# Effect of Cooperation on Economic Growth of Both China and Japan

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## Introduction

This paper tries to measure the effect of cooperation on economic growth of both China and Japan by setting up an econometric model. This measuring is based on the basic framework of cooperation economics (Huang shao-an,2000) . The structure of the paper is as follows: The first part introduces the basic idea and analytical methods of cooperation economics; the second part establishes an econometric model for measuring the effect of cooperation on economic growth of both China and Japan; The third part measures degree of cooperation between China and Japan from two dimensions which are political factor and bilateral trade between China and Japan, and lists all the macroeconomic data that the econometric model needs; The fourth part employs the econometric model and the macroeconomic data to calculate the effect of cooperation on economic growth of both China and Japan; the final part is a brief conclusion.

## 1. Basic framework of cooperation economics

From the very beginning, the research of economics was always focused on "competition", so we can call economics as economics of competition. Nowadays, although people are still competing among each other, "cooperation" among people has been more and more. In other words, the propensity of cooperation becomes stronger along with accumulation of mankind's knowledge and increase of rationality. Now many people find that they can solve the problem through cooperation other than through competition, and even better. Therefore, economics should strengthen the research toward cooperation, and try to build economics concerning "cooperation" (Huang shao-an,2000) .

In fact, some action we think as competition is cooperation in essence. For example, the division of labor is taken as competition superficially, but in fact it is made for getting "cooperative residual". Institutional economics points out that one of the basic functions of institution is to reduce conflict or antinomy in order to provide a solution for the cooperation among people. Moreover, establishment of reciprocal institution has the character of "path dependence". The evidence given by Falk, Fehr and Fischbacher (2002) prove that the propensity of reciprocity are of vital importance to bilateral

negotiation, working of market system, the structure of property rights and contracts, and cooperation and collective action. As a result, studying cooperation and establishing economics concerning "cooperation" is the frontier issue of modern economics.

In the history of mankind, the cooperation among people can be divided into three stages.

The motive to cooperation of the first stage came from natural pressure, which forces mankind to evolve the preference to cooperate. Internalization of social norms was established through self-constraint under the pressure of natural forces. Therefore, we can call this stage "lawmaking by nature".

Along with continuous increase of productivity of mankind, the pressure imposed by nature began to decrease, and the expanding cooperation institution can not hold on solely relying on self-constraint. This is the second stage of cooperation. In this stage, though internalized social norm was still functioning, punishment institution has a unique role in maintaining cooperation institution. Therefore some scholars call this stage "lawmaking by individual".

In modern society, division of labor brought by Industrial Revolution caused radical change in the field of cooperation in both scale and degree. This kind of cooperation should be based on judicial institution which is in turn based on rationality and democracy. Therefore, we call this stage "lawmaking by society".

In order to establish cooperation economics, we should solve some basic questions. Of course, it is a systemic task and we only do some tentative discussion.

(1) Basic assumptions of cooperation economics

Traditional economics has two basic assumptions: the assumption of resource scarcity and assumption of rationality. We still reserve these assumptions, but we need do some modification.

The assumption of resource scarcity

Scarcity of resource is always the reason for existence of economics. The eternal issue of economics is to realize utility maximization under the condition of scarce resource. The traditional economics pays attention to "competition", which can promote the efficiency of resources. But we also should know that competition sometimes may result in severe waste of resources. The means to realize utility maximization is not restricted to competition. Along with the accumulation of knowledge and experience, the mankind has already discovered that under many circumstances, cooperation is advantageous to competition. Cooperation brings higher efficiency than competition under many circumstances; the partners can get more cooperative residual.

The assumption of interest-pursuing agent

Cooperation is not contradictory to the assumption of rational agent. Both competition and cooperation are the rational choice of mankind. If cooperation is more advantageous than competition, then people may choose cooperation. Both competition and cooperation

are means to realize one's interest.

Assumption of increasing rationality

We oppose the assumption of rationality which is the trait of neo-classical economics. Later, Simon et al substitute "bounded rationality" for "rationality", which is accepted by most economists. However, both the conception of rationality and bounded rationality are static conceptions, which do not realize that mankind's rationality may change along with accumulation of knowledge and experience. The assumption of "increasing rationality" we advance here is a dynamic and changing conception. Up to now, knowledge has been accumulated, and mankind's skill of learning has been increasing. We can solve many problems which we at past solved by competition because of lack of information. The famous "prisoner dilemma" is an example for imperfect information, uncumulative knowledge. But under the assumption of "increasing rationality", we can indirectly learn other's experience and avoid "prisoner dilemma" (Huang shao-an,2000) .

(2) Methodology of cooperation economics

The basic mythology of cooperation economics can be boiled down to "cooperationism, Reciprocity and liberalism", which are different from and related to "individualism, utilitarianism and liberalism". In fact, "individualism, utilitarianism and liberalism" is the precondition of "cooperationism, Reciprocity and liberalism". The aim of mankind's cooperation is the judgment and pursuit of utility. But "cooperationism and Reciprocity" goes further than "individualism and utilitarianism" and illustrates the nature of cooperation. "cooperationism" is based on "individualism" (Huang shao-an,2000) .

