplifying mutual causal interactions among the major powers. At any one time a random initial kick produces a deviation into a certain direction. Deviation amplification takes over and this deviation is amplified consistently in the same direction. This is a typical case of the positive amplifying feedback situation. Because of the belligerency of north Korea, the chance of upsetting the existing balance of power system in the Far East has become greater than before. From the modern theory of thermodynamic perspective, this situation can be in the nonequilibrium thermodynamic state of interactions between North and South.

In nonequilibrium thermodynamics there are the reciprocity relations. Reciprocity relations have been the most important dynamics in the thermodynamics of irreversible processes. Physicists discovered that there are the thermodynamic potentials whose extrema correspond to the states of equilibrium toward which thermodynamic evolution tends irreversibly. The thermodynamics of a close-to-equilibrium systems also introduces a potential function. It suggests that this potential is the entropy-production itself. The theorem of minimum entropy suggests that the state of interactions between North and South evolves toward a stationary state characterized by the minimum entropy production compatible with the constraints imposed upon the boundary conditions in the period from early 1960s to late 1970s. These constraints are determined by the boundary conditions of both North and South systems as well as the state of interactions between both sides over time. They may correspond to a flux of energy or information that continuously support a series of reactions and eliminate their products. The stationary state toward which the state of interactions evolves is then necessarily a nonequilibrium state at which dissipative processes with nonvanishing rates occur.

From the theoretical viewpoint of thermodynamic evolution, it can be assumed further that the stationary state of interactions between North and South continuously increased the entropy of its environment. The particular stationary state toward which the state of interactions tended was the one in which this transfer of entropy to the environment was as small as is compatible with the imposed boundary conditions. On the Korean peninsula, the equilibrium state corresponded to the special case that occurred when the boundary conditions allowed the vanishing entropy production until late 1970s. When the boundary conditions prevent the state of interactions from going to equilibrium it does the next best thing; it goes to a state of minimum entropy production, that is, to a state as close to equilibrium as "possible."

It can be said that the dynamic interactions between North and South Korea were in the equilibrium or nonequilibrium thermodynamic state for more than 40 years by the
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armistice and delicate military balance on the Korean peninsula. In other words, the relatively stable peace could be maintained by the joint efforts of both South Korea and the United States troops even though North Korea has violated very often the provisions of the armistice. It can be assumed that the armistice and United States troops on the Korean peninsula have been playing the role of the attractor to maintain stability, namely, peaceful situation.

However, as North Korea attempted deliberately to disrupt the status quo on the Korean peninsula, the equilibrium state of interactions between North and South has been often threatened by North Korean unilateral actions. In relation to this delicate situation in terms of equilibrium or near-equilibrium system one can assume that the most important consequence of assuming equilibrium conditions is the Second Law of Thermodynamics which states that the world is irreversibly and monotonously approaching a state of universal disorder, or maximum entropy. The more North Korea disrupts the status quo, the more the Korean peninsula unstabilizes. As North Korea showed its aggressive actions, the state of interactions between both sides was reflected in the unstable pattern of the far-from-equilibrium.

FAR-FROM-EQUILIBRIUM STATE OF INTERACTIONS BETWEEN NORTH AND SOUTH

For more than 40 years North Korea has showed its zigzag course in dealing with South Korea and the United States, which can be characterized by the Communist's typical revolutionary strategy and tactics. On one occasion North Korea preferred to pursue its policy of appeasement but on other occasion showed very tough policy toward South Korea by its principles military conflict of revolutionary tactics. During the last four years North Korea's pattern of policy reflected such a fluctuating course of actions and reactions which no one could predict.

North Korea from time to time attempted to threaten the status quo on the Korean peninsula by provoking military conflict or violating the armistice provisions in the Demilitarized Zone or bluffing offensive operation. This kind of calculated provocative actions seemed likely to disrupt the fragile peace on the Korean peninsula.

