Culture Coherence and Regional Economic Cooperation in Northeast Asia

Len-kuo Hu*
National Chengchi University

Abstract

China (including Hong Kong), Japan, South Korea and Taiwan constitute the sphere in which Chinese characters are (or were) used and the ideology of Confucianism (or its modification) is the common denominator in determining the working attitude of people within the sphere. The emergence of an economic cooperation, or more specifically a regional economic agreement, compatible with this ideology is not only promising but inevitable. This study is intended to provide a rationale to justify the role of culture in forming an economic cooperation among countries. By endogenizing a representative individual's willingness to cooperate through its direct impact on his utility function and incorporating the factors of cooperative attitude and a country's output share in the Ricardian type of production function, this model is able to describe the cyclical fluctuation of each country's willingness to cooperate. This study concludes that except for perfect alignment of the initial cooperativeness among its constituents, the dynamics of each country's cooperative attitude and the associated economic performance is very irregular and eventually leads to the collapse of the regional economic cooperation.

Keywords: Culture Coherence; Regional Economic Agreement; Prospect theory; Northeast Asian Economy; Cyclical Cooperation

JEL: D2, D9, L2, O5, P1

* Department of International Trade, National Chengchi University, Taipei, Taiwan;Tel: +886-2-29387469; Fax: +886-2-29387699; e-mail address: lkhu@nccu.edu.tw. Part of this study was conducted when I was a visiting scholar at the International Centre for the Study of East Asian Development (ICSEAD), Kitakyushu, Japan. I am grateful to Erbiao Dai, Susumu Hondai, Nazrul Islam, Xizhe Peng, Sadayuki Takii, Shoichi Yamashita and Kazuhiko Yokota for their valuable suggestions and to ICSEAD for financial support.

1. Introduction

China (including Hong Kong), Japan, South Korea and Taiwan constitute the sphere in which Chinese characters were used and the ideology of Taoism and Confucianism (or its modifications) is the common denominator forming the mental attitude of people within these countries. Max Weber in his “Protestant Ethic and the Spirit of Capitalism” said that given the ideology and ethic, any type of economy which necessitates the people’s possessing an ethos incompatible with that ethic will not develop; rather the emergence of an economy compatible with this ideology and ethic is inevitable. It is from this standpoint that the prospect of economic cooperation among these countries is sanguine.

Futurologist Herman Kahn has labeled the cultures of the East Asian countries “neo-Confucian”—that is, rooted in the teachings of Confucius. Kahn’s neo-Confucian hypothesis is that the countries of East Asia have common cultural roots going far back into history, and that under the world-market conditions of the past 40 years this cultural inheritance has constituted a competitive advantage for successful business activity. Based on the 20-country (China was excluded) survey conducted by Geert Hofsted and Michael Harris Bond, they found that Hong Kong (1), Taiwan (2), Japan (3) and South Korea (4) have the highest scores for Confucian Dynamism. The latter refers to three types of expected social behavior: behavior toward seniors or juniors, toward the group, and as a function of one’s sex. Therefore, I select China, Hong Kong, Taiwan, Japan and South Korea as the candidate countries to form the Northeast Asian economic cooperation pact based on the Confucian ideology.

The tools of orthodox economic theory were constructed to explain the gains from trade between consumers and firms through an effective market operation. However, due to the limitation of markets, internal organization as an engine of growth has become more prevailing not only for multinationals but also for countries. Recently anti-globalization movement undermines the free-trade principle of WTO. There are instances where a group of countries will decide to completely eliminate all tariffs between them, without eliminating tariffs on goods imported from the rest of the world. This is so called regional agreement between countries involved. There must be some rationale behind the development of internal organization and the prevalence of regional economic agreement, especially its motivation, size and dynamic behavior.

My study is intended to provide a rationale to justify the importance of culture factor in forming an economic cooperation among countries. The literature about regional economic relation or agreement is abundant. Most of these studies explore the economic gain or loss from the agreements like CUSFTA, NAFTA or MERCOSUR etc. without any specific consideration of cultural impact. My study pinpoints the role of culture coherence in the success of long-term economic integration. It is important that the member countries of the community should have pretty much the same ethos. Although there is a difference of ethos between the countries within this community, the difference is a difference within the same Confucian content – comparable to the difference between Catholic and Protestant within the EU. The difference between Northeast Asia and Southeast Asia are far greater. Except for Vietnam, the countries of Southeast Asia lie outside the Confucian sphere, and have been marketed influenced by the culture of India and Western societies.

The current world trading system is at a crossroad. While the case for free trade is robust and is capable of meeting the recent objectives from civil society and labor unions as well, the headlong rush into preferential trade has left free trade in a sorry state. There are instances where a group of countries decide completely eliminate all tariffs between them, without eliminating tariffs on goods imported from the rest of world. This is called a regional agreement or preferential agreement between countries involved. These agreements violate the “most favored nation” (MFN) principle, since the countries within the agreements are treated different from those outside. But such agreements are permitted under Article XXIV of the GATT (now known as WTO), provided that “the duties with outside parties shall not on the whole be higher or more restrictive than the general incidence of the duties…prior to the formation.” The myriad FTAs around the world are described by Jagdish Bhagwati (2002) as a spaghetti bowl: a messy maze of preferences as FTAs formed between two countries, with each having bilaterals with other and different countries, the latter in turn bonding with yet others, each in turn having different rules of origin for different sectors.

A country would behave like a representative individual if we could ignore the problem of aggregation. Henceforth, I will treat the issue of inter-country’s relationship as the one of inter-person’s, and focus on the general theory of cooperation or organization. Different structure of cooperation provides different incentives to the individuals (or member countries) of the cooperation. The bottom-up

system is primarily driven by an individual's self-interest. The organization thus formed provides a platform to accomplish the benefit of cooperation based on a Nash non-cooperated solution concept. On the other hand, the individuals in the top-down system give up more of their own freedom of choice in return for a greater joint benefit. The individuals distribute more of their utilities toward the joint benefit rather than their own benefit. The organization is thus constructed on a more cooperated basis. In general, the proportion of an individual's utility put on the organization as a whole (altruism) versus the proportion put on the individual himself should be dynamically determined in the system.

This study attempts to provide a model explaining the dynamic behavior of an individual's cooperativeness and the evolution of an economic system based on the implications of prospect theory developed by Tversky and Kahneman (1979). According to the prospect theory, the objective function that a representative individual is intended to achieve is defined to be the gain or loss relative to some reference point. If the individual accomplishes more gain than loss in the past, his reference point will be raised by the Bayesian learning rule, thereby making the further gain less likely and bringing in the seed of withdrawing from his initial economic choice (e.g., backing up from the regional agreement). Analogously, when the individual suffers from more loss than gain and refrains from making an initial choice, his reference point will become lower and lower and facilitate the gain from his further choice.

The formation of reference point in determining the gain or loss from advancing a relation with its counterpart is critical to overturn an initial decision and result in a cycle. According to the experience of our learning process, our reference point is closely related to our past history and the position of our peers. As for the source of value from which potential gain or loss might be derived, it is defined from the content of each issue. For instance, if we would like to evaluate the consequence of joining a regional agreement, either the factor ratio difference (as in the Heckscher-Ohlin model) or the diverse relative comparative advantage (as in the Ricardo model) among the member countries in the region is the driving force that causes the gain or loss of the value function.

This study will reexamine the human decision by extending the implication of prospect theory in several dimensions. First of all, I categorize two different forces that drive the formation of our daily decision, that is, conforming (or cooperative) force vs. centrifugal (or self-loving) force. The former facilitates us to adapt for the

outer environment by conforming our decision to the majority of society. The reference points or benchmarks for our decision are the imprints on our minds that are cultivated gradually from our education, experience, culture and history. To secure our survivorship we tend to seek a mental and physical safe harbor by abiding by the majority rule. The latter (centrifugal or self-loving) force accounts for the formation of self-identification. By purposefully distinguishing ourselves from others we are able to ascertain our own identity and pride. Under the patronage of property and human right an individual's character can be nurtured and developed. The resulting idiosyncrasy of our society contributes to the innovation and the continuation of our growth.

Secondly, this study suggests a theory of organization that is able to relate its performance to the degree of compactness or coherence among its components. Akin to the concept of synchronization between two oscillators (Pikovsky, Rosenblum and Kurths, 2001), I measure the degree of compactness by the cooperation attitude embraced by all its members. It is a well-known physical phenomenon that whenever the phase difference between two interacting oscillators is not too big, a common congruous phase will be developed eventually. The speed of convergence is closely related to the degree of coherence among the components. Analogously, if the constituents of an organization have embraced a common goal or mission like most of the Japanese enterprises, their cooperative momentum will be more in tandem and more prone to developing into a common cooperation pattern. When the degree of coherence or correlation among the constituents exceeds some threshold, we will observe the formation of synchronization. As we change the correlation coefficient (or cooperation coefficient in my model) from null to one, the coupled system will evolve from strongly asynchronized, weakly asynchronized, to weakly synchronized, and strong synchronized. The generalization of this model can pave the way for understanding the corporate behavior with different degree of coherence among its members..