The utility which cooperation pursues is more extensive than the utility which competition pursues. Under some circumstance, cooperation is advantageous to partners of cooperation and the essence of cooperation is "Reciprocity".

Of course, we do not hold that only "pursuit of self-interest" can explain the action of cooperation. The latest study of institution economics shows that many actions of mankind, such as "volunteering to give blood", do not come from "Reciprocity", but embody the nature of human. Polanyi pointed out the motive of reciprocity is not self-interest, but fear of being despised or excluded by others. Reeves pointed out that one of presuppositions is that "life of mankind is a tiny, interdependent and stable social group".

## 2. Two econometric models measuring the effect of cooperation on economic growth of both China and Japan

The econometric model based on Cobb-Douglas production function is as follows:

$$ln(Y_t^i)=\beta_0+\beta_1 ln(K_t^i)+\beta_2 ln(L_t^i)+u_t^i, i=China, Japan \quad (1)$$

$Y_t^i$, $K_t^i$, $L_t^i$ is the output, capital and labor based on fixed price respectively. $t$ is the time series. We argue that white noise $u_t^i$ $(i=China, Japan)$ includes the effect of cooperation between China and Japan on $Y_t^{China}$, $Y_t^{Japan}$. This paper tries to abstract this factor from $u_t^i$,

and analyze the effect of this factor on economic growth of both China and Japan.

It is difficult to quantify "factor of cooperation" by time series, so we don not adopt the method that factor of cooperation directly comes into model (1) as Control- variant. And it is also difficult to find observable Instrument variable and employ IV estimation. We employ dummy variable to abstract the effect on economic growth of cooperation. The basic idea is as follows: for different years $t, t\in(1,2,\ldots n)$, the degree of cooperation is obviously different, and the degree of cooperation has effect on economic growth of both China and Japan. To distinguish "the degree of cooperation" is easier than quantifying "the degree of cooperation" by time series. Obviously, the degree of cooperation in peaceful period is much higher than that during war time. The degree of cooperation during normalization of diplomatic relation between China and Japan is higher than that during non- normalization of diplomatic relation between China and Japan. And the degree of cooperation during normalization of diplomatic relation between China and Japan is higher that during the period of political friction. The degree of cooperation is higher during the period of higher degree of open-up of bilateral trade between China and Japan. Of course, we can dig more factors to depict the degree of cooperation between China and Japan. It is not wise to precisely depict the degree of cooperation between China and Japan of each year. The method we employ here is to classify $n$ years to four ranks: the year of basically no cooperation ($C_0$) ; the year of weak-cooperation ($C_1$) ; the year of relatively strong-cooperation ($C_2$) ; the year of strong-cooperation ($C_3$) . And the concrete classification is in part three. $C_1$、$C_2$、$C_3$ come into the model (1) by dummy variables.

$$ln(Y_t^i)=\beta_0+\beta_1 ln(K_t^i)+\beta_2 ln(L_t^i)+\lambda_1 C_{1,t}+\lambda_2 C_{2,t}+\lambda_3 C_{3,t}+v_t^i, i=China, Japan \quad (2)$$

If $t\in C_j$, $C_{j,t}=1$ ; if $t\notin C_j$, $C_{j,t}=0$ ; $J=1,2,3$ 。$X$ denotes a matrix of row $n$ (row $t$ denotes year $t$ ) five columns (respectively $ln(K_t^i)$、$ln(L_t^i)$、$C_{1,t}$、$C_{2,t}$、$C_{2,t}$)。equation (2) should satisfies：1) $E(\nu_t^i|X)=0, t=1,2,\ldots n$；2) $Var(\nu_t^i|X)=Var(\nu_t^i)=\sigma^2, t=1,2,\ldots n$；3) $Corr(\nu_t^i, \nu_s^i|X)=0, t\neq s$；4) $\nu_t^i$ is independent of $X$, and $\nu_t^i$ □ $Normal(0=\sigma^2)$。

According to (2), the meaning of $\lambda_j, j=1,2,3$ is ：

$$\lambda_j=ln(Y_t^i|C_j;K_t^i,L_t^i)-ln(Y_t^i|C_0;K_t^i,L_t^i), j\in(1,2,3) \quad (3)$$

It can be deduced from (3) 式：

$$\frac{(Y_t^i|C_j;K_t^i,L_t^i)-(Y_t^i|C_0;K_t^i,L_t^i)}{(Y_t^i|C_0;K_t^i,L_t^i)}=\exp(\lambda_j)-1 \quad (4)$$

The meaning of equation (4) is that ceteris paribus, relative to basically no-cooperation ($C_0$), when the degree of cooperation is $C_j$, average of output is higher by per cent$100\cdot[\exp(\lambda_j)-1]$。

Based on this conclusion, we can establish a time series which can help to analyze the effect of cooperation on economic growth of both of China and Japan. We define time series $C_t$ as follows:

$$C_t = \begin{cases} Trade_t, t \in C_0 \\ Trade_t + Trade_t \cdot [\exp(\lambda_j) - 1], t \in C_j \end{cases} \quad (5)$$

$Trade_t$ is the value of bilateral trade between China and Japan in year t. the value of bilateral trade between China and Japan may be the easiest observable variable describing the degree of cooperation. In this time series, we introduce factor [exp （$\lambda_j$） -1 ] by additional rule. $C_t$ includes both [exp （$\lambda_j$） -1 ] and $Trade_t$, so it can better depict the degree of cooperation than [exp （$\lambda_j$） -1 ] or $Trade_t$.

Now, we set up SVAR model to analyze the effect of $C_t$ on output of both of China and Japan （$Y_t^{China}$、$Y_t^{Japan}$） . The model of SVAR can describe linear lagged relation of multi-variable stationary series. We define a SVAR model of three-variable.

$B_0 y_t = \Gamma_1 y_{t-1} + \Gamma_2 y_{t-2} + \cdots + \Gamma_p y_{t-p} + \varepsilon_t, \quad t = 1,2,\cdots n$

$$y_t = \begin{pmatrix} ln(Y_t^{China}) \\ ln(C_t) \\ ln(Y_t^{Japan}) \end{pmatrix}, B_0 = \begin{pmatrix} 1 & -b_{12} & -b_{13} \\ -b_{12} & 1 & -b_{23} \\ -b_{31} & -b_{32} & 1 \end{pmatrix}, \Gamma_m = \begin{pmatrix} \gamma_{11}^{(m)} & \gamma_{12}^{(m)} & \gamma_{13}^{(m)} \\ \gamma_{21}^{(m)} & \gamma_{22}^{(m)} & \gamma_{23}^{(m)} \\ \gamma_{31}^{(m)} & \gamma_{32}^{(m)} & \gamma_{33}^{(m)} \end{pmatrix}, \varepsilon_t = \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{pmatrix}, m = 1,2,3,\ldots p \quad (6)$$

Equation (6) requires: 1) $ln(Y_t^{China})$、$ln(C_t)$、$ln(Y_t^{Japan})$ is stationary stochastic process; (2) $\varepsilon_t$ is the vector of white noise; (3) cov （$\varepsilon_{rt}, \varepsilon_{st}$） $=0, r \neq s$。So we need exert $k$ （$k-1$） /2 constraint model. Lag rank $p$ is decided by information rule of AIC and SC. We can employ AR Roots to test stability. We suppose that the role of $ln(Y_t^{China})$、$ln(C_t)$、$ln(Y_t^{Japan})$ has a lagged effect, so the effect between every two variables is tiny ( this do not mean that the effect among three variables is tiny) . So we can deduce three constraint conditions: 1) $b_{12}=0$; 2) $b_{32}=0$; 3) $b_{13}=0$.

Then we introduce the method of decomposition by Cholesky, and we can prove that:

First, the instant effect of cooperation factor ($ln(C_t)$) on Chinese economic growth ($ln(Y_t^{China})$) is: $d_{China}^{(q)} = \partial ln(Y_{t+q}^{China}) / \partial \varepsilon_{2t}, \quad t = 1,2,\cdots n$; The cumulative effect is $\sum_{q=1}^{\infty} d_{China}^{(q)}$。

Secondly, the instant effect of cooperation factor ($ln(C_t)$) on Japanese economic growth ($ln(Y_t^{Japan})$) is: $d_{Japan}^{(q)} = \partial ln(Y_{t+q}^{Japan}) / \partial \varepsilon_{2t}, \quad t = 1,2,\cdots n$; The cumulative effect is $\sum_{q=1}^{\infty} d_{Japan}^{(q)}$。

## 3. Measuring of degree of cooperation and data

Data 1: the year of basically no cooperation （$C_0$） ; the year of weak-cooperation （$C_1$） ; the year of relatively strong-cooperation （$C_2$） ; the year of strong-cooperation （$C_3$） .

We depict the degree of economic cooperation between China and Japan by two dimensions which are 1) the degree of political cooperation and 2) the degree of economic cooperation.

(1) The degree of political cooperation

According to main events in history, we divide the period of 1960~2006 to four sub-periods:

1960~1971: the premier Zhou-enlai put forward three principles of Sino-Japanese political relationship, which created the precondition for Sino-Japanese bilateral trade. But during this period China and Japan were in the status of basically no cooperation.

1972~1982: in 1972, China and Japan realized the normalization of Sino-Japanese political relationship. And in 1978, China and Japan subscribed a long-term trade agreement.

1982~1996: the leaders of China and Japan visited each other frequently, and the economic relationship is fine. But there were many political frictions during this period.

1996~2006: the politicalrelationship was inclined to worsen.

We refer to concrete events happened each year to quantify the degree of cooperation between China and Japan.

Table1: measuring of degree of cooperation between China and Japan (political factor)

| year | The degree of political cooperation (full mark10) | year | The degree of political cooperation (full mark10) | year | The degree of political cooperation (full mark10) | year | The degree of political cooperation (full mark10) |
|---|---|---|---|---|---|---|---|
| 1960 | 1 | 1972 | 6 | 1984 | 8 | 1996 | 5 |
| 1961 | 1 | 1973 | 6 | 1985 | 7 | 1997 | 7 |
| 1962 | 1 | 1974 | 6 | 1986 | 7 | 1998 | 7 |
| 1963 | 1 | 1975 | 6 | 1987 | 8 | 1999 | 7 |
| 1964 | 1 | 1976 | 6 | 1988 | 8 | 2000 | 7 |
| 1965 | 1 | 1977 | 6 | 1989 | 6 | 2001 | 6 |
| 1966 | 1 | 1978 | 8 | 1990 | 8 | 2002 | 6 |
| 1967 | 1 | 1979 | 8 | 1991 | 8 | 2003 | 6 |
| 1968 | 1 | 1980 | 8 | 1992 | 8 | 2004 | 6 |
| 1969 | 1 | 1981 | 8 | 1993 | 8 | 2005 | 6 |
| 1970 | 1 | 1982 | 7 | 1994 | 6 | | |
| 1971 | 1 | 1983 | 8 | 1995 | 6 | | |