In late 1991 and early 1992, the two Koreas negotiated and signed an agreement calling for reconciliation, nonaggression, cooperation and denuclearization of the peninsula. But the agreement broke down once North Korea threatened to pull out of the Nuclear Nonproliferation Treaty in 1993. This surprising act furthermore gave rise to tension on the Korean peninsula. Thereafter North Korea openly announced its intention to threaten South Korea. What is most concerned with South and the United States was North Korea's nuclear capability to threaten South and to change the Far Eastern international system. After a long tedious negotiation North Korea was successful to reach the Framework Agreement with the United States by its brinkmanship diplomacy in 1994. South was making necessary adjustments to its policy toward North Korea by suggesting its policy guidelines for actively pursuing economic cooperation with North Korea and for supporting North's participation in the Asia-Pacific Economic Cooperation(APEC) in
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the hope that such moves will induce North Korea to open up and to facilitate inter-
Korean reconciliation and cooperation. But North Korea is still desperate not only to
normalize its relationship but also to have a peace treaty with the United States.

In April 5-7, 1996 North Korea sent heavily armed troops into the joint security area in
the Demilitarized Zone, a violation of the armistice. As a foreign observer pointed out,
the situation on Korean peninsula is potentially so risky that it may lead to the crisis. In
April 17, 1996 with their proposal for peace talks with North Korea, President Bill
Clinton and South Korean President, Kim Yong Sam have broken new ground and raised
a spark of hope that the last front of the Cold War will finally see an ultimate
reconciliation. The two leaders publicly invited North Korea to take part in peace talks
involving four countries - the two Koreas, the United States and China. Japan and China
responded positively to the proposal. Russia, which would be left out of the talks, has
expressed an interest in having a role.

It can be argued that a constellation of factors - the economic troubles and famine in
North Korea and election year politics in the United States and South Korea - make this a
propitious time to try again to achieve the elusive peace that would formally end the
Korean War. However, it is pointed out the United States and South Korea are gambling
that Pyongyang will come to the table to help ease its economic woes, which include
famine and factories being shuttered for lack of fuel. The immediate significance of the
new proposal is that in agreeing to four talks, South Korea has relaxed its insistence that
any peace treaty be negotiated only by the two Koreas. On the other hand, as North Korea
has suffered from a serious shortage of food because of flood and drought, North Korea is
very eager to ease the people's misery from famine. North Korea has often asked the
United States, Japan, South Korea, and U.N. to have the humanistic assistance without
compensation. Some observer says that because of their deepened economic and political
crisis, they may provoke war by their self-destructive action against the South. The way
North Korea showed its responses to South Korea is likely to lead to the far-from-
equilibrium state of relation between North and South.

In the theory of nonlinear thermodynamics, the far-from-equilibrium state of interactions
of both sides may still evolve to some steady state, but in general this state can no longer
be characterized in terms of some suitably chosen potential (such as entropy production
for near-equilibrium state). As long as the existence of armistice and the presence of the
United States troops play very important role as the attractor to keep peace, the state of
interactions between North and South Korea can be defined by the minimum of a
potential such as the entropy production. Thereby the stability on the Korean peninsula
could be guaranteed. Furthermore, Prigogine and Stengers stressed that when the
thermodynamics forces acting on a system become such that the linear region is
exceeded, however, the stability of the stationary state, or its independence from
fluctuations, can no longer be taken for granted. Stability is no longer the consequence of
the general laws of physics. It is necessary to examine the way a stationary state reacts to
the different types of fluctuation produced by the system or its environment.

At this point one can apply some propositions of the far-from equilibrium
thermodynamics to the present state of interactions between North and South. In a
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deoretical sense, the fluctuations started off by the four talks proposal will give some impacts upon North Korean government's position in the near future. As North Korean leaders are very cautious to deal with the United States in the multiple channels of negotiations, their statements are very ambiguous. However, it is evident that they show gradually some positive nuance in their statements but to capitalize adroitly the four talks proposal to maximize their gains in the bargaining table. Thus it can be assumed that the nonequilibrium state of North Korean political system and interactions between North and South Korea can lead to the far-from-equilibrium state. If it can be assumed that the instability in the state of interactions between North and South is exhibited, one has to ascertain the threshold, the distance from equilibrium, at which fluctuations may lead to new behavior, different from the 'normal' stable behavior characteristic of equilibrium or near-equilibrium system on the Korean peninsula.