The third element of this study is to endogenize the degree of coherence among the constituents in an organization. Each individual will dynamically choose his weight associated with the aforementioned conforming (cooperative) force and centrifugal (self-loving) force in the determination of his ultimate welfare. If he puts more weight on the conforming force, he can gain more from affiliating with an organization as a result of increased coherence with his colleague but weaken his incentive to innovate and start his own business. If he favors more on the centrifugal force, he will gain more from his own way of life (business) than the shared benefit of

a giant corporation. Depending on the adjustment of his reference point, we can depict a dynamic cycle of cooperation (more weight on conforming force) and non-cooperation (more weight on centrifugal force).

I lay out the basic model in the section 2. The optimal cooperative strategy for each individual or member country is derived in the section 3. A computer simulation of the model is conducted in the section 4. Section 5 applies this model to the formation of economic cooperation in the Northeast Asian countries. Some concluding remarks are made in the section 5.

2. Basic Model

In the western economies, economic activities are driven by self-interest. Any interaction with others is described on the non-cooperated basis. Even the existence of cooperative behavior can also be illuminated by the spur of our self interest. In other words, there would be no such things as unconditional cooperation. In this study, I consider a country's welfare is represented by her representative individual's utility that incorporates the measure of harmonious relationship with the outer world in addition to the conventional self-interest argument.

For simplicity it is assumed that there are two countries (A and B) and two goods (X and Y). Based on a Ricardian economy, each country is characterized by his productivity in X and Y. For instance, country A (B) can produce α_X^A (α_X^B) of X good and α_Y^A (α_Y^B) of Y good per unit of labor input. Initially country A has a relatively comparative advantage in producing X good while country B has an advantage in producing B, i.e., $\alpha_X^A / \alpha_Y^A > \alpha_X^B / \alpha_Y^B$.

In an autarkic economy each country produces both goods with the proportion depending on the preference of her representative individual. With the arrangement of free trade agreement with the other country, she will now specialize in the production of the good that caters to her comparative advantage, that is, country A specializes in producing good X while country B in good Y. When a country decides to cooperate with her trading partner in the free trade zone, her working attitude and productivity as measured by $\alpha_i^j (i = X \,\&\, Y,\ j = A \,\&\, B)$ will change accordingly. I assume that the productivity of each country is a positive function of the degree of her cooperativeness (η) and her share of the total output in the free trade zone (S). More

specifically, η measures the proportion of a country's representative utility that she is willing to place on the welfare of her trading partner. The greater η is, the greater concern she will give toward the overall performance of the FTA and the more cooperative she will become. It is also apparent that the greater share (S) of the total output for this country, the more motivated the country's representative individual will be to work hard for the FTA as a whole. Both η and S are changing in time in my model (see below). Therefore I can depict a country's productivity as

$$\alpha_i^j(t) = \alpha_i^j(\eta_t^j, S_t^j), i = X \,\&\, Y,\ j = A \,\&\, B, \text{ with the property that}$$

$$\alpha_{i\eta}^j \equiv \frac{\partial \alpha_i^j}{\partial \eta_t^j} > 0 \quad \& \quad \alpha_{iS}^j \equiv \frac{\partial \alpha_i^j}{\partial S_t^j} > 0.$$

Each country (say country A) will maximize the following inter-temporal utility by choosing the optimal weight (η_t^A) of the other's utility in her own utility for all time t $(t = 1,...\infty)$:

(1) $$\sum_{t=1}^{\infty} \delta^t (U^A(t) - \gamma U^A(t-1)), \text{where}$$

$$U^A(t) = (1-\eta_t^A)\left[\beta * \ln\left(\alpha_X^A(t) * S_t^A\right) + (1-\beta) * \ln\left(\alpha_Y^B * (1-S_t^B)\right)\right] + \eta_t^A\left[\beta * \ln\left(\alpha_X^A(t) * (1-S_t^A)\right) + (1-\beta) * \ln\left(\alpha_Y^B * S_t^B\right)\right]$$

$U^A(t-1)$ can be similarly derived. δ denotes the representative individual's time preference. We have taken a logarithm of the utility level that is of Cobb-Douglas type with parameter β. When country A maintains a relative comparative advantage in producing good A (so country B has an advantage in good B), S_t^A stands for country A's share of both good X and good Y in the joint production at time t while S_t^B stands for country B's share at time t. The first term in $U^A(t)$ represents the utility derived from the direct allocation to country A based on her productivity contribution while the second term reflects her altruistic satisfaction from the allocation to her trading partner (country B). In case that country A's relative comparative advantage for good A and good B is reversed, she will shift to specialize in the production of good B instead. Then the $U^A(t)$ above will change to be

$$U^A(t) = (1-\eta_t^A)\left[(1-\beta) * \ln\left(\alpha_Y^A(t) * S_t^A\right) + \beta * \ln\left(\alpha_X^B * (1-S_t^B)\right)\right] + \eta_t^A\left[(1-\beta) * \ln\left(\alpha_Y^A(t) * (1-S_t^A)\right) + \beta * \ln\left(\alpha_X^B * S_t^B\right)\right]$$

The subtraction of $U^A(t-1)$ from $U^A(t)$ in the above inter-temporal utility function is considered so that I can examine the implication of the prospect theory. In other words, the reference point for the person A is her previous utility level. The parameter $\gamma\ (0 \le \gamma \le 1)$ is written to measure the degree of adherence for this countrry's behavior to abide by the prospect theory. When $\gamma = 1$, she is only concerned with the relative change of utility by completely ignoring the absolute level of her present utility. When $\gamma = 0$, this model returns to the conventional economic setting in which the individual is only interested in her absolute utility level. When $0 < \gamma < 1$, this representative individual will pay attention to both absolute and relative utility level with the weight of $1-\gamma$ and γ respectively.

3. Optimal Choice of Cooperative Strategy

Each country will choose her best cooperative strategy so as to maximize her inter-temporal utility (1). According to the Euler equation, we can derive the first order condition for country A as

$$\frac{dV^A(t)}{d\eta^A_{t-1}} + \delta_1 \cdot \frac{dV^A(t-1)}{d\eta^A_{t-1}} = 0. \tag{2}$$

where $V^A(t)$ measures the gain or loss for country A in period t. Similarly $V^A(t-1)$ measures the gain or loss in period t-1. That is, $V^A(t) \equiv U^A(t) - \gamma U^A(t-1)$ & $V^A(t-1) \equiv U^A(t-1) - \gamma U^A(t-2)$.

To analyze the equation (2) we first need to examine the terms $\frac{dS^A_t}{d\alpha^A_X(t-1)}$, $\frac{d\alpha^A_X(t)}{d\eta^A_{t-1}}$, $\frac{d\alpha^B_Y(t)}{d\eta^A_{t-1}}$ and $\frac{d\alpha^A_X(t-1)}{d\eta^A_{t-1}}$ in the case that country A specializes in the production of good X or the terms $\frac{dS^A_t}{d\alpha^A_Y(t-1)}$, $\frac{d\alpha^A_Y(t)}{d\eta^A_{t-1}}$, $\frac{d\alpha^B_X(t)}{d\eta^A_{t-1}}$ and $\frac{d\alpha^A_Y(t-1)}{d\eta^A_{t-1}}$ when country A specializes in the production of good Y. Initially I assume that country A has a comparative advantage and specializes in producing A. The share of both good X and good Y attributed to country A in the joint FTA at time t is based on the relative productivity of country A in the FTA in at time t-1, that is,

$S^A_t = \frac{\alpha^A_X(t-1)}{\alpha^A_X(t-1) + \alpha^B_Y(t-1)}$. So the share of country B becomes $S^B_t = 1 - S^A_t$.

