Prepared for the 10th INFORUM World Conference
at the University of Maryland, MD, 20742,
July 28- August 3, 2002.

Structural Changes and International Competitiveness
- An analysis based on Jidea5 -

Takeshi Imagawa

1. Introduction

In the last INFORUM world Conference held in Switzerland, Japanese team has promised to present Jidea5 model in 10th INFORUM world Conference held in the USA. To our great regret, the model is still under construction partly because of delay in revising capital stock and employment data to the entirely new one from the old database. However, at least time series data of Japanese input-output tables from 1985 to 1999 at 1995 constant price have been prepared.

This paper is one of the outcomes produced from the newly prepared time series data of input-output tables. The purpose of this paper is to investigate the relationship between structural changes and international competitiveness of Japanese manufacturing sectors with special reference to the effects of the changes in domestic demands on the international competitiveness or the index of "revealed comparative advantage (RCA). Ballance, *et al*. (1987), after examining alternative indices as measures of comparative advantage, reached a conclusion recommending a RCA measure based on net exports.[1] In our analysis an index of net export divided by total trade is playing a major role as a RCA measure, which was also adopted in the study by UNIDO[2]. Analysis on the international competitiveness of the Japanese industry is not new. In the 4th INFORUM World Conference held at the Shonan Village Center, Japan in 1996, Japanese team presented an analysis on the relationship between total factor productivity and the index of international competitiveness (here after abbreviated as IIC) in relation to the analysis on the deregulation and international competitiveness

[1] Ballance, R. H., *et al*. (1987), "Consistency Test of Alternative Measures of Comparative Advantage", *the Review of Economics and Statistics*, vol. LXIX, No. 1, February, pp. 157-161.
[2] UNIDO (1982), *World Industry in 1980*, United Nations, New York, chapter II.

based on Jidea3 model[3]. Now we are able to report, based on the Jidea5 database, the analysis from the different point of view, on the structural changes in domestic demands and the international competitiveness.

The Japanese economy is still suffering from the after-effects of the burst of bubble economy, though during the course of this adjustment period the Japanese economy is surely trying to recover from the state of depression and to adapt to the new situation of low levels of intermediate demand as well as final demand by means of the unavoidable changes in its intermediate input structure. Yet we can't expect brighter future in our economy for a time being, though the latest report from Japanese Government tells us, "While the economy continues to be in a difficult situation, movements of an incipient recovery can be seen in some areas"[4]. It depends on the stability in the foreign exchange rate, especially dollar-yen rate whether the Japanese economy will achieve full-scale recovery or not, since our domestic demand seems to be at the saturation level.

There are lots of discussions on when the end of the bubble economy was. Some say it was in early 1989, and others argue it was in 1991. Naturally it differs from one industrial sector to the other sector. If we are interested in the macro economic behavior we can clearly indicate in figure-1 showing the changes in growth rate of GDP in real term, that is, the changes from the same quarter of previous year, that the real GDP's growth rates up to the first quarter of 1991 differ from the growth rates at the second quarter of 1991 and after. Then, if we are interested in the economy of sectoral industrial level, the time when the bubble economy finally burst, and the turning point showing the structural changes to adapt to the new economic situation are quite different from one group of industries to the other, the analysis of which will be discussed by one of the colleagues of Japanese team.

Here what interests me most is to examine the effects on the IIC by the structural changes in the Japanese manufacturing sectors and to find out the turning point of the IIC. Here by the definition of our input-output table of 100 by 100, the manufacturing sector includes sectors 10 to 64. In the next section, brief summary of the past performance of IIC will be presented. Comparison of the movement of IIC during the bubble economy and in the period of after-bubble economy is useful as an introduction to the third section.