(2) Value of bilateral trade between China and Japan

We employ Value of bilateral trade between China and Japan to measure the degree of cooperation between two countries. The reasons are as follows: 1) the political factor is hard to be quantified, which may cause inaccuracy; 2) political factor can not fully illustrate the degree of economic cooperation. For instance, the relationship between China

and Japan from 1994 to now is a good proof. Therefore, we introduce Value of bilateral trade between China and Japan as second dimension to measure the degree of cooperation.

Table2: Value of bilateral trade between China and Japan (fixed price, unit：1 billion yen；based on year 2000)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1960 | 15.93 | 1972 | 562.811 | 1984 | 2497.667 | 1996 | 6546.332 |
| 1961 | 31.985 | 1973 | 783.17 | 1985 | 3667.083 | 1997 | 7312.738 |
| 1962 | 57.71 | 1974 | 1048.086 | 1986 | 2338.366 | 1998 | 7205.598 |
| 1963 | 92.026 | 1975 | 1191.439 | 1987 | 2096.863 | 1999 | 7524.476 |
| 1964 | 208.149 | 1976 | 910.431 | 1988 | 2309.413 | 2000 | 9215 |
| 1965 | 312.582 | 1977 | 926.586 | 1989 | 2451.408 | 2001 | 10889.001 |
| 1966 | 403.061 | 1978 | 1073.301 | 1990 | 2327.694 | 2002 | 13074.074 |
| 1967 | 356 | 1979 | 1372.042 | 1991 | 2751.792 | 2003 | 16191.781 |
| 1968 | 347.742 | 1980 | 1701.671 | 1992 | 3328.78 | 2004 | 18931.322 |
| 1969 | 387.475 | 1981 | 1808.961 | 1993 | 3925.961 | 2005 | 21301.945 |
| 1970 | 491.978 | 1982 | 1710.696 | 1994 | 4521.531 | | |
| 1971 | 526.898 | 1983 | 1890.772 | 1995 | 5258.937 | | |

We define the value of bilateral trade in 2005 as 10, and the value of bilateral trade in other years is divided by the value of bilateral trade in 2005.

Table 3: the measuring of degree of cooperation between China and Japan (economic factor)

| year | The degree of economic cooperation (full mark10) | year | The degree of economic cooperation (full mark10) | year | The degree of economic cooperation (full mark10) | year | The degree of economic cooperation (full mark10) |
|---|---|---|---|---|---|---|---|
| 1960 | 0.01 | 1972 | 0.26 | 1984 | 1.17 | 1996 | 3.07 |
| 1961 | 0.02 | 1973 | 0.37 | 1985 | 1.72 | 1997 | 3.43 |
| 1962 | 0.03 | 1974 | 0.49 | 1986 | 1.1 | 1998 | 3.38 |
| 1963 | 0.04 | 1975 | 0.56 | 1987 | 0.98 | 1999 | 3.53 |
| 1964 | 0.1 | 1976 | 0.43 | 1988 | 1.08 | 2000 | 4.33 |
| 1965 | 0.15 | 1977 | 0.43 | 1989 | 1.15 | 2001 | 5.11 |
| 1966 | 0.19 | 1978 | 0.5 | 1990 | 1.09 | 2002 | 6.14 |
| 1967 | 0.17 | 1979 | 0.64 | 1991 | 1.29 | 2003 | 7.6 |
| 1968 | 0.16 | 1980 | 0.8 | 1992 | 1.56 | 2004 | 8.89 |
| 1969 | 0.18 | 1981 | 0.85 | 1993 | 1.84 | 2005 | 10 |
| 1970 | 0.23 | 1982 | 0.8 | 1994 | 2.12 | | |
| 1971 | 0.25 | 1983 | 0.89 | 1995 | 2.47 | | |

We sum up above two measuring (each measuring as 50%) to gain total measuring (10 as full mark) , then we classify the whole period of 1960~2005:

6~10 : Strong cooperation

4~6 : Relatively strong cooperation

2~4 : Weak cooperation

0~2 : Basically no cooperation

Table: 4 the total measuring of degree of cooperation between China and Japan (including political factor and economic factor)

| year | measuring | degree | year | measuring | degree |
|---|---|---|---|---|---|
| 1960 | 0.51 | Basically no cooperation | 1983 | 4.45 | Relatively strong cooperation |
| 1961 | 0.51 | Basically no cooperation | 1984 | 4.59 | Relatively strong cooperation |
| 1962 | 0.52 | Basically no cooperation | 1985 | 4.36 | Relatively strong cooperation |
| 1963 | 0.52 | Basically no cooperation | 1986 | 4.05 | Relatively strong cooperation |
| 1964 | 0.55 | Basically no cooperation | 1987 | 4.49 | Relatively strong cooperation |
| 1965 | 0.58 | Basically no cooperation | 1988 | 4.54 | Relatively strong cooperation |
| 1966 | 0.6 | Basically no cooperation | 1989 | 3.58 | Weak cooperation |
| 1967 | 0.59 | Basically no cooperation | 1990 | 4.55 | Relatively strong cooperation |
| 1968 | 0.58 | Basically no cooperation | 1991 | 4.65 | Relatively strong cooperation |
| 1969 | 0.59 | Basically no cooperation | 1992 | 4.78 | Relatively strong cooperation |
| 1970 | 0.62 | Basically no cooperation | 1993 | 4.92 | Relatively strong cooperation |
| 1971 | 0.63 | Basically no cooperation | 1994 | 4.06 | Relatively strong cooperation |
| 1972 | 3.13 | Weak cooperation | 1995 | 4.24 | Relatively strong cooperation |
| 1973 | 3.19 | Weak cooperation | 1996 | 4.04 | Relatively strong cooperation |
| 1974 | 3.25 | Weak cooperation | 1997 | 5.22 | Relatively strong cooperation |
| 1975 | 3.28 | Weak cooperation | 1998 | 5.19 | Relatively strong cooperation |
| 1976 | 3.22 | Weak cooperation | 1999 | 5.27 | Relatively strong cooperation |
| 1977 | 3.22 | Weak cooperation | 2000 | 5.67 | Relatively strong cooperation |
| 1978 | 4.25 | Relatively strong cooperation | 2001 | 5.56 | Relatively strong cooperation |
| 1979 | 4.32 | Relatively strong cooperation | 2002 | 6.07 | Strong cooperation |
| 1980 | 4.4 | Relatively strong cooperation | 2003 | 6.8 | Strong cooperation |
| 1981 | 4.43 | Relatively strong cooperation | 2004 | 7.45 | Strong cooperation |
| 1982 | 3.9 | Weak cooperation | 2005 | 8 | Strong cooperation |

According to table 4, $C_0$、$C_1$、$C_2$、$C_3$ is as follows :

Table 5: $C_0$、$C_1$、$C_2$、$C_3$

| | |
|---|---|
| Basically no cooperation（$C_0$） | 1960－1971 |
| Weak cooperation（$C_1$） | 1972－1977；1982；1989 |
| Relatively strong cooperation（$C_2$） | 1978－1981；1983－1988；1990－2001 |
| Strong cooperation（$C_3$） | 2002－2005 |

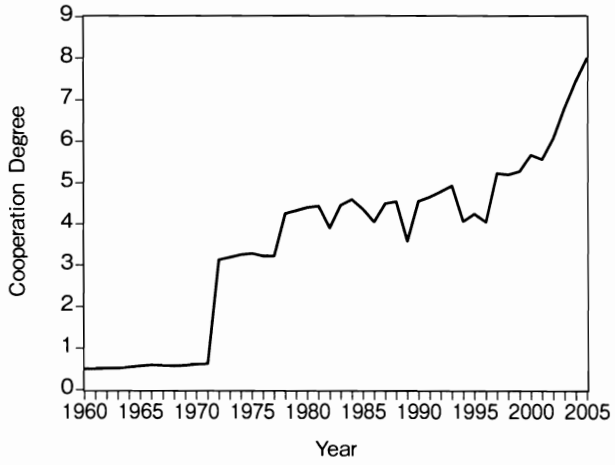



Chart 1: the total measuring of degree of cooperation between China and Japan (time series)

We can see from chart 1 that the total measuring of degree of cooperation between China and Japan has been increasing in totally, but the course is devious.

Data2: Japanese macro-economic data ($K_t^{japan}$,$L_t^{japan}$) .

Table 6: Japanese macro-economic data

| year | GDP fixed price（based on year 2000） unit：1 billion yen | employment unit：10 thousand | Stock of fixed assets unit：1 billion yen | Deflator（year 2000=100） | Stock of fixed assets（based on year 2000）unit：1 billion yen |
|---|---|---|---|---|---|
| 1960 | 74330.50 | 4436 | | 53.0 | |
| 1961 | 83282.50 | 4498 | | 53.5 | |
| 1962 | 90702.10 | 4556 | | 52.7 | |
| 1963 | 98387.90 | 4595 | | 53.6 | |
| 1964 | 109877.00 | 4655 | | 53.7 | |
| 1965 | 116270.00 | 4730 | | 54.1 | |
| 1966 | 128640.00 | 4827 | | 55.5 | |
| 1967 | 142896.00 | 4920 | | 56.4 | |
| 1968 | 161305.00 | 5002 | | 56.9 | |

| | | | | | |
|---|---|---|---|---|---|
| 1969 | 181432.00 | 5040 | 241,045.5 | 58.1 | 414880.379 |
| 1970 | 200861.00 | 5094 | 294,784.5 | 60.2 | 489675.249 |
| 1971 | 210300.00 | 5121 | 349,849.8 | 59.7 | 586013.065 |
| 1972 | 227993.00 | 5126 | 469,108.8 | 60.2 | 779250.498 |
| 1973 | 246307.00 | 5259 | 620,063.3 | 69.8 | 888342.837 |
| 1974 | 243289.00 | 5237 | 682,969.6 | 91.7 | 744786.914 |
| 1975 | 250811.00 | 5223 | 737,424.2 | 94.4 | 781169.703 |
| 1976 | 260780.00 | 5271 | 811,957.8 | 99.2 | 818505.847 |
| 1977 | 272229.00 | 5342 | 876,735.5 | 101.1 | 867196.340 |
| 1978 | 286581.00 | 5408 | 980,815.6 | 98.6 | 994741.988 |
| 1979 | 302297.00 | 5479 | 1,160,107.7 | 105.8 | 1096510.113 |
| 1980 | 310815.00 | 5536 | 1,336,823.2 | 124.5 | 1073753.574 |
| 1981 | 319672.00 | 5581 | 1,473,575.7 | 126.3 | 1166726.603 |
| 1982 | 329722.00 | 5638 | 1,565,530.5 | 128.5 | 1218311.673 |
| 1983 | 337200.00 | 5733 | 1,623,371.8 | 125.7 | 1291465.235 |
| 1984 | 350135.00 | 5766 | 1,697,371.5 | 125.4 | 1353565.789 |
| 1985 | 365416.00 | 5807 | 1,804,568.1 | 123.9 | 1456471.429 |
| 1986 | 362620.80 | 5853 | 2,081,070.0 | 112.6 | 1848197.158 |
| 1987 | 376382.21 | 5911 | 2,540,129.7 | 108.4 | 2343293.081 |
| 1988 | 401843.62 | 6011 | 2,763,129.4 | 107.3 | 2575143.896 |
| 1989 | 423104.88 | 6128 | 3,152,070.6 | 110.1 | 2862916.076 |
| 1990 | 445112.56 | 6249 | 3,473,167.1 | 112.3 | 3092757.881 |
| 1991 | 460026.93 | 6369 | 3,360,057.4 | 111.6 | 3010804.122 |
| 1992 | 464498.30 | 6436 | 3,183,423.1 | 109.8 | 2899292.441 |
| 1993 | 465648.34 | 6450 | 3,151,583.4 | 106.7 | 2953686.410 |
| 1994 | 470764.08 | 6453 | 3,139,830.2 | 104.5 | 3004622.201 |
| 1995 | 480223.21 | 6457 | 3,118,492.0 | 103.5 | 3013035.749 |
| 1996 | 496718.47 | 6486 | 3,100,345.9 | 103.6 | 2992611.873 |
| 1997 | 505517.05 | 6557 | 3,139,440.4 | 105.2 | 2984258.935 |
| 1998 | 500224.64 | 6514 | 3,072,823.5 | 103.6 | 2966045.849 |
| 1999 | 499546.67 | 6462 | | 100.1 | |
| 2000 | 511462.29 | 6446 | | 100.0 | |
| 2001 | 512501.47 | 6412 | | 99.1 | |
| 2002 | 510949.31 | 6330 | | 97.2 | |
| 2003 | 517619.22 | 6316 | | 94.9 | |
| 2004 | 531594.95 | 6329 | | 96.1 | |
| 2005 | 536538.50 | 6356 | | 97.7 | |
| 2006 | 548264.90 | 6382 | | | |

Data 3：Chinese macroeconomic data：$K_t^{China}$, $L_t^{China}$

Table 7: Chinese macroeconomic data

| year | GDP fixed price unit：1 billion RMB | employment unit：10 thousand | Stock of fixed assets (based on year 2000) unit：1 billion RMB |
|---|---|---|---|
| 1960 | 293.48 | 25880 | 604.808 |
| 1961 | 213.94 | 25590 | 690.116 |
| 1962 | 200.88 | 25910 | 731.818 |
| 1963 | 221.66 | 26640 | 766.889 |
| 1964 | 256.76 | 27736 | 813.994 |
| 1965 | 298.77 | 28670 | 882.758 |
| 1966 | 330.74 | 29805 | 962.174 |
| 1967 | 311.89 | 30814 | 1023.142 |
| 1968 | 299.10 | 31915 | 1064.004 |
| 1969 | 349.65 | 33225 | 1114.07 |
| 1970 | 417.48 | 34432 | 1202.299 |
| 1971 | 446.71 | 35620 | 1314.798 |
| 1972 | 463.68 | 35854 | 1428.833 |
| 1973 | 500.31 | 36652 | 1560.365 |
| 1974 | 511.82 | 37369 | 1707.876 |
| 1975 | 556.35 | 38168 | 1869.609 |
| 1976 | 547.45 | 38834 | 2041.316 |
| 1977 | 589.05 | 39377 | 2229.051 |
| 1978 | 657.97 | 40152 | 2459.089 |
| 1979 | 707.98 | 41024 | 2726.955 |
| 1980 | 763.20 | 42361 | 2749.123 |
| 1981 | 802.89 | 43725 | 3010.024 |
| 1982 | 875.95 | 45295 | 3282.205 |
| 1983 | 971.43 | 46436 | 3589.606 |
| 1984 | 1119.08 | 48197 | 3956.292 |
| 1985 | 1270.16 | 49873 | 4425.89 |
| 1986 | 1381.93 | 51282 | 5031.834 |
| 1987 | 1542.24 | 52783 | 5750.49 |
| 1988 | 1716.51 | 54334 | 6541.187 |
| 1989 | 1786.89 | 55329 | 7322.575 |
| 1990 | 1854.79 | 64749 | 8063.517 |
| 1991 | 2025.43 | 65491 | 8829.038 |
| 1992 | 2313.04 | 66152 | 9688.779 |
| 1993 | 2636.87 | 66808 | 10705.46 |
| 1994 | 2982.30 | 67455 | 11899.89 |

| | | | |
|---|---|---|---|
| 1995 | 3307.37 | 68065 | 13282.37 |
| 1996 | 3638.10 | 68950 | 14928.66 |
| 1997 | 3976.45 | 69820 | 16829.48 |
| 1998 | 4286.61 | 70637 | 18906.68 |
| 1999 | 4612.39 | 71394 | 21167.54 |
| 2000 | 4999.84 | 72085 | 23609.16 |
| 2001 | 5414.82 | 73025 | 26185.96 |
| 2002 | 5907.57 | 73740 | 29001.02 |
| 2003 | 6498.33 | 74432 | |
| 2004 | 7154.66 | | |
| 2005 | | | |
| 2006 | | | |

## 4. Results of econometric models

Table: 8 The result of model (2)

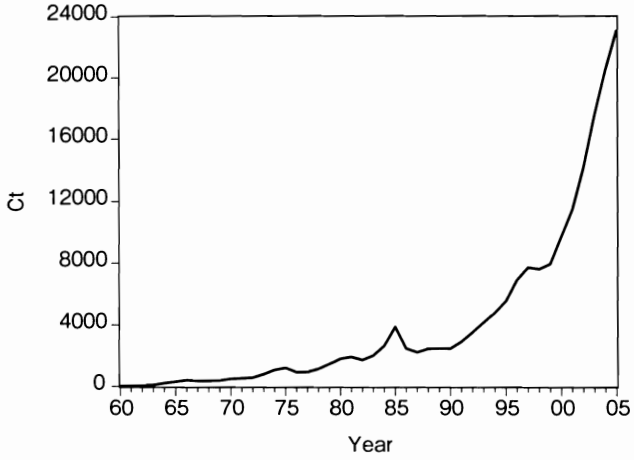
| | $i = China$ | $i = Japan$ |
|---|---|---|
| $\lambda_1^*$ | 0.010149 | 0.007342 |
| $\lambda_2^*$ | 0.078722 | 0.030067 |
| $\lambda_3^*$ | 0.091484 | 0.070762 |

Notation: prominence only on 15%[1] .

We put the mean of $\lambda_1$、 $\lambda_2$、 $\lambda_3$ in equation (5) , and we can gain a time series :

[1] The result we get here is not ideal. We argue that there are two reasons for this. First, the sample we employ is small, if we can expand to the period of 1914～2006, then we can get a better result. Secondly, we do not include education factor in our model. We can improve the results if we can get more data.

Chart 2




Test of stationarity of model (6)

We test unit value by seeing $ln(Y_t^{China})$、$ln(C_t)$、$ln(Y_t^{Japan})$ as a time series.

Table 9

| Method | Statistic | Prob.** | Cross-sections | Obs |
|---|---|---|---|---|
| Null: Unit root (assumes common unit root process) | | | | |
| Levin, Lin & Chu t* | -5.65388 | 0.0000 | 3 | 130 |
| Breitung t-stat | 2.23194 | 0.9872 | 3 | 127 |
| | | | | |
| Null: Unit root (assumes individual unit root process) | | | | |
| Im, Pesaran and Shin W-stat | -3.31101 | 0.0005 | 3 | 130 |
| ADF - Fisher Chi-square | 42.5468 | 0.0000 | 3 | 130 |
| PP - Fisher Chi-square | 42.2922 | 0.0000 | 3 | 134 |
| | | | | |
| Null: No unit root (assumes common unit root process) | | | | |
| Hadri Z-stat | 8.03186 | 0.0000 | 3 | 137 |

Determining lag-rank $p$ of model (6)

We adopt LR、AIC、SC、HQ to determine lag-rank $p$, the test result is as following:

Table 10

| Lag | LogL | LR | AIC | SC | HQ |
|---|---|---|---|---|---|
| 0 | -57.95601 | NA | 2.835163 | 2.958038 | 2.880476 |
| 1 | 194.4595 | 457.8701 | -8.486491 | -7.994993 | -8.305241 |
| 2 | 218.1530 | 39.67283* | -9.169909* | -8.309788* | -8.852723* |

We adopt LR、AIC、SC、HQ to determine lag-rank , all the tests except HQ show that we should define that p equals 2。

Test of stability of model (6)

We adopt AR to test stability of the model, and the results is as follows :

Table 11

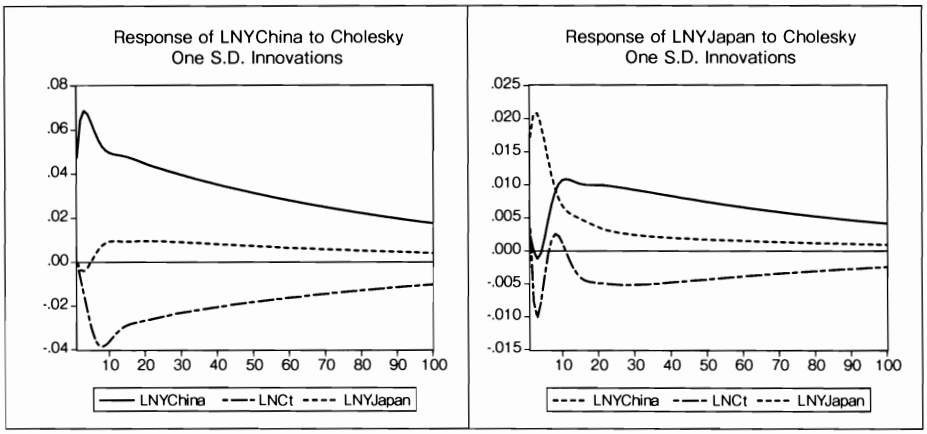
| Root | Modulus |
|---|---|
| 0.988517 | 0.988517 |
| 0.864692 | 0.864692 |
| 0.670434 - 0.326254i | 0.745603 |
| 0.670434 + 0.326254i | 0.745603 |
| 0.299478 | 0.299478 |
| 0.076397 | 0.076397 |

We can see from table 11 that the reciprocal of all eigenvalues (except unit root) is in the field of unit circle, so the model is stable.

The solution of model: the effect of cooperation on economic growth of China and Japan

(1)、The time path of instant effect of cooperation on economic growth of both of China and Japan. ($q=100$)

Chart 3: The time path of instant effect of cooperation on economic growth of both of China and Japan. ($q=100$)



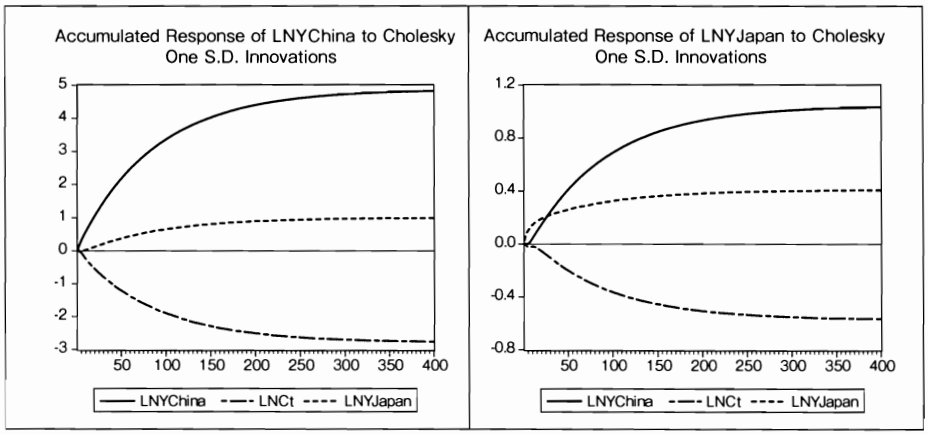

Notation:

LNYChina= $d^{(q)}_{China}= \partial ln\ (Y^{China}_{t+q})\ /\partial \varepsilon_{2t}$ ； LNYJapan= $d^{(q)}_{Japan}= \partial ln\ (Y^{Japan}_{t+q})\ /\partial \varepsilon_{2t}$ 。

In chart 3, LNYChina and LNYJapan describe the instant effect of cooperation between China and Japan on economic growth of China and Japan respectively. Both of the effects are positive.

(2) . Chart 4 the time path of accumulative effect of cooperation on economic growth of both of China and Japan ($q=400$) .

Chart 4: the time path of accumulative effect of cooperation on economic growth of both of China and Japan. ($q=400$)




notation：

LNYChina = $\sum_{q=1}^{\infty} \partial ln\ (Y^{China}_{t+q})\ /\partial \varepsilon_{2t}$ ； LNYjapan = $\sum_{q=1}^{\infty} \partial ln\ (Y^{Japan}_{t+q})\ /\partial \varepsilon_{2t}$ 。

In chart 4, LNYChina and LNYJapan describe the accumulative effect of cooperation between China and Japan on economic growth of China and Japan respectively. Both of the effects are positive, and the effect on China is greater than on Japan.

## Conclusion

The econometric model we adopt shows that during the period from 1960 to 2005, cooperation between China and Japan played a remarkable active role in promoting economic growth of both China and Japan, and the increase of the degree of cooperation between China and Japan has positive effect in promoting economic growth of both China and Japan (both instant effect and accumulative effect). From the aspect of GDP, cooperation between China and Japan has greater effect on China than on Japan[2]. Ceteris paribus, relative to basically no cooperation, the average of output under the condition of weak cooperation is greater by 0.87 percent, and the average of output under the condition of relatively strong cooperation is greater by 5.4 percent, and the average of output under the condition of strong cooperation is greater by 8.1 percent[3].

Main reference:

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[2] If we consider other economic index, we may get different results. For example, if we adopt index of profit, the profit Japan gained is greater than profit China gained.。of course, it is beyond this paper.

[3] By putting the data of table 8 in equation (4).