Therefore,

$$\frac{dS_t^A}{d\alpha_X^A(t-1)} = \frac{\alpha_Y^B(t-1)}{(\alpha_X^A(t-1)+\alpha_Y^B(t-1))^2}.$$
$$\frac{dS_t^B}{d\alpha_X^A(t-1)} = \frac{-\alpha_Y^B(t-1)}{(\alpha_X^A(t-1)+\alpha_Y^B(t-1))^2}.$$

Moreover,

$$\frac{d\alpha_X^A(t-1)}{d\eta_{t-1}^A} = \alpha_{X\eta}^A(t-1)$$

$$\frac{d\alpha_X^A(t)}{d\eta_{t-1}^A} = \alpha_{XS}^A(t)\cdot\frac{dS_t^A}{d\alpha_X^A(t-1)}\cdot\frac{d\alpha_X^A(t-1)}{d\eta_{t-1}^A}$$
$$= \frac{\alpha_{XS}^A(t)\cdot\alpha_{X\eta}^A(t-1)\cdot\alpha_Y^B(t-1)}{(\alpha_X^A(t-1)+\alpha_Y^B(t-1))^2}$$

Also, country A's cooperativeness in the previous period, η_{t-1}^A, can affect country B's productivity in the present period, $\alpha_Y^B(t)$, through the indirect impact on output share, S_t^B. Therefore, we can get

$$\frac{d\alpha_Y^B(t)}{d\eta_{t-1}^A} = \alpha_{YS}^B(t)\cdot\frac{dS_t^B}{d\alpha_X^A(t-1)}\cdot\frac{d\alpha_X^A(t-1)}{d\eta_{t-1}^A}$$
$$= \frac{-\alpha_{YS}^B(t)\cdot\alpha_{X\eta}^A(t-1)\cdot\alpha_X^B(t-1)}{(\alpha_X^A(t-1)+\alpha_Y^B(t-1))^2}$$

The expressions for $V^A(t)$ and $V^A(t-1)$ can be simplified as

$$V^A(t) = \beta\cdot\left[\ln\alpha_X^A(t)-\gamma\cdot\ln\alpha_X^A(t-1)\right]+(1-\beta)\cdot\left[\ln\alpha_Y^B(t)-\gamma\cdot\ln\alpha_Y^B(t-1)\right]$$
$$+(1-\eta_t^A)\cdot\left(\ln S_t^A-\gamma\ln S_{t-1}^A\right)+\eta_t^A\cdot\left(\ln S_t^B-\gamma\cdot\ln S_{t-1}^B\right)$$

and

$$V^A(t-1) = \beta\cdot\left[\ln\alpha_X^A(t-1)-\gamma\cdot\ln\alpha_X^A(t-2)\right]+(1-\beta)\cdot\left[\ln\alpha_Y^B(t-1)-\gamma\cdot\ln\alpha_Y^B(t-2)\right]$$
$$+(1-\eta_t^A)\cdot\left(\ln S_{t-1}^A-\gamma\ln S_{t-2}^A\right)+\eta_t^A\cdot\left(\ln S_{t-1}^B-\gamma\cdot\ln S_{t-2}^B\right)$$

Therefore

$$\frac{dV^A(t)}{d\eta_{t-1}^A} = \beta\cdot\left[\frac{\alpha_{XS}^A(t)\cdot\alpha_{X\eta}^A(t-1)}{\alpha_X^A(t)}\cdot\frac{dS_t^A}{d\alpha_X^A(t-1)}-\gamma\cdot\frac{\alpha_{X\eta}^A(t-1)}{\alpha_X^A(t-1)}\right]$$
$$+(1-\beta)\cdot\left[\frac{-\alpha_{YS}^B(t)\cdot\alpha_{X\eta}^A(t-1)}{\alpha_Y^B(t)}\cdot\frac{dS_t^A}{d\alpha_X^A(t-1)}\right]+\left[\frac{1-\eta_t^A}{S_t^A}-\frac{\eta_t^A}{1-S_t^A}\right]\cdot\alpha_{X\eta}^A(t-1)\cdot\frac{dS_t^A}{d\alpha_X^A(t-1)}$$

and

$$\frac{dV^A(t-1)}{d\eta^A_{t-1}} = \beta \cdot \frac{\alpha^A_{X\eta}(t-1)}{\alpha^A_X(t-1)} - \left(\ln S^A_{t-1} - \gamma \cdot \ln S^A_{t-2}\right) + \left[\ln(1-S^A_{t-1}) - \gamma \cdot \ln(1-S^A_{t-2})\right]$$

By substituting the above expressions into equation (2), we can solve an optimal η^A_t as

$$(3A)\quad \eta^A_t = S^A_t(1-S^A_t)\cdot\left\{\frac{\beta\cdot\alpha^A_{XS}(t)\cdot}{\alpha^A_X(t)} - \frac{(1-\beta)\cdot\alpha^B_{YS}(t)}{\alpha^B_Y(t)} + \frac{1}{S^A_t}\right\} + \frac{S^A_t(1-S^A_t)/\alpha^A_{X\eta}(t-1)}{dS^A_t/d\alpha^A_X(t-1)}$$
$$\cdot\left\{\delta\left[\frac{\alpha^A_{X\eta}(t-1)}{\alpha^A_X(t-1)} - \left(\ln S^A_{t-1} - \gamma\ln S^A_{t-2}\right) + \left(\ln S^B_{t-1} - \gamma\ln S^B_{t-2}\right)\right] - \frac{\beta\gamma\alpha^A_{X\eta}(t-1)}{\alpha^A_X(t-1)}\right\}$$

If there exists a reversal of productivity comparative advantage between country A and country B at time t-1, i.e., $\frac{\alpha^A_X(t-1)}{\alpha^A_Y(t-1)} < \frac{\alpha^B_X(t-1)}{\alpha^B_Y(t-1)}$ which implies $\frac{\alpha^A_X(t-1)}{\alpha^A_X(t-1)+\alpha^B_Y(t-1)} < \frac{\alpha^A_Y(t-1)}{\alpha^A_Y(t-1)+\alpha^B_X(t-1)}$, then country A will start to specialize in the production of good Y and country B in the production of good B. As a result, $V^A(t)$ and $V^A(t-1)$ will become

$$V^A(t) = \beta\cdot\left[\ln\alpha^B_X(t) - \gamma\cdot\ln\alpha^B_X(t-1)\right] + (1-\beta)\cdot\left[\ln\alpha^A_Y(t) - \gamma\cdot\ln\alpha^A_Y(t-1)\right]$$
$$+ (1-\eta^A_t)\cdot\left(\ln S^A_t - \gamma\ln S^A_{t-1}\right) + \eta^A_t\cdot\left(\ln S^B_t - \gamma\cdot\ln S^B_{t-1}\right)$$

and

$$V^A(t-1) = \beta\cdot\left[\ln\alpha^B_X(t-1) - \gamma\cdot\ln\alpha^B_X(t-2)\right] + (1-\beta)\cdot\left[\ln\alpha^A_Y(t-1) - \gamma\cdot\ln\alpha^A_Y(t-2)\right]$$
$$+ (1-\eta^A_t)\cdot\left(\ln S^A_{t-1} - \gamma\ln S^A_{t-2}\right) + \eta^A_t\cdot\left(\ln S^B_{t-1} - \gamma\cdot\ln S^B_{t-2}\right),$$

where country A's production share at time t is redefined as $S^A_t(t) = \frac{\alpha^A_Y(t-1)}{\alpha^A_T(t-1)+\alpha^B_X(t-1)}$, and country B's share is equal to $S^B_t = 1 - S^A_t$.

Analogous to the preceding derivation, we can solve the optimal degree of cooperation for country A according to equation (2) as

$$(3B)\quad \eta^A_t = S^A_t(1-S^A_t)\cdot\left\{\frac{(1-\beta)\cdot\alpha^A_{YS}(t)}{\alpha^A_Y(t)} - \frac{\beta\cdot\alpha^B_{XS}(t)}{\alpha^B_X(t)} + \frac{1}{S^A_t}\right\} + \frac{S^A_t(1-S^A_t)/\alpha^A_{Y\eta}(t-1)}{dS^A_t/d\alpha^A_Y(t-1)}$$
$$\cdot\left\{\delta\left[\frac{\alpha^A_{Y\eta}(t-1)}{\alpha^A_Y(t-1)} - \left(\ln S^A_{t-1} - \gamma\ln S^A_{t-2}\right) + \left(\ln S^B_{t-1} - \gamma\ln S^B_{t-2}\right)\right] - \frac{(1-\beta)\gamma\alpha^A_{Y\eta}(t-1)}{\alpha^A_Y(t-1)}\right\}$$

where $\frac{dS^A_t}{d\alpha^A_Y(t-1)} = \frac{\alpha^B_X(t-1)}{(\alpha^B_X(t-1)+\alpha^A_Y(t-1))^2}$.

Similarly, we can derive the optimal choice of cooperativeness for country B when country A specializes in good X and country B specializes in good Y as follows:

$$(4A)\quad \eta_t^B = S_t^B(1-S_t^B)\cdot\left\{\frac{(1-\beta)\cdot\alpha_{YS}^B(t)}{\alpha_Y^B(t)}-\frac{\beta\cdot\alpha_{XS}^A(t)}{\alpha_X^A(t)}+\frac{1}{S_t^B}\right\}+\frac{S_t^B(1-S_t^B)/\alpha_{Y\eta}^B(t-1)}{dS_t^B/d\alpha_Y^B(t-1)}$$
$$\cdot\left\{\delta\left[\frac{\alpha_{Y\eta}^B(t-1)}{\alpha_Y^B(t-1)}-\left(\ln S_{t-1}^B-\gamma\ln S_{t-2}^B\right)+\left(\ln S_{t-1}^A-\gamma\ln S_{t-2}^A\right)\right]-\frac{(1-\beta)\gamma\alpha_{Y\eta}^B(t-1)}{\alpha_Y^B(t-1)}\right\}$$

where $S_t^B=\dfrac{\alpha_Y^B(t-1)}{\alpha_Y^B(t-1)+\alpha_X^A(t-1)}$, and $\dfrac{dS_t^B}{d\alpha_Y^B(t-1)}=\dfrac{\alpha_X^A(t-1)}{(\alpha_X^A(t-1)+\alpha_Y^B(t-1))^2}$.

And when there is a productivity reversal at time t-1, the optimal degree of cooperation for country B becomes

$$(4B)\quad \eta_t^B = S_t^B(1-S_t^B)\cdot\left\{\frac{\beta\cdot\alpha_{XS}^B(t)}{\alpha_X^B(t)}-\frac{(1-\beta)\cdot\alpha_{YS}^A(t)}{\alpha_Y^A(t)}+\frac{1}{S_t^B}\right\}+\frac{S_t^B(1-S_t^B)/\alpha_{X\eta}^B(t-1)}{dS_t^B/d\alpha_X^B(t-1)}$$
$$\cdot\left\{\delta\left[\frac{\alpha_{X\eta}^B(t-1)}{\alpha_X^B(t-1)}-\left(\ln S_{t-1}^B-\gamma\ln S_{t-2}^B\right)+\left(\ln S_{t-1}^A-\gamma\ln S_{t-2}^A\right)\right]-\frac{\beta\gamma\alpha_{X\eta}^B(t-1)}{\alpha_X^B(t-1)}\right\}$$

where $S_t^B=\dfrac{\alpha_X^B(t-1)}{\alpha_X^B(t-1)+\alpha_Y^A(t-1)}$, and $\dfrac{dS_t^B}{d\alpha_X^B(t-1)}=\dfrac{\alpha_Y^A(t-1)}{(\alpha_Y^A(t-1)+\alpha_X^B(t-1))^2}$.

4. Simulation of Cooperation Cycle

In this section I examine the pattern of cooperation cycle by computer simulation. To simplify the calculation, I choose a productivity function for both countries as follows:

$$\alpha_i^j(t)=\alpha_i^j(0)\cdot\frac{\eta_t^j+S_t^j}{\eta_0^j+1},\quad i=X\ \&\ Y,\ j=A\&B,$$

where the output share to each person needs to take into account the possible change in the relative comparative advantage in the production of each good as explained in the preceding section. The functional form of productivity revises each person's productivity at any period based on the ratio of his current levels of cooperation coefficient and output share to her original levels at time 0 when she hasn't joined the FTA.

I assume in the basic scenario the following value of exogenous variables contained in the equations (3A), (3B), (4A) and (4B) above:

(i) Assumption in basic scenario: $\beta=0.5;\ \gamma=1;\ \delta=0.9;\ \eta_0^A=0.75;\ \eta_0^B=0.25$,

and the initial productivity for both countries $\alpha_X^A(0) = 0.8, \alpha_Y^A(0) = 0.2, \alpha_X^B(0) = 0.2, \alpha_Y^B(0) = 0.8$

In other words, each countryn only concerns with the relative change of her utility level ($\gamma = 1$) in this basic scenario. Moreover, a symmetry of product preference ($\beta = 0.5$) and relative comparative advantage of production for each country ($\alpha_X^A(0)/\alpha_Y^A(0) = \alpha_Y^B(0)/\alpha_X^B(0) = 0.8/0.2$) is assumed so as to pinpoint the impact on cooperation cycle as a result of changes in the other factors.

With these assumptions of functional form and parameter value, I can depict the evolution of cooperation coefficient for each country, η_t^A & η_t^B, according to equations (3A), (3B), (4A) & (4B) in Table 1 and Figure 1 below.

[insert Table 1 and Figure 1 here]

We can see from the Figure 1 that country A and country B alter their cooperative attitude irregularly. Initially, country A works harder than country B due to her more willing to accommodate country B's output share into her own welfare ($\eta^A > \eta^B$). But country B will take advantage of country A's altruism and gain more welfare increase than country A. According to the implication of prospect theory, the greater welfare improvement in the current period will raise the hurdle of further welfare increase in the next period and dampen the cooperation attitude and productivity for both countries thereafter.

The time period of a cooperation cycle is ranged from 2 to 4 in an irregular pattern. We observe an enlargement of cycle amplitude as time goes on and there is not any indication that the dynamics of cycle will converge. If we compare the inter-temporal utilities of both countries in the beginning stages of cooperation (8 periods in the basic scenario), country B gains more from the join production than country A. By all means, the cooperation as a team elevates the welfare level of both countries from the one in the autarky.[1]

The pattern of cycle is affected by how a country visualizes her welfare in terms of the current absolute level or the relative change as compared to the past period. If

[1] The optimal amount of production in good X and Y at time t in the absence of FTA is determined by the tangent point of his linear production frontier function and utility function, which ends up with $X(t) = \beta \cdot \alpha_X(t)$ & $Y(t) = (1-\beta) \cdot \alpha_Y(t)$. The total inter-temporal utility can thus be derived by substituting these amounts into $U^A(t)$ & $U^B(t)$ for all t in the equation (1) above.

she puts more weight on her current absolute amount of utility, i.e., γ is smaller, the impact of prospect theory will become less severe. I depict this scenario in Table 2 and Figure 2 below:

(ii) Scenario with more weight on current absolute utility level:

$$\gamma = 0.2;\ \beta = 0.5;\ \delta = 0.9;\ \eta_0^A = 0.75;\ \eta_0^B = 0.25,$$

and the initial productivity for both countries $\alpha_X^A(0) = 0.8, \alpha_Y^A(0) = 0.2, \alpha_X^B(0) = 0.2, \alpha_Y^B(0) = 0.8$

[insert Table 2 and Figure 2 here]

It is apparent that the cycle is delayed, lengthened and dampened in its amplitude in the initial periods as the countries think less highly of the relative change in utility level than their absolute utilities. Nevertheless, the alternation of cooperation attitude between these two countries is still inevitable in this scenario. Akin to the basic scenario, country B who is less cooperative than country A can accomplish more gain from the joint production than country A. As usual, both countries improve their inter-temporal utility levels from the ones in an autarkic economy.

In the next scenario I consider the impact of the diversity of cooperation attitude between the two countries on the formation of cooperation cycle. Relative to the basic scenario, I narrow the difference in initial cooperation coefficients for country A and country B from $\eta^A = 0.75 \,\&\, \eta^B = 0.25$ to $\eta^A = 0.55 \,\&\, \eta^B = 0.45$.

(iii) Scenario with small difference in cooperation attitude :

$$\eta_0^A = 0.55;\ \eta_0^B = 0.45;\quad \beta = 0.5; \gamma = 1; \delta = 0.9,$$

and the initial productivity for both countries $\alpha_X^A(0) = 0.8, \alpha_Y^A(0) = 0.2, \alpha_X^B(0) = 0.2, \alpha_Y^B(0) = 0.8$

[insert Table 3 and Figure 3 here]

Table 3 and Figure 3 show that each country will align her working attitude with her trading partner more closely. The diversity of their cooperation cycles will become more distinctive after period 5. Moreover, country A who is a little more cooperative than country B will now overtake country B in the overall welfare improvement.

An extreme scenario when both countries are perfectly in tandem in their cooperation attitude is examined in Table 4 and Figure 4 below:

(iv) Scenario with cooperation attitude perfectly in tandem :

$$\eta_0^A = 0.5; \eta_0^B = 0.5; \quad \beta = 0.5; \gamma = 1; \delta = 0.9,$$

and the initial productivity for both countries $\alpha_X^A(0) = 0.8, \alpha_Y^A(0) = 0.2, \alpha_X^B(0) = 0.2, \alpha_Y^B(0) = 0.8$

[insert Table 4 and Figure 4 here]

An obvious conclusion derived from Table 4 and Figure 4 is that both countries become even more cooperative after a couple of rounds. An effect similar to the synchronization between two coupled oscillators takes place here. When two countries with a perfect alignment in their initial cooperative tendency will lead to a complete synchronization and create an stimulus (synergy) in their working attitude once they work together. The welfare improvement is the greatest among all scenarios.

Another implication from the scenario with perfect alignment is that the cycle will taper off gradually. The resulting common cooperation coefficient will converge to a constant eventually (0.9 in this scenario). This scenario presents an ideal cooperation structure. If an FTA is established by a group of countries embracing an identical belief in their cooperation attitude toward others, the overall productivity of this FTA will be buttressed by strong cooperative mentality mutually shared among its constituents. However, if there is a non-negligible disagreement of cooperation attitude among its constituents like the scenario in Table 3 and Figure 3, the cycle will no longer diminish. Instead we will observe a divergent and amplified cooperation cycle after a certain period. Eventually this cooperation agreement is doomed to break down.

5. Implications on the FTA in Northeast Asia

(5.1) Common Culture Factors among Northeast Asian Countries

The history of the Northeast Asian countries is interwoven with romantic relations and bitter turf fighting. Each episode of the histories of these countries is penetrated with a sophisticated emotion and can be witnessed as a sequel of cyclical cooperation and non-cooperation. Under the ebbs and surges of the historical wave, there flows the undercurrent of two common beliefs: Taoism and Confucianism.

Taoism is a religion indigenous to China itself. It is a mystic religion, deeply concerned with people's lives, souls and deaths, and with life after death. Confucianism, by contrast, is concerned with the mundane, with relations between one person and another, and the rules governing people's lives. Rather than a religion, it is more an ethic, or moral philosophy.

China was a country where dynasties continued to change as a result of revolutions, but despite these changes of dynasty China consistently remained a Confucian state. The imperial court consisting of the empress and large numbers of concubines attended by maidservants and eunuchs, however, almost always professed Taoism. Since the imperial court was the model for elite households, they, too, adhered to Taoism within the family, but conducted themselves in public along Confucian lines. The people in Taiwan and Korea who share the same ideology as those in China (including Hong Kong) were in that respect polytheists, in that they believed in more than one religion.

In Japan, the situation is hardly any different. What the Japanese have instead of Taoism is Shinto. Shinto claims to be the ancient indigenous religion of the country, as does Taoism in China. It is also the religion of the imperial family. In general, in Japanese households there are not many people who believe in Shinto, but they do not repudiate it either. In China early Taoism sought out mystics with powers relating to eternal youth and so it came to be known as *Shentaojiao (shintokyo* in Japanese), meaning 'the teaching of the way of the gods'. Afterwards the word *shen*, meaning gods, was removed, and it came be called just *taojiao*, meaning 'the teaching of the way of the gods'. In the case of the word for Japanese Shinto it is the final part of the compound, *jiao*, meaning 'teaching', that has gone. This might lead us to think that Shinto is the Japanese version of Taoism. In so far as the essence of Taoism is indigenous religious belief conceived and believed in by the ordinary people of that area, then Shinto, with its emphasis on the significance of being indigenous to Japan, is endowed with the essence of Taoism, and can probably at least be said to be the Japanese counterpart of Taoism.

Confucianism sets a value on hierarchical relationships. Within the family this means reverence for parents, and for elder brothers and sisters. Where consideration is extended to deceased family members, it means reverence for ancestors. Outside the family reverence is owed to those with a higher social ranking. The emperors in these countries were revered as well as members of the upper classes and one's superiors at work. Confucianism is a creed based on the feelings of respect for those above oneself.

The Chinese character used to represent loyalty consists of two parts that mean ‘inside the heart’. This is because people had to be loyal within their own hearts, i.e., in their thoughts. Any difference between one’s own ideas and those of one’s sovereign would create an untenable situation, and the retainer would resign his post, leave the city, and pass the remainder of his life quietly as a member of the literati.

This was related to the concept of heaven. In China it was believed that heaven was always right, and that in human society it was the emperor who was closest to heaven. Should the emperor err and act in contravention of the way of heaven, then heaven would rebuke the emperor, and in some cases decree a change of emperor. In ancient Japan, however, the ruling classes perceived heaven as a source of danger, and hence denied its existence. They believed not that the emperor existed close to heaven, but that he was heaven itself. The word for emperor thus underwent a name change, from the Chinese term *huangdi (kotei* in Japanese), to the Japanese word *tenno*, meaning ‘heavenly emperor’.

Apart from virtue in the conduct of superior-inferior relationships, Confucianism also emphasizes virtues with respect to horizontal relationships of equality. Virtues of importance here are benevolence, justice, propriety, knowledge and trust. There has to be mutual trust between friends. In so far as people adhering to these principles they could be regarded as having good manners. In terms of human relationships, benevolence means acting with generosity and human love. People experience this kind of human love at first within the context of the family. Within the family, children first learn about filial piety towards their parents and obedience toward older brothers and sisters. Confucianism thinks first about the individual, then thinks about the family, then the native village, then the state and finally about mankind as a whole. Confucianism attempts to achieve an understanding of ethics not through rationality, but through experiences, especially those cultivated in the family which can be applied to reinforce its socialist ideas.

The horizontal relationships of Confucian socialism are relations of cooperation, and not the competitive ones of capitalism. At first glance such cooperation would seem to be a good thing, and competition often seems hard to accept, especially where it entails a process of eliminating the defeated. However, the absence of any rival plan or opposing force is the root of stagnation. This is why western-style socialism has accepted a competitive type of socialism. What is meant by the term ‘ competitive socialism’ here is a system whereby society does not merely comply with directions from above, but proposals from below compete with plans from above, and whichever

one is thought to be better is then adopted. If state plans are understood to be inefficient, they are modified or withdrawn. Taiwan and South Korea are good examples of this competitive socialism. The Chinese economy is now at a stage where it is opening up to competition. This is just like Japan which, having rebuilt following defeat, is currently trying to make the transition from capitalism from above to capitalism from below. Whatever the case, Confucianism is likely to become all the more ‘aggressive’ as a result of its incorporation into socialism.

(5.2) Collaborative Economic Development in Northeast Asia

One other view of China is as the home of Chinese thought. All countries are somewhat self-centered, and think of other countries as being clustered around their own. In China’s case it was something more than this, however. Chinese people regarded their own culture as superior to any other, and their own country as the center of the world. The cultures of other countries were regarded with contempt. China regarded neighboring countries as being inhabited by barbarians, and saw all these countries as being culturally backward. However, Chinese history witnesses the fact that the Chinese people (the Han peoples) could not claim an overwhelming military superiority in relation to neighboring ‘barbarians’. From the time of Sui and Tang onwards there was a total of 614 years during which China was ruled by Han people, while ruled by non-Han peoples lasted for a total of 690 years.

What, then, does Chinese thought tell us about the mentality of the Chinese people? Does it not show on the one hand their capacity for inclusiveness, and on the other hand their adaptability? The foreign enemies who invaded China were skillfully Sinicized. Although China may have been ruled by people from outside, it was successful in protecting to the end the culture of the Han people. If we term a confidence in China against this kind of actual historical background, it is confidence that does not entail looking down on other people, a confidence in their own adaptability to other peoples, and their own ability to make those peoples adapt to them. The Han people have skillfully acquired the trick of taking influences from outside, adapting them to their own culture, and displaying the result to everyone, including other peoples, as Chinese culture.

According to the implications of this model, the coherence of cooperative attitudes among the constituents of FTA is the primary factor that contributes to an enduring success of cooperation. The northeast Asian countries have long been

immersed in the milieu of Confucian doctrine and Taoistic discipline and share a more or less homogenous degree of respect toward their superiors and benevolence toward their equals or inferiors. These observations can be rephrased as the roughly similar and high values of η in my model above. Therefore, we can predict a relatively longer duration of cooperation relation in the northeast Asian FTA than others with dissimilar cultural background among their constituent countries.

Another immediate conclusion from the model is that unless there is a remedial action to rectify the gradual divergence of cultural development among the member countries of Northeast Asian FTA, the cooperation pact will still be led to collapse eventually. In this regard, I would suggest that China, which is the origin of Confucianism and Taoism, assume the responsibility of assimilating the cultural difference and schism that might develop in the process of economic cooperation as the Han people did in the past. This task requires the China government acknowledge and maintain the sovereign dignity of each member country and strenuously promote the cultural exchange in the region.

The idea of intensive cultural exchange to fortress the cooperation pact in the Northeast Asian countries is akin to the concept of the Greater East Asian Co-prosperity Sphere espoused by Japan in 1943 except that we emphasize the role of culture and limit the initial size of sphere to those countries with similar cultural background. The past century has witnessed that the ‘Japanese spirit’ made the Japanese overbearing towards its minorities including the military invasion toward its neighboring countries. This kind of ‘Japanese spirit’ that is so alien to ‘Confucian thought’ would be detrimental to the economic cooperation pact thus formed. Therefore, either ‘Japanese spirit’ or ‘Chinese spirit’ should be replaced and generalized by ‘Confucian spirit’ in order to assimilate multifaceted version of Confucian culture in these countries.

According to the implications of this model, the less cooperative country will gain more than the country with a greater cooperative attitude once these two countries form a cooperation relationship. To alleviate the problem of unequal welfare distribution among member countries of FTA, some stability fund contributed by each member country is recommended. This fund can be used to subsidize those suffering from the free trade among these countries.

As for how to collect and use the fund so that no one would be worse off from the FTA, we can draw on the program suggested by Grinols and Wong (1991) or Ju

and Krishna (2000) as follows: Let the domestic price vector for consumers and producers be denoted by $p = p^* + t$, where p* is the vector of foreign production prices, and t is the vector of trade taxes and subsidies. When the prices change from $p^0 = p^{*0} + t^0$ to $p^1 = p^{*1}$ (assuming that $t^1 = 0$ after signing the FTA), the government transfer to country h within the FTA becomes

$$R^h = (p^1 - p^0) \cdot c^{h0} - (w^1 - w^0) \cdot v^{h0}.$$

Where c^{h0} is the vector of consumption for country h before signing the FTA, w^1, w^0 & v^{h0} are the vectors of factor prices before and after the FTA and the vector of endowment for country h before FTA, respectively. Provided that $(p^{*0} - p^{*1}) \cdot m^0 \geq 0$ (m^0 is the vector of the initial total imports of the member countries in FTA), then no one will be worse off and the stability fund will be balanced.

6. Discussion and Conclusion

The most famous study of how culture relates to values in the workplace was undertaken by Geert Hofstede. As part of his job as a psychologist working for IBM, Hofstede collected data on employee attitudes and values for more than 100000 individuals from 1967 to 1973. These data enabled him to compare dimensions of culture across 40 countries. Hofstede subsequently expanded his original research to include a fifth dimension that captured additional differences not brought out in his earlier work. He referred to this dimension as "Confucian dynamism" According to Hofstede (1988), Confucian dynamism captures attitudes toward time persistence, ordering by status, protection of face, respect for tradition, and reciprocation of gifts and favors. He showed in the study that hierarchical dualities and interrelatedness lie at the heart of the Chinese conception of being human (the “wu Lun”). This sense of hierarchy and complementarity of relations undoubtedly makes the entrepreneurial role easier to play and contributes to the startling economic growth in the four Asian Dragon countries.

This study expands the above concept to the formation of regional economic cooperation among the countries with the highest scores of “Confucian dynamism”. The cooperative attitude cultivated by the influence of Confucianism will fortify the economic benefit to each member country of the Northeast Asian FTA. Given the initial cooperative attitude of each country, I then endogenize the dynamic cooperative behavior of each country in the joint organization (FTA) from the optimization of the country’s inter-temporal utility and reinforce the conclusion that cultural coherence

among member countries has a profound and positive impact on the stability of the FTA.

By adapting the Ricardian production function to incorporate the impact of cooperativeness in an organization and each country's output share, this model presents a framework to resolve the optimal degree of altruism for each member country. At the beginning of the cooperation, every country has an incentive to raise the weight of her utility that is associated with the other's wellbeing. The increased concern with the latter's output share in the FTA will drive her to work harder for an entire organization and contribute to an improvement of her productivity in the organization, which will benefit herself and her trading partner as well. The formation of a cooperation cycle is primarily due to the nature of human behavior as expounded by the prospect theory. The resulting utility enhancement after her initial elevation of cooperativeness will raise her reference point and render it more difficult to further improve her utility level, dampening the incentive to cooperate in the subsequent periods.

An important implication of this study is that except for the perfect alignment of cooperativeness among its constituents, all the cooperation cycles are irregular and lead to a widening divergence of cooperation attitudes and the breakdown of the entire organization eventually. This outcome is analogous to the synchronization behavior of two coupled oscillators. Unless the initial frequencies of the two oscillators are close enough, the coupling of two distinct oscillators will easily end up a chaotic cycle when confronting a nonlinear interaction between the two. However, the system provides a striking self-fulfilling force to align the two interacting entities and generate a great synergy when these two entities are close enough in their initial conditions (i.e., frequency in the oscillator case and cooperation attitude in this study).

In the beginning, any organization will provide noticeable benefit to all its constituents due to the exploitation of comparative advantage for each country. However, unless there is perfect alignment in cooperativeness, the widening divergence of benefit and cooperation attitude among its members will challenge the stability of the organization and trigger the inevitable collapse in the end. Therefore, the cultivation of a common cooperation attitude among its members at the inception is very crucial for the persistent prosperity of an organization. We can witness the success of the Japanese economy in the last century as an evidence of this proposition. A strongly-held national ethos that took root in Japan by the influence of Confucianism, Taoism and Buddhism helps her rise swiftly to the status of a first-rate

power following the Meiji Revolution after 1867 (Michio Morishima, 1982). This consensus of complete loyalty to the firm and to the state as transformed by the ethical doctrines plays a critical role in the creation of Japan's economic success.

This study points out a caveat on the instability of an international organization. Japan's past economic success was built on her extraordinary congealing force nurtured in the fertile cultural background. However, the international organizations such as the United Nation or WTO were established by the countries with diverse cultural backgrounds. Despite the early success in meeting their original goals, the enlarged disparity of economic or political benefit among their member countries will bring the organizations into a collapse unless some measure of the realignment of common goal for its participants is seriously taken. The recent surge of regional economic agreements among the countries with similar economic or cultural background seems relatively encouraging. Nevertheless, we should not be too sanguine about the prospect of these agreements if the member countries could not tolerate and accommodate the cultural shock from other countries even though the distinction might be nominal. In this regard, I would suggest that China, which is the origin of Confucianism and Taoism, assume the responsibility of assimilating the cultural difference and schism that might develop in the process of economic cooperation as the Han people did in the past. This task requires the China government acknowledge and maintain the sovereign dignity of each member country and strenuously promote the cultural exchange in the region.

References

Bhagwati, Jagdish. 2002. *Free Trade Today*. New Jersey: Princeton University Press.

Grinols, Ear L., and Kar-yiu Wong. 1991. "Am Exact Measure of Welfare Change." *Canadian Journal of Economics* 24:420-49.

Herman, Kahn. 1979. *World Economic Development: 1979 and Beyond.* Groom Helm.

Hofstede, Geert. 1983. "The Cultural Relativity of Organizational Practices and Theories." *Journal of International Business Studies*, 75-89.

Hofstede, Geert and Michael Harris Bond. 1988. "The Confucius Connection: From

Cultural Roots to Economic Growth." *Organizational Dynamics*, 5-21.

Ju, Jiandong, and Kala Krishna. 2000. "Evaluating Trade Reform with Many Consumers." *Canadian Journal of Economics* 33:787-98.

Kahneman, D. and A. Tversky. 1979. "Prospect Theory: An Analysis of Decision under Risk," *Econometrica*, 14(2), 263-91.

Morishima, Michio. 1982. *Why has Japan Succeeded?"*. Cambridge University Press.

Morishima, Michio. 2000. *Collaborative Development in Northeast Asia*. MacMillan Press LTD.

North, Douglass C. 2005. *Understanding the Process of Economic Change*. Princeton University Press.

Pikovsky, A., M. Rosenblum, and J. Kurths. 2001. *Synchronization: A universal concept in nonlinear sciences.* Cambridge University Press.

Yamamura, Kozo. 1997. "Entrepreneurship, Ownership and Management in Japan." In *The Economic Emergence of Modern Japan.* Ed. Kozo Yamamura. Cambridge University Press.

Table 1: Simulation of Cyclical Cooperation - basic scenario									
Basic Assumptions:		β 0.5			η_0^A 0.75			η_0^B 0.25	
		γ 1			$\alpha_X^A(0)$ 0.8			$\alpha_X^B(0)$ 0.2	
		δ 0.9			$\alpha_Y^A(0)$ 0.2			$\alpha_Y^B(0)$ 0.8	
Time Period (t):	0	1	2	3	4	5	6	7	8
$\alpha_X^A(t)$	0.8	0.571	0.591	0.608	0.466	0.634	0.921	0.795	0.268
$\alpha_Y^A(t)$	0.2	0.143	0.148	0.152	0.117	0.158	0.23	0.199	0.067
$\alpha_X^B(t)$	0.2	0.12	0.113	0.237	0.235	0.248	0.059	0.347	0.252
$\alpha_Y^B(t)$	0.8	0.48	0.452	0.948	0.94	0.993	0.237	1.39	1.007
S_t^A	0.5	0.5	0.543	0.567	0.391	0.332	0.389	0.795	0.364
S_t^B	0.5	0.5	0.457	0.433	0.609	0.668	0.611	0.205	0.636
$dS_t^A / d\alpha_X^A(t-1)$		0.313	0.434	0.415	0.392	0.476	0.375	0.177	0.291
$dS_t^A / d\alpha_Y^A(t-1)$)		1.25	1.737	1.661	1.566	1.902	1.501	0.708	1.164
$dS_t^B / d\alpha_X^B(t-1)$		1.25	2.068	2.172	1.005	0.943	0.957	2.746	0.666
$dS_t^B / d\alpha_Y^B(t-1)$		0.313	0.517	0.543	0.251	0.236	0.239	0.687	0.167
$\alpha_{Xn}^A(t) = \alpha_{XS}^A(t)$		0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457
$\alpha_{Y\eta}^A(t) = \alpha_{YS}^A(t)$		0.114	0.114	0.114	0.114	0.114	0.114	0.114	0.114
$\alpha_{X\eta}^B(t) = \alpha_{XS}^B(t)$		0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
$\alpha_{Y\eta}^B(t) = \alpha_{YS}^B(t)$		0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
η_{t+1}^A	0.75	0.75	0.763	0.629	1.054	1.625	0.945	0.222	-0.88
η_{t+1}^B	0.25	0.25	1.048	0.859	0.884	-0.24	1.967	0.938	4.321
PV{ $V^A(t)$ }		-0.34	0.6	1.952	2.927	4.404	5.027	5.54	6.458
PV{ $V^B(t)$ }		-0.34	0.6	2.169	2.71	3.746	4.854	8.132	6.369
Total utility_A (join)	26.57			Total utility_A (disjoin)			23.12		
Total utility_B (join)	28.24			Total utility_B (disjoin)			23.12		

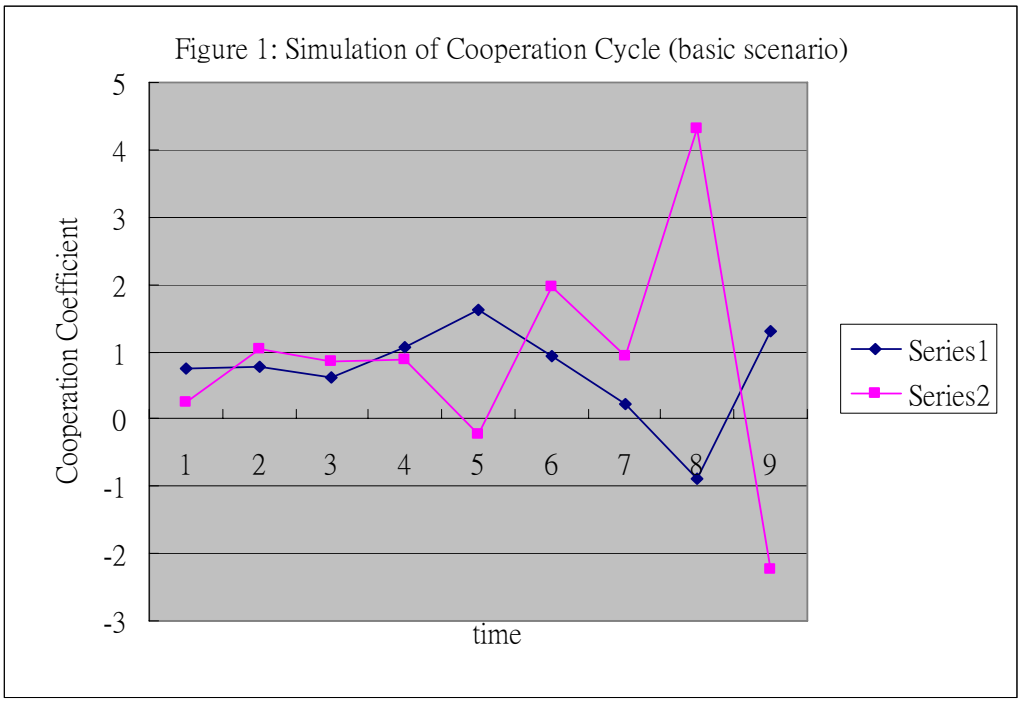
Figure 1: Simulation of Cooperation Cycle (basic scenario)
Cooperation Coefficient
5
4
3
2
1
0
-1
-2
-3
1
2
3
4
5
6
7
8
9
time
Series1
Series2

Table 2: Simulation of Cyclical Cooperation - more weight on present absolute utility

Basic Assumptions:	β	0.5	η_0^A	0.75	η_0^B	0.25
	γ	0.2	$\alpha_X^A(0)$	0.8	$\alpha_X^B(0)$	0.2
	δ	0.9	$\alpha_Y^A(0)$	0.2	$\alpha_Y^B(0)$	0.8

Time Period (t):	0	1	2	3	4	5	6	7	8	9
$\alpha_X^A(t)$	0.8	0.571	0.591	0.785	0.563	0.796	0.968	1.213	1.131	0.079
$\alpha_Y^A(t)$	0.2	0.143	0.148	0.196	0.141	0.199	0.242	0.303	0.283	0.02
$\alpha_X^B(t)$	0.2	0.12	0.113	0.305	0.252	0.381	0.132	0.324	0.177	0.598
$\alpha_Y^B(t)$	0.8	0.48	0.452	1.22	1.008	1.523	0.528	1.297	0.709	2.391
S_t^A	0.5	0.5	0.543	0.567	0.392	0.358	0.343	0.647	0.483	0.615
S_t^B	0.5	0.5	0.457	0.433	0.608	0.642	0.657	0.353	0.517	0.385
$dS_t^A / d\alpha_X^A(t-1)$		0.313	0.434	0.415	0.304	0.408	0.283	0.236	0.206	0.209
$dS_t^A / d\alpha_Y^A(t-1)$		1.25	1.737	1.661	1.214	1.633	1.132	0.944	0.823	0.837
$dS_t^B / d\alpha_X^B(t-1)$		1.25	2.068	2.172	0.781	0.912	0.592	1.73	0.77	1.337
$dS_t^B(t) / d\alpha_Y^B(t-1)$		0.313	0.517	0.543	0.195	0.228	0.148	0.432	0.192	0.334
$\alpha_{Xn}^A(t) = \alpha_{XS}^A(t)$		0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457
$\alpha_{Y\eta}^A(t) = \alpha_{YS}^A(t)$		0.114	0.114	0.114	0.114	0.114	0.114	0.114	0.114	0.114
$\alpha_{X\eta}^B(t) = \alpha_{XS}^B(t)$		0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
$\alpha_{Y\eta}^B(t) = \alpha_{YS}^B(t)$		0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
η_{t+1}^A	0.75	0.75	1.15	0.84	1.384	1.773	2.007	1.991	-0.44	12.95
η_{t+1}^B	0.25	0.25	1.472	0.967	1.738	0.169	1.674	0.591	3.351	0.009
PV$\{V^A(t)\}$		-1.14	-1	-0.3	-0.05	0.877	0.945	-0.02	0.896	0.685
PV$\{V^B(t)\}$		-1.14	-1	0.137	-0.41	-0.36	0.334	1.599	0.79	1.577

Total util_A(join)	0.891	Total util_B (disjoin)	-5.48
Total util_B(join)	1.531	Total util_B (disjoin)	-5.48

Figure 2: Simulation of Cooperation Cycle (gamma equals 0.2)

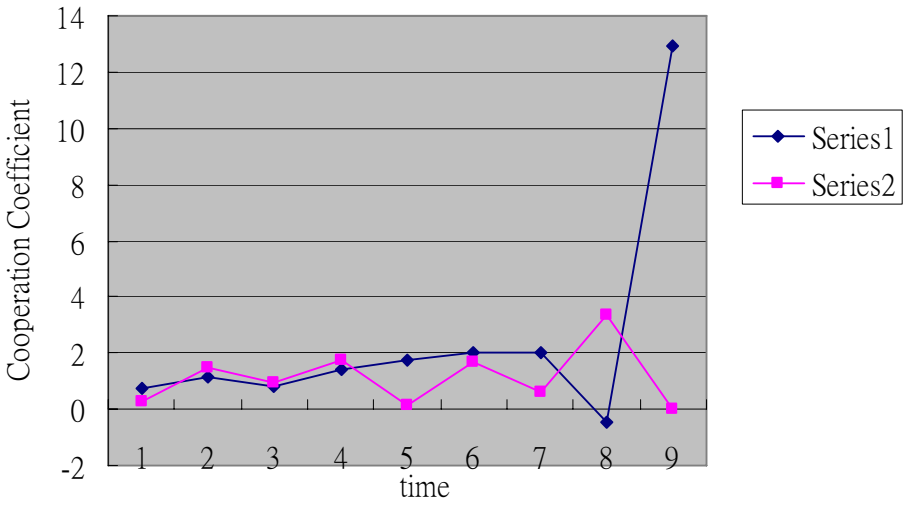

Table 3: Simulation of Cyclical Cooperation - small difference in cooperation attitude										
Basic Assumptions:	β	0.5		η_0^A	0.55		η_0^B	0.45		
	γ	1		$\alpha_X^A(0)$	0.8		$\alpha_X^B(0)$	0.2		
	δ	0.9		$\alpha_Y^A(0)$	0.2		$\alpha_Y^B(0)$	0.8		
Time Period (t):	0	1	2	3	4	5	6	7	8	9
$\alpha_X^A(t)$	0.8	0.542	0.546	0.716	0.641	0.733	0.782	0.763	0.671	0.552
$\alpha_Y^A(t)$	0.2	0.135	0.137	0.179	0.16	0.183	0.195	0.191	0.168	0.138
$\alpha_X^B(t)$	0.2	0.131	0.13	0.195	0.183	0.2	0.164	0.191	0.199	0.241
$\alpha_Y^B(t)$	0.8	0.524	0.52	0.78	0.732	0.802	0.656	0.763	0.795	0.963
S_t^A	0.5	0.5	0.508	0.513	0.478	0.467	0.478	0.544	0.5	0.458
S_t^B	0.5	0.5	0.492	0.487	0.522	0.533	0.522	0.456	0.5	0.542
$dS_t^A / d\alpha_X^A(t-1)$		0.313	0.461	0.457	0.349	0.389	0.34	0.317	0.328	0.37
$dS_t^A / d\alpha_Y^A(t-1)$		1.25	1.845	1.83	1.395	1.554	1.361	1.269	1.31	1.48
$dS_t^B / d\alpha_X^B(t-1)$		1.25	1.907	1.924	1.279	1.36	1.245	1.512	1.31	1.249
$dS_t^B / d\alpha_Y^B(t-1)$		0.313	0.477	0.481	0.32	0.34	0.311	0.378	0.328	0.312
$\alpha_{X\eta}^A(t) = \alpha_{XS}^A(t)$		0.516	0.516	0.516	0.516	0.516	0.516	0.516	0.516	0.516
$\alpha_{Y\eta}^A(t) = \alpha_{YS}^A(t)$		0.129	0.129	0.129	0.129	0.129	0.129	0.129	0.129	0.129
$\alpha_{X\eta}^B(t) = \alpha_{XS}^B(t)$		0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138
$\alpha_{Y\eta}^B(t) = \alpha_{YS}^B(t)$		0.552	0.552	0.552	0.552	0.552	0.552	0.552	0.552	0.552
η_{t+1}^A	0.55	0.55	0.874	0.763	0.954	1.037	0.935	0.8	0.613	1.278
η_{t+1}^B	0.45	0.45	0.927	0.805	0.919	0.667	0.927	0.941	1.204	0.515
PV $\{V^A(t)\}$		-0.32	0.675	1.996	2.95	4.1	5.02	5.957	6.993	8.007
PV $\{V^B(t)\}$		-0.32	0.675	2.036	2.901	3.983	4.957	6.108	6.992	7.868
Total util_A (join)	35.37			Total util_A (disjoin)			30.52			
Total util_B (join)	35.2			Total util_B (disjoin)			30.52			

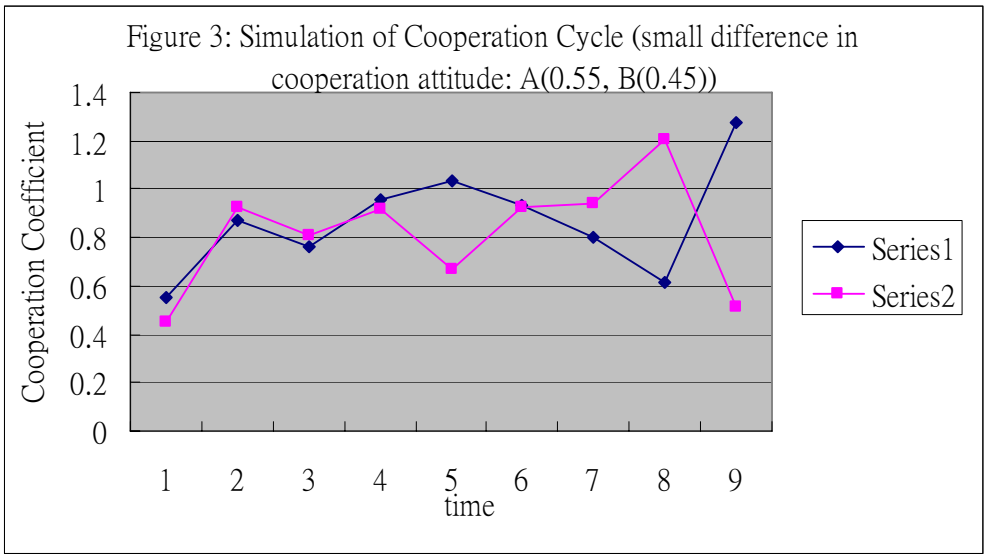
Figure 3: Simulation of Cooperation Cycle (small difference in cooperation attitude: A(0.55, B(0.45))
Cooperation Coefficient
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1
2
3
4
5
6
7
8
9
time
Series1
Series2

Table 4: Simulation of Cyclical Cooperation - perfectly in tandem										
Basic Assumptions:	β 0.5		η_0^A 0.5		η_0^B 0.5					
	γ 1		$\alpha_X^A(0)$ 0.8		$\alpha_X^B(0)$ 0.2					
	δ 0.9		$\alpha_Y^A(0)$ 0.2		$\alpha_Y^B(0)$ 0.8					
Time Period (t):	0	1	2	3	4	5	6	7	8	9
$\alpha_X^A(t)$	0.8	0.533	0.533	0.747	0.686	0.766	0.724	0.759	0.737	0.753
$\alpha_Y^A(t)$	0.2	0.133	0.133	0.187	0.171	0.191	0.181	0.19	0.184	0.188
$\alpha_X^B(t)$	0.2	0.133	0.133	0.187	0.171	0.191	0.181	0.19	0.184	0.188
$\alpha_Y^B(t)$	0.8	0.533	0.533	0.747	0.686	0.766	0.724	0.759	0.737	0.753
S_t^A	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
S_t^B	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
$dS_t^A / d\alpha_X^A(t-1)$		0.313	0.469	0.469	0.335	0.365	0.327	0.345	0.329	0.339
$dS_t^A / d\alpha_Y^A(t-1)$		1.25	1.875	1.875	1.339	1.458	1.306	1.38	1.318	1.357
$dS_t^B / d\alpha_X^B(t-1)$		1.25	1.875	1.875	1.339	1.458	1.306	1.38	1.318	1.357
$dS_t^B / d\alpha_Y^B(t-1)$		0.313	0.469	0.469	0.335	0.365	0.327	0.345	0.329	0.339
$\alpha_{X\eta}^A(t) = \alpha_{XS}^A(t)$		0.533	0.533	0.533	0.533	0.533	0.533	0.533	0.533	0.533
$\alpha_{Y\eta}^A(t) = \alpha_{YS}^A(t)$		0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133
$\alpha_{X\eta}^B(t) = \alpha_{XS}^B(t)$		0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133
$\alpha_{Y\eta}^B(t) = \alpha_{YS}^B(t)$		0.533	0.533	0.533	0.533	0.533	0.533	0.533	0.533	0.533
η_{t+1}^A	0.5	0.5	0.9	0.786	0.936	0.858	0.923	0.882	0.912	0.892
η_{t+1}^B	0.5	0.5	0.9	0.786	0.936	0.858	0.923	0.882	0.912	0.892
PV$\{V^A(t)\}$		-0.32	0.678	2.015	2.93	4.04	4.984	6.031	7.002	8.023
PV$\{V^B(t)\}$		-0.32	0.678	2.015	2.93	4.04	4.984	6.031	7.002	8.023
Total util_A (join)	35.38			Total util_A (disjoin)			30.52			
Total util_B (join)	35.38			Total util_B (disjoin)			30.52			

Figure 4: Simulation of Cooperation Cycle (perfect in tandem: A(0.5), B(0.5))