Again, it can be suggested that phenomena of this kind can be seen in the field of hydrodynamic and fluid flow. For instance, it has been long known that once a certain flow rate of flux has been reached, turbulence may occur in a fluid. Indeed, while turbulent motion appears as irregular or chaotic in the macroscopic scale, on the contrary, highly organized on the microscopic scale. The interactions of a system with outside world, its embedding in nonequilibrium conditions, may become in this way the starting point for the formation of new dynamic states of matter-dissipative structure.

The mechanism responsible for the instabilities, and accordingly for the existence of bifurcations with creation of dissipative structures arises from the existence of fluctuations. Every physical macroscopic system necessarily undergoes local fluctuations. As an offset, instabilities correspond to an amplification of fluctuations which permits them to attain macroscopic value. Through this mechanism, a dissipative structure may be interpreted as a giant fluctuation stabilized by the energy and mass flows as imposed by the boundary conditions.

As de Green suggests, movement of the system away from equilibrium, associated with some internal irreversible processes, increase the rate of dissipation as measured by the entropy production. Instability, triggered by nonequilibrium environmental conditions, leads to further dissipation and entropy production; this in turn leads to the appearance of further instabilities. Farther from equilibrium, the probability increases that the system, with its internal processes, is unstable with respect to given fluctuations. It is characterized by nonequilibrium conditions leading to the system's crossing a critical threshold. Beyond this threshold the system becomes structurally unstable with regard to the fluctuations, which leads to increased dissipation and, in a positive-feedback loop, change in the threshold. Thus, there is an acceleration of irreversible evolution over time.6)

If North Korea attempts to normalize its relation with the United States or to show its willingness to the four talks proposal or to open its dialogue with South, North Korea may lead to the bifurcation process in the near future. It can be said that in nonequilibrium thermodynamics bifurcation refers to the behavior of complex systems in states and conditions that are far from equilibrium. Bifurcation occurs when such systems are destabilized in their environments, stressed out of states in which they could
comfortably remain virtually forever. When a system is stressed beyond certain threshold limits, it shifts from one set of attractors to another and then behaves differently. It is at the point of transition that bifurcation takes place. The system no longer follows the trajectory of its initial attractors, but responds to new attractors that make the system appear to be behaving randomly. The outcome of a bifurcation is determined neither by the past history of the systems nor by their environment, but only by the interplay of more or less random fluctuations in the chaos of critically destabilized systems. 7)

One or another of the fluctuations that rock such systems will suddenly nucleate. The nucleating fluctuation will amplify with great rapidity and spread to the rest of the system. In a surprisingly short time, it dominates the system's dynamics. The new order that is then form from the womb of chaos reflects the structural and functional characteristics of the nucleated fluctuation. Whatever their origins, the instabilities are likely to spread to all sectors and all segments of society. They then open the door to rapid and fundamental change. They are the result of the opening of underdeveloped social and economic systems as they are suddenly exposed to full impact of global flows of information, technology, trade, and people. When politically isolated or semi-isolated systems open up, they are caught up in the vortex of the globalizing modern world.

If one considers North Korea as a partially open system in the state of nonequilibrium or far-from-equilibrium, there will be a possibility of system change, which can be induced by dissipative structure. "If systems of any kind are in a sufficiently nonequilibrium state, have many degrees of freedom and partially open to the inflow of energy (information) and / or matter, the ensuing instabilities do not lead to random behavior. Instead, they tend to derive the system to a new dynamic regime which corresponds to a new state of complexity." 8)

In such a transition, North Korea acquires new margins to produce entropy, new possibility for action. As the system approaches closer to maximum entropy, which corresponds to the lowest state of order, it would approach an equilibrium state of rest or collapse. If it does happen, the far-from-equilibrium state of interactions between both sides will lead to a drastic unification process. If North Korea, in contrast, is to be a partially open nonequilibrium system, the system moves through a sequence of mutatory transitions to new regime which generates the conditions for renewed high entropy production within a new regime, and thus open up the possibility for the survival activity. Now it is clear that North Korea faces a serious dilemma to cope with the critically stressful situation in its survival game.

REFERENCES

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