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JAPAN'S STEEL SUPPLY AND DEMAND TRENDS

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ABSTRACT

Steel, as an important basic material, has a close relationship with the economic structure of Japan. This paper will attempt to analyze as quantitatively as possible the mid-and-long term trends of Japan's steel supply and demand under the enormous changes of her economy including the growth of information and service industries, and the drastic yen appreciation after 1985.

Following the introductory statements of Chapters 1 and 2, Chapter 3 discusses the methodology used to forecast demand for steel. Here we have developed a new model that uses an explicit approach adopting input-output analysis method and incorporating the idea of a relationship between steel demand and economic structure, which traditional forecasting models (steel GNP intensity, SWIP index, etc.) have not done.

In Chapter 4, we use this model to predict what Japan's steel supply and demand will be around the year 1995. Interviews were also conducted with representatives of such steel-using industries as construction, automobiles, and electrical machinery in order to verify the prediction.

In conclusion, It is forecasted that domestic steel demand in Japan will fall over a mid-and-long term perspective because of the changes in the industrial structure. Net exports will also fall because of the strengthening of international competitiveness in newly developing steel countries.

The prediction by our model is basically supported by the interviews with the major steel-using industries. More specifically, the model is an adequate one when looking at the relationship between steel supply and demand, and the domestic economy. One of the remaining problems is the forecasting of exports and imports, which requires that a world steel trade model be developed.

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CONTENTS

1. INTRODUCTION

Steel is called the backbone of industry. Its widespread application in civil engineering and construction, automobiles, electrical machinery, general machinery and shipbuilding makes it the most critical of metals. Japan currently leads the free world in basic steel production volume and accounts for more than 20% of all steel exported around the world. It goes without saying that Japan's steel industry plays a very important role in the world.

The drastic appreciation of the yen from the latter half of FY 1985 resulted in a drop in Japanese exports and put damper on the operations of steel-using industries, causing a corresponding decline in steel production. This situation has been turned around, however, since the second quarter of FY 1987, thanks to adjustments made in inventories and the introduction of government measures to stimulate domestic demand, which increased the demand for steel by the construction industry. In addition, Japan's steel industry is dealing with such mid- to long-term matters as the establishment of more efficient production systems, production of higher grade products, and more flexible production processes, in order to counteract the economic upheaval caused by the yen's appreciation.

Under these conditions this paper attempts to forecast supply and demand trends for steel in Japan. This paper is distinctive in that existing methodology was disregarded in order to create a totally new forecasting method. In the new method, demand is predicted according to the depth of the relationship between steel and the Japanese economic and social structure, as well as the relative importance of the Japanese steel industry in the global steel trade.

2. THE CURRENT STATE OF STEELMAKING

Japanese crude steel production exceeded 100 million tons for the first time in 1973 when it reached a record-setting 119.32 million tons. Then the world was hit with the first oil crisis, causing a drop in Japanese domestic demand and the imposition of strict energy conservation measures. Despite the fact that 1976 crude steel production increased over the previous year because of an increase in steel exports, the stage for a downward trend had been set, and production fell to 102.11 million tons in 1978. Though crude steel production recovered somewhat 111.75 million tons in 1979, the world was rocked by

another oil shock, which further stagnated domestic demand. Together with increased steel imports and increased price of iron ore and other raw materials, this caused four consecutive years of decline starting in 1980, with production for 1982 dropping below the 100-million ton level for the first time in ten years. 1983 saw a further drop to a modern day all-time low of 97.18 million tons. The 100-million ton mark was regained in 1984, thanks to an increase in domestic demand, but it still accounted for only 88.5% of the 1973 peak. Though exports continued to decline, production in 1987 was boosted to 98.51 million tons by a second half increase in domestic demand. This 0.2% increase over the previous year was due to a recovery of demand by the construction industry, fueled by public works spending, as well as renewed demand from manufacturing industries. In 1988 continuing strong steel demand led to steel production of 105.68 million tons, a 7.3% increase over the previous year, firmly reestablishing the Japanese steelmaking industry above the 100-million ton level (see Figure 2-1).