In the third section the method to find out the turning point of the IIC in the Japanese manufacturing sectors will be discussed. The differences between pre- and post turning point equations are captured by the technique to include "coefficient change" variables[5]. More precisely,

---

[3] Hasegawa, T., T Imagawa, D Meade, Y Sasai and (1998), "Deregulation and International Competitiveness", *Proceedings of the IVth INFORUM World Conference* at the Shonan Village Center, September 16-21 1996 ITI

[4] *Monthly economic report for June* by Cabinet Office, quoted in *Japan Times*, July 12, 2002.

[5] An earlier example applying this method to the study of Japanese trade is in Petri, P. A.,

the sectoral IIC were regressed by one of the sectoral explanatory factors, the same sectoral explanatory factor multiplied by dummy variable as the second explanatory variable, the relative price as the third, and time trend as the fourth. In the fourth section the turning point in the IIC will be discussed, and in the final section a tentative conclusion will be presented.

2. Past performance of the international competitiveness

Past performance of the IIC is clearly summarized in table-1, table-2 and table-3. Figures in the upper half of the table-1 are the average of IIC from 1985 and 1999 by top fifteen sectors with their minimum and maximum values during the period. Sector 59; ships comes first and the last one is sector 47; other machinery. It seems that, in general, the minimum values of IIC come in 1990s, and the maximum appear in 1985 or 1986. However, sector 21; petro-chemical products is different, its minimum value comes in 1985, and its maximum in 1999, and the reason of its uniqueness is not discussed here.

In the lower half of the table the worst thirteen sectors in the international competitiveness are in a row. The worst is sector 15; wooden products, and the second worst is sector 11; beverages. Here again we can find different patterns in the performance of sectoral IIC. The minimum value looks coming in 1990s and the maximum value in late 1980s, though such sectors as sector 61; air plane and sector 39; non ferrous metal are exceptional.

In table-2 the trend coefficient of sectoral IIC was picked up. Top eleven sectors with the positive coefficient come in the upper part of the table, and the smallest ten sectors with the negative coefficient in the lower part of the table. Sector 21; chemical products comes first, and the 11^{th} position was given to sector 20; basic chemicals. From the 12^{th} position (sector 59; ships, not included in the table-2) to the last (sector 52; communication equipment) the trend coefficients are all negative showing their IIC are deteriorating. The lowest negative coefficient belongs to sector 52; communication equipment, and the second lowest is sector 38; steel cast.

In table-3 average of sectoral IIC in the period of bubble economy and in the period of after-bubble economy were calculated separately. The top column shows 14 industrial sectors from sector 45; general machinery to sector 11; beverages that could improve international competitiveness in the period of after-bubble economy, though half of them have negative value of IIC yet.

In the middle of the table those sectors with the positive but deteriorating IIC after the burst of bubble economy were collected. The first is sector 59; ships and the last one is sector 55; electric parts. In the lowest of the table, sectors that have negative IIC in both periods and worsened the international competitiveness were grouped. There are ten sectors in this category, but to save the

---

(1991), "Market Structure, Comparative Advantage, and Japanese Trade under the Strong Yen," Chapter 2 in P. Krugman ed., *Trade with Japan -Has the door opened wider?*, The University of Chicago Press.

space of the table, only the worst five sectors are included. They are sector 16; furniture, sector 12; feeds & fertilizer, sector 14; clothing, sector 10; food products and sector 15; wooden products. All of them belong to the sectors of light industry not competitive in the world market.

If we compare the sectors grouped in the upper half of table-2 and the sectors collected in the upper part of table-3, we can find that not all of them, which could improve their IIC in the post-bubble economy, necessarily have positive trend coefficient. Sectors 32; glass, 33; cement, and 11; beverages could improve their IIC in the post-bubble period but their trend coefficients are negative. This suggests that it should be much more careful in demarcating the observation period into pre- and post-bubble economy for the sectoral analysis of structural changes. The answer will be found in the discussion in the next section.

3. Factors determining the international competitiveness

First, it is most appropriate to make the definition of variables and factors as well as industrial sectors included in this analysis. Industrial sectors selected in this analysis are tradable goods sectors from sector 10 to sector 64, namely, the manufacturing sector.

Basic identities in input-output table:

intermediate demand + final demand (excl export) + export - import = total output, or intermediate demand + final demand (excl export) + export = import + total output,

or diagonal intermediate demand + non-diagonal intermediate demand + final demand (excl export) + export = import + total output = total supply

intermediate input + value added = total output

Definition of the index of international competitiveness (IIC):

IIC = (export - import) / (export + import)

Relative share of various types of demand to total supply:

diagintr = diagonal intermediate demand / total supply

rndintr = non-diagonal intermediate demand / total supply

rfdrxex = final demand (excl export) / total supply

rintrfdr = total demand (excl export) / total supply

Relative shares of intermediate input and value added to total output:

ratint = intermediate input / total output

rva = value added / toal output

Other indices:

Price of domestic demand (PDD) = nominal domestic demand/real domestic demand

Import price = nominal import / real import

relpri = PDD / import price

Factors determining international competitiveness:

IIC = f (- *diagintr, - rndintr, - rfdrxex, - rintrfdr, rva, - ratint, - relpri,* etc)

Meaning of the explanatory variables:

Diagintr as an explanatory variable with negative sign is meant to show the effective use of resources within the sector.

Rndintr, rfdrxex and *rintrfdr* as explanatory variables with negative sign are meant to act as export absorption factors.

Ratint as an explanatory variable with negative sign is meant to show the resource saving effect by reducing the intermediated input.

Rva as an explanatory variable with positive sign is meant to show profitability to induce export drive effect.

Relpri as an explanatory variable with negative sign is meant to show price effect.

Dummy variables:

B_1 = 1.0 for 1985 - 1989 (first sub period), and B_1 = 0 for 1990 - 1999 (second sub period)

B_2 = 1.0 for 1985 - 1990 (first sub period), and B_2 = 0 for 1991 - 1999 (second sub period)

B_3 = 1.0 for 1985 - 1991 (first sub period), and B_3 = 0 for 1992 - 1999 (second sub period)

B_4 = 1.0 for 1985 - 1992 (first sub period), and B_4 = 0 for 1993 - 1999 (second sub period)

B_5 = 1.0 for 1985 - 1993 (first sub period), and B_5 = 0 for 1994 - 1999 (second sub period)

Specification of the equation used in the analysis:

Type A $IIC_i = a_0 + a_1\text{time} + a_2 diagintr_i + a_3 diagintr_i B_j + a_4 relpri_i$

Type B $IIC_i = a_0 + a_1\text{time} + a_2 rfdrxex_i + a_3 rfdrxex_i B_j + a_4 relpri_i$

Type C $IIC_i = a_0 + a_1\text{time} + a_2\text{rintrfdr}_i + a_3 rintrfdr_i B_j + a_4 relpri_i$

Type D $IIC_i = a_0 + a_1\text{time} + a_2 rva_i + a_3 rva_i B_j + a_4 relpri_i$

Type E $IIC_i = a_0 + a_1\text{time} + a_2 ratint_i + a_3 ratint_i B_j + a_4 relpri_i$

Where,

i = 10-64, j = 1-5.

In each type of equation there are five alternative types of estimation results according to the type of the dummy variable from B_1 to B_5. In this analysis criteria to select equations are (1) sign condition of the parameter is to be consistent with the assumption and (2) adjusted RSQ should be over 0.6.

Results of estimation are in table-4 to table-8. As tables show some sectors could not succeed in getting the good result of estimation. We can examine the effects of structural changes on the IIC by comparing the size of parameter of (a_2+a_3) with a_2, since (a_2+a_3) is the size of parameter in the first sub period, and a_2 indicates the size of parameter in the second sub period. If the comparison shows big difference, it suggests the effects of the factor determining the level of IIC in a certain sector in the first sub period is quite different from that in the second sub period. Whether it shows the existence of some structural changes in the factors determining the level of IIC or not, it remains to be seen until

we examine much more carefully the data and relations by the further test such as Chow's test. At least we can indicate the turning point of IIC of some sectors, which will be discussed in the next section.

4. Turning points in the index of international competitiveness

The table-9 shows, in the sectoral IIC equation, the relative size of the structural parameter in the second sub period compared with the size of the parameter in the first sub period. There are five types of equations with different explanatory variables, and each type has five alternative equations with the different dummy variable of B_1 to B_5. The figure in the shadowed cell in the table shows the lowest or the highest relative value in the five alternatives of estimation using five different types of dummy variables. It is most appropriate to start from the upper left corner of the table. It is the results of type A where *diagintr* is an explanatory variable of IIC with a "coefficient change" dummy variable. The lowest figure of the relative size of the parameter of IIC in sector 10; food products is 0.614, when the dummy variable of B_3 was included in the equation. It is meant that in the equations with other dummy variables than B_3, the parameter value in the second sub period relative to the value in the first sub period is larger than the figure calculated from the parameters in the equation with the dummy variable of B_3. Then it suggests that the turning point of IIC of sector 10 may be in some time between 1991 and 1992, and after that the level of IIC is worsening, though we can't confirm it by the results of other types of equations. In the case of sector 14; clothing, we can read from the results of type B and type C that the turning point of that sector's IIC was same as in the case of sector 10; food products. This turning point was one year after the year, in the macroeconomic sense, when the bubble economy burst.

Sector 17; pulp & paper products is quite different from sectors 10 or 14. The peak value of relative size of the parameter appears when the IIC equation was estimated with the dummy variable B_4 suggesting the turning point to be in some time between 1992 and 1993, and after that the level of IIC is improving, though we can not confirm it by the result of other types of equations. In the case of sector 30; rubber products the turning point seems to be in some time between 1990 and 1991, and after that the level of IIC is improving, though we can't confirm it by the result of other types of equations.

In the case of sector 43; other metal products, all five types of equations were successfully estimated. Type A, type C and type D present the same results suggesting the turning point seems to be in some time between 1991 and 1992, though the result by type B was somewhat different. It was in some time between 1992 and 1993. The result by type E was fluctuating and could not indicate a clear turning point.

We can't identify the turning point of the IIC of 28 sectors discussed below. The estimated results for these sectors could neither produce enough information to point out their turning point

(sectors 11; beverages, 12; feeds & fertilizer, 15; wooden products, 19; chemical fertilizer, 20; basic chemicals, 23; chemical resin, 25; medicine, 27; petro-products, 29; plastic products, 38; steel cast, 39; non ferrous metal, 41; metal construction, 42; other metal products, 45; machine tool, 49; machine services, 50; house electric machinery, 53; electric appliance, 60; rail equipment and 62; other transportation equipment), nor clear the criteria to select the equations at all (sectors 13; textiles, 22; organic chemicals, 24; chemical fiber, 32; glass, 33; cement, 36; pig iron, 37; steel, 48; office machine and 57; other light electric machinery).

We can classify remaining 27 sectors into three categories according to the difference in the turning point the followings;

Category 1: with dummy B_2, turning point is in some time between 1990 and 1991.

Category 2: with dummy B_3, turning point is in some time between 1991 and 1992.

Category 3: with dummy B_4, turning point is in some time between 1992 and 1993.

Table-10 shows the distribution of 27 sectors by type of equation and by category.

In category 1 following sectors are grouped; sectors 16; furniture, 18; printing, 26; final chemicals, 30; rubber products, 34; pottery, 51; computer, 52; communication equipment, 55; electric parts, 56; heavy electric machinery, 61; air plane, and 63; precision industry. Their turning point coincides with the year when the bubble of macro economy burst.

In category 2 following sectors are included; sectors 10; food products, 14; clothing, 18; printing, 21; petro-chemicals, 28; coal products, 31; leather products, 34; pottery, 40; processed nonferrous metal, 43; other metal products, 44; general machinery, 46; special machinery, 47; other machinery, 52; communication equipment, 54; IC, 58; motor vehicle, 61; air plane, and 64; miscellaneous manufacturing. Their turning point was one year after the year, in the macroeconomic sense, when the bubble economy burst.

Category 3 contains the following sectors; sectors 17; pulp & paper products, 35; other ceramic, 43; other metal products, 51; computer, 59; ships, and 61; air plane. Their turning point is two years after the year when the bubble of macro economy burst.

It should be noted that, as table-10 shows, some sectors are classified into two or three different categories making their turning point somewhat ambiguous. On the contrary, we may safe to say that the following 10 sectors are showing clear turning point; sectors 16; furniture, 26; final chemicals, 31; leather, 63; precision industry, 14; clothing, 40; processed nonferrous metal, 44; general machinery, 47; other machinery, 58; motor vehicle, and 59; ships. For example it was confirmed that sector 26; final chemicals belonged to category 1 by the equations type A and type E. In the case of sector 59; ships, equations of type A, type D and type E show that it belonged to category 3.

5. Conclusion

In this analysis of structural changes and international competitiveness, we are not satisfied

with what we have done so far. Our purpose to identify the turning point of sectoral IIC in the past observation period was not fully achieved. Some reasons for our half done job will be discussed later, but firstly the brief summary of the content of this analysis should be presented. In section 2 past performance of IIC was observed from a various angles to distinguish the sectoral pattern of movements. It was found out that out of 55 sectors only 11 sectors were showing upward trend in the movement of their IIC in the observation period of 1985-1999. If we compare the average of IIC during the bubble economy of 1985-1990 and that in the period of 1991-1999, three more sectors showed that their IIC were improving.

In section 3 factors related to the movement of IIC was investigated in the framework of input-output database. Five factors of *diagintr*, *rfdrxex*, *rintrfdr*, *rva*, *ratint* were selected as the domestic factors determining international competitiveness, and IIC was regressed by one of them in addition to time trend and the relative price. The most successful factor determining behavior of IIC was *diagintr*, and the next was *rfdrxex*. In finding out the turning point of IIC the above equations were modified to the equations with the "coefficient change" dummy variable.

The discussion on the result of these regressions, the main part of this analysis, is the content of section 4. Out of 55 sectors 27 sectors were more or less identified as showing their turning point, though only 10 sectors were successful in describing their definite turning point. For the remaining 28 sectors we can't identify the turning point of their IIC. The estimated results for these sectors could neither produce enough information to point out their turning point, nor clear the criteria to select the equations at all.

Our tentative conclusion from this analysis is while the international competitiveness of some industries were certainly affected by the structural changes in the intermediate demand and final demand, most of them did not show clear turning point of their IIC partly because of the lack of additional explanatory factors such as labor output ratio, capital output ratio, R & D, *etc*[6]. Our intention is, as a first step, to investigate the relations between IIC and the industrial structure within the framework of input-output database. The other finding is that the turning point of sectoral IIC is quite different by sector. The reasons of this sectoral difference should be investigated in the separate study.

Since this analysis is not yet finished, it is most appropriate to point out the remaining works that should be done for the completion of this analysis of structural changes and international competitiveness. First, one of the most urgent tasks is to finish building our Jidea5 model as quickly as possible, and this study on the relationship between IIC and structural changes should be completely reexamined in the framework of the simulation analysis based on Jidea5 model. In this

[6] An earlier example is available in Urata, S., (1983), "Factor Inputs and Japanese Manufacturing Trade Structure", *The Review of Economics and Statistics*, Vol. LXV, No. 4, November, pp. 678-684.

study the definition of IIC is net exports divided by total trade. It may be of much interest to apply, as an alternative measure of our IIC, net exports, adoption of which is available in Noland (1993).[7]

[7] Noland, M. (1993), "The Impact of Industrial Policy on Japan's Trade Specialization", *The Review of Economics and Statistics*, Vol. LXXV, No. 2, May, pp. 241-248.