3. METHODOLOGY USED TO FORECAST DEMAND FOR STEEL

(1) Reviewing the Current Forecasting Methods

Some commonly applied methods to forecast the demand for steel are the steel GNP intensity, SWIP index, and simple macroeconomic models. Each has its own relative merits and demerits.

The steel GNP intensity expresses volume of steel consumption relative to gross national product. Therefore, if the future GNP can be forecasted, the steel GNP intensity can be used to forecast the corresponding steel demand. However, GNP alone is inadequate in interpreting steel demand because it is overly macro-oriented and does not sufficiently take into account the impact of changes in the economic structure and industrial structure. History has proven that events such as the oil shocks result in a significant gap between GNP and steel consumption, as illustrated in Figure 3-1.

The SWIP (Steel Weighted Industrial Production) index converts the production levels of various steel-using industries into a steel consumption volume. The following is the formula used for the conversion:

$$SW_t = \sum_{i=1}^{n} W_{io} I_{it} \qquad (1)$$

SW_t: SWIP at time t

I_{it}: Production of industry i at time t

W_{io}: Steel intensity relative to the production of industry i at time o

Since the SWIP index reflects both overall economic growth and the growth differentials between the industries that comprise the GNP, it provides a more accurate forecast of steel consumption than that using the steel GNP intensity measures. However, the steel intensity factor used for each industry in the SWIP calculation is fixed at a standard point in time, so events that cause large changes in steel intensity generate significant differences between the SWIP index and the volume of steel consumption. The historical data in Figure 3-1 show that the validity of the SWIP index declined during the periods following the oil shocks as well as that of GNP. In addition to all of this, consumption forecasting requires the preparation of production estimates for each steel consuming industry, and so application of the SWIP index is much more complex than the steel GNP intensity, which deals with GNP only.

The simple macroeconomic model interprets the volume of steel consumption in terms of such variables as the floor area of

building starts, the number of automotive vehicles produced, and the gross domestic fixed capital formation. However, such a model tends to rely on rules of thumbs that give priority to a convenient fit with the facts. Consequently, the simple macro-economic model is effective for short-term forecasts of demand where the economic structure is assumed to change little, but is ill-fitted for mid- to long-term forecasts.

(2) Development of the Demand Forecast Model[1)]

Though each of the forecast models described above has its own particular shortcomings, they all share one flaw: none of them adequately incorporates the relationships between demand and steel consumption into their formulations. Of course, this statement is open to the rebuttal that trying to theoretically produce a more accurate forecast would make the model more complex, detailed, and unwieldy, and would lead to problems caused by unavailability of data. Once the ideal model is constructed, however, it can play an important role in locating defects in and improving current models. Even though the ideal model cannot be entirely employed due to lack of data now, it can be practically and effectively employed as the data becomes available.

The consumption forecast model used here was developed and the forecast was formulated, with such problems firmly in mind. The actual forecast results are presented in Section 4 of this paper, while this section deals with the formulation of the forecast.

The following equilibrium equation for the Input-Output Analysis was used as a base:

$$X = AX + F_d + E - M \tag{2}$$

X: Production vector

A: Input coefficient matrix

F_d: Final domestic demand vector

E: Export vector

M: Import vector

Since imports are expressed as a function of total domestic demand:

$$M = \bar{M}\,(AX + F_d) \tag{3}$$

$\bar{M}$: Import coefficient matrix. In the competitive-import type model being applied here, a diagonal matrix is formed of product-specific import coefficient m_i.

Consequently, the Input-Output model becomes the following:

$$X = (I - (I - \bar{M})\ A)^{-1}\ (\ (I - \bar{M})\ F_d + E) \qquad (4)$$

Using this to calculate steel demand SD:

$$SD = ki\ (I - (I - \bar{M})\ A)^{-1}\ (\ (I - \bar{M})\ F_d + E) \qquad (5)$$

k: Conversion coefficient from monetary base of steel amount to a physical amount

i: Row vector where steel sector is represented by 1 and other sector by 0.

Final domestic demand is further broken down as follows:

$$F_d = F_c + F_i + F_h + F_p + F_s \qquad (6)$$

F_c: Private consumption vector

F_i: Private plant and equipment investment vector

F_h: Private housing investment vector

F_p: Government fixed capital formation vector

F_s: Inventory net increase vector

Using the formulas presented here, for instance, domestic steel demand caused by private investment in plant and equipment becomes:

$$SD\ (F_i) = ki\ (I - (I - \bar{M})\ A)^{-1}\ (I - \bar{M})\ F_i \qquad (7)$$

The coefficient vector of F_i is equivalent to "steel intensity relative to private plant and equipment investment". "Steel intensity" is not simple, because it depends on input industry constitution to private investment, import ratio of each product and production technology. Next, domestic steel demand caused by export becomes:

$$SD\ (E) = ki\ (I - (I - \bar{M})\ A)^{-1}\ E \qquad (8)$$

In this formula, kiE represents direct steel exports, while SD (E) - kiE is equivalent to indirect steel exports.

Expressing steel GNP intensity by using this model results in the following. From formula (1):

$$X = (I - A)^{-1}\ (F_d + E - M) \qquad (9)$$

$$SD = ki\ (I - A)^{-1}\ (F_d + E - M) \qquad (10)$$

$$GNP = GNE = j\ (F_d + E - M) \qquad (11)$$

j: Unit row vector

Consequently:

$$SI=SD/GNP=ki(I-A)^{-1}(F_d+E-M)/j(F_d+E-M) \quad (12)$$

The steel GNP intensity can be approximated by the weighted sum of the steel intensity relative to each component sector of GNE. Consequently, it depends on GNE configuration, input industry ratio, the import ratio for each product, and production technology coefficient. Therefore steel demand forecasts become useless in mid- to long-range forecasting because changes in the economic structure becomes more complex.

(3) Procedure for Forecasting Steel Demand in FY 1995

(i) Steel demand forecasts for each final domestic demand sector (including indirect exports) were made using the demand forecast model described above.

The Nikkei Macroeconomic Model was used for the final demand sector forecast. The following are the premises for the main exogenous variables:

1) Exchange rate, in FY 1995...¥115/dollar
2) Actual world export growth rate, until FY 1995... 3.0%/year
3) Actual U.S. GNP growth rate, until FY 1995...3.0%/year

Trends following the last oil shock were used to forecast the input industry ratio to each final demand sector and the production technology coefficient. (Strictly speaking, the RAS method or Lagrange's method should be used in order to maintain model equilibrium, but the simpler method was adopted here because of the time limitation.) For the import ratio for each product, trends following the appreciation of the yen were used.

(ii) By grasping trends for the main steel-consuming industries (i.e. construction, automobiles, electrical machinery) through discussions with representatives in each industry, the forecast in (i) above was verified.

(iii) Problems such as international competition and measures to limit imports such as those being imposed by the U.S. make a quantitative forecast of steel trade very difficult. Therefore, a separate forecast was prepared, using the forecast produced by the model in (i) as a reference.

Note:[1)] Opinions have been voiced that technological change, composition of demand and acceleration principle should be considered as factors explaining the relationship between GNP and steel consumption. Actually those factors are already

considered in our model.

First, concerning technological change, the technological coefficient of the input-output submodel, Aij, is estimated for FY 1995 in our model. As for the composition of demand, the input-output submodel covers all the sectors of final demand and user industries.

Finally, the following is one of the models considering acceleration principle.

$$SD = F\ (GNP,\ \Delta\ GNP) \tag{13}$$

where SD is domestic demand for steel,

Δ GNP is the difference of GNP over the previous period.

This model is better than the steel intensity model, which explains the steel demand by GNP only. However (13) is transformed into:

$$SD = G\ (GNP,\ I) \tag{14}$$

$$I = v\Delta\ GNP \tag{15}$$

where I is investment,

v is acceleration coefficient.

(14) is included in the input-output submodel and (15) in

the macroeconomic submodel, respectively.

4. TRENDS IN STEEL SUPPLY AND DEMAND

(1) The Japanese Economy and Steel Demand in Fiscal 1995

According to model predictions, Japan's GNP in fiscal 1995 will be 375 trillion yen (based on 1980 constant prices). Due to the continuing strong yen and development of overseas direct investment, exports will experience only slight growth and reach about 62 trillion yen. As for imports, factors such as increased imports from the NIES countries will bring this figure to about 54 trillion yen. Concerning domestic demand, there will be only slight increases in private housing investment and public fixed capital formation, but an overall increase in demand can be expected because of higher rates of private consumption and investment in private facilities. Thus, this figure will be about 367 trillion yen.

Turning our attention to changes in industrial structure we see that the level of dependence on exports in Japan's manufacturing industries will decrease accompanied by the further

advance of a horizontal division of labor as manufactured goods imports increase. Dependence on foreign demand will thus decrease. At the same time, manufacturing industries are shifting their emphasis to higher value-added and the economy will be increasingly characterized by service industries. What will happen to steel demand under the conditions just described?

i) A decrease in indirect exports

A decrease in indirect exports will be brought about by the synergetic effect of two factors. First of all, the steel exports themselves will grow less rapidly than before. Following the appreciation of the yen in 1985, the manufacturing industries have been promoting development of domestic markets and establishing overseas production facilities. This will result in less dependence on exports. Secondly, steel export intensity will continue to decline. As Figure 4-1 shows, the steel intensity relative to export has shown a downward tendency ever since 1980, the period immediately following the second oil shock. This is due to a decrease in ships among export items and an increase in electronic items or products containing such items. This trend is expected to continue, resulting in the continued decline of indirect exports. Thus, the indirect exports of ordinary steel material in fiscal 1995 will be about 11.78 million tons as

compared with 15.59 million tons in fiscal 1985 (Table 4-1).

ii) A decrease in investment-related steel consumption

Changes in the content of private facility investment and public investment will be seen as the information-oriented society develops and service industries continue to grow. As Figure 4-1 shows, steel intensity relative to domestic investment has been declining since around 1980, with the exception of private housing investment. This reflects a decrease in large investment items and an increase in technology-intensive investment, especially computers and OA-related investment.

In addition, such service industries as consulting and leasing are expected to account for an increasing proportion of the input industry to overall investment. This in turn will lead to a further decrease in steel investment intensity. In contrast, investment in private housing has shown an increase in steel intensity since FY 1982. This reflects a burgeoning market for non-wooden structures during this period and it will no doubt hit a peak eventually.

Summing up, we can say that the consumption volume of ordinary steel materials in all domestic investment sectors was 39.07 million tons in fiscal 1985 and that this figure will probably decrease to 38.94 million tons by fiscal 1995.

As Table 4-1 shows, the forecast of domestic consumption of ordinary steel materials in fiscal 1995 will be 56.66 million tons. When we add special steel materials, the domestic demand for steel materials will be 66.03 million tons.

(2) Trends in the Major Steel-Using Industries

To verify predictions made according to the model, interviews were conducted with representatives of such steel-using industries as construction, automobiles, and electrical machinery to obtain a forecast of FY 1995.

Table 4-2 shows trends for domestic steel demand by industry, of which the above three industries accounted for 60% during FY 1985.

The results of the interviews can be summarized as follows: demand for steel in the construction and electrical machinery industries will be about the same in 1995 as it is now while demand in the automotive industry will have declined. When declining demand in the shipbuilding industry and others is included, the anticipated domestic demand quite closely matches the 66 million-ton figure predicted by the model.

i) Construction

A medium-range prediction of steel consumption in the construction industry has not been conducted. Predictions have mostly been limited to the subsequent year in order to plan the procurement of materials. As a result, there is no solid prediction method and no medium-range prediction figures have been obtained using theoretically based analysis. Nevertheless, we can say that steel consumption in this industry up to 1995 will probably be slightly higher than 30 million tons.

The present total steel consumption volume in Japan is about 70 million tons, of which about 30 million tons is accounted for by the construction industry.

Demand held fairly steady at 25 to 26 million tons between 1982 and 1986. In the last two or three years, however, there has been growth that could be interpreted as special procurement (Steel demand in the construction industry as a whole during fiscal 1986 can be broken down as follows: 19.54 million tons for building construction and 8.51 million tons for public works for a total of 28.05 million tons. The 1987 figures were 22.04 million tons for construction and 9.07 million tons for public works for a total of 31 million tons). In general, steel consumption rises or decreases about two years after an actual fluctuation in the economy. Lively demand for steel construction materials continues because of governmental stimulation that has

led to an increase in construction projects. This demand will probably continue for the next two or three years at more or less the same level. However, demand has reached a plateau since the end of 1987 and will probably begin to decline in 1990, though it is not likely to fall below 30 million tons.

One of the reasons that demand will remain stable at 30 million tons is because there are limits to import growth. In recent years, imports of steel materials have been on the increase, but this trend is not expected to continue. Although materials from South Korea have shown exceptional improvement in quality, it will be difficult for Korean steelmakers to carry out a large-scale retooling of production lines to meet JIS standards unless there is a large guaranteed demand in Japan.

Moreover, Japanese steelmakers are a large potential customer for the domestic construction industry in the building of their factories and buildings, and the construction industry cannot afford to ignore them. Even in 1995 the percentage of imported steel materials used in construction is not expected to climb to more than 1%. Thus, it is negligible as a factor that would alter the demand prediction.

A second reason why steady demand for domestically produced steel is expected is the growing popularity of steel-frame buildings. Although skilled laborers are needed in considerable numbers to construct concrete buildings, steel-frame buildings

feature a simple construction method based on standardized techniques (They require less time, are simpler to build, and make labor supervision easier.). In addition, steel-frame buildings are highly suitable as tenant buildings, which are expected to occupy an increasing share of the construction market. Although their initial cost is high[1)], steel-frame buildings are highly adaptable, and answer the need for increased building height[2)].

We have outlined two reasons why demand for steel in Japan will not be less than 30 million tons in 1995. It is also predicted that demand will not significantly exceed the 30 million-ton level. Since ordinary construction demand is at a high level even now, big projects using large amounts of steel in Japan around 1995 will be necessary if demand is to exceed the 30 million ton level.

The Tokyo Bay Crossover Project is the only project planned around that time. However it will not be until the end of that project that large amounts of steel will be consumed, so not very much steel will be used before 1995.

There is also the view that since big projects do not occur regularly, one should not attach much importance to them in mid-

term forecasts of steel demand.

Note: 1)Soaring land prices have reduced construction costs to less than 10% of total project costs. A slightly more expensive construction method is therefore more likely to be tolerated than before, if it offers certain other advantages.
2)It is common practice to use steel frameworks in buildings higher than 31 meters, which corresponds to about 10 floors. Buildings lower than this are generally constructed with reinforced concrete. Skyrocketing land prices have prompted contractors to build higher structures in order to make optimum use of available space.

ii) Automobiles

Because of the solid domestic demand, automobile production has been good so far. However future prospects are very uncertain.

First of all, domestic demand is expected to slow in 1990, especially in the passenger car sector because of a round of replacement demands.

As for trucks, there used to be quite a close correlation between truck demand and such factors as a rise or fall in the GNP, the volume of goods transported, and the number of trucks produced. Recently, however, other factors that are not directly affected by the GNP have been playing a greater role. These include increased consignment shipping, greater business rationalization and efficiency, and longer vehicle service life. Thus, production figures for trucks are expected to decrease in 1990 and the years following.

The export environment will continue to worsen. At present, more than 70% of the world market has become part of "managed trade." It is no longer possible to increase production simply by stepping up exports. There will be more and more local production overseas: Japanese car makers are expected to increase local production by 200 thousand vehicles during this fiscal year. According to one research institute, local production figures in 1986 amounted to 570 thousand vehicles, and this figure will climb to 1.64 million vehicles by 1990. Local production capacity for 1990 is expected to stand at 2 million vehicles. Knock-down exports are expected to increase considerably, but an increased ratio of locally procured parts will keep the growth of knock-down exports lower than the growth of local production.

There will be an even greater increase in imports. The total number of imported cars sold on the Japanese market in 1987

amounted to 97,750 cars, an increase of 43% over the previous year, continuing a trend that began in 1985. The Japanese government's import promotion policies and the energetic efforts of overseas makers and Japanese dealers will no doubt continue to increase the number of imported car sales, which will reach about 300 thousand by 1995.

A final factor that cannot be ignored is the fact that the automobile industry is a mature industry. Automobile saturation rates around the world have reached 70 percent. There are also physical constraints to growth such as roads, traffic control, and parking lots. Thus, the demand will eventually reach its peak. Predicted world car demand for 1990 is 48.7 million cars, which is some 3 million cars less than the predicted production capacity, which is expected to exceed 51 million.

From the above it becomes clear that domestic production of cars in Japan will not grow that much in the medium term. Instead, there will be an increase in overseas local production and local parts procurement. The most likely scenario is a slow and steady decline in domestic car production, which would result in a decline in domestic demand for steel in this sector.

Steel imports are not expected to have a significant impact on domestic market conditions in the years up to 1995. Japan has the most advanced steel rolling technology in the world. Thus, it is highly unlikely that Japanese auto makers will start to rely

on imports for the high-grade steel they use in their cars. Nor is it predicted that new materials will be used as replacements for steel to a significant extent up to 1995.

iii) Electrical Machinery

Medium-range predictions are not generally formulated in this industry. Production figures were expected to decline for electrical equipment last year, but they were sustained by domestic demand so that in fact there was an increase of 4.1% over the previous year. This demonstrates the impossibility of forecasting even a year into the future. Our attempt at prediction will be limited to trends in domestic demand and overseas production.

The shift to overseas production is expected to continue steadily. One large manufacturer, for example, is presently planning to construct a factory on an 80-acre in Thailand for production of electrical appliances. All major firms are stepping up local production of household and office equipment in North America and Europe in order to respond more sensitively to local markets. In recent months, of course, the idea of shifting overseas to deal with trade friction has also taken on increasing

importance. In the future, production is likely to become more specialized: high-grade electronic products that use integrated circuits, and other high-tech products will be produced in Japan, while other electrical appliances and equipment will be manufactured abroad.

Other matters of interest in 1995 include the question of how competitive South Korea and Taiwan will be, and what the exchange rate will be. Both of these factors are extremely difficult to predict.

Japanese manufacturers of electrical equipment can expect three advantages in the years up to 1995: 1) new product development will stimulate demand; 2) consumers will replace old products with new products faster; and 3) Japanese products will retain their superior competitiveness on the international market (The first two advantages will not be greatly influenced by economic trends). Disadvantages will include the shift to overseas local production and a decline in steel intensity relative to production of electrical equipment. Taking all of these factors into consideration, it is predicted that consumption of ordinary steel materials by the electric machinery industry in 1995 will be in the area of 4.5 million tons.

Specialty steel is used mainly in the heavy electric industry to make generators and other equipment for producing electricity. Since electric power consumption in Japan is not

expected to grow much, it is probably safe to assume that demand for specialty steel will level off.

There are few products that will make use of imported steel materials. The technical level of Japanese steelmakers in the area of fine steel is ahead of the rest of the world, so that Japanese manufacturers are unlikely to turn to imports, particularly for the visible areas of their products. Consumer demands are very exacting, especially with regard to specifications and delivery, and foreign steel does not meet these requirements. When it comes to procurement on the spot market, too, there are problems with deadlines and securing volumes. Of course, the exchange rate and international conditions will have an influence, but in general no significant increase in the use of imported materials is expected up to 1995. Moreover, Japanese manufacturers are endeavoring to produce high-quality products inexpensively[1)], further undercutting the position of imports. Nevertheless, when there are overwhelming differences in price, there is a chance that people on the demand side will begin thinking about finding ways to incorporate steel products of inferior quality. This would include using such steel in parts that are not visible or changing the production facilities so that they can accommodate materials of lesser quality.

Turning now to the issue of local production overseas, we

find that local procurement in foreign countries is likely to increase. Two factors promoting this trend are; 1) Foreign countries are demanding an increase in the local procurement ratio; and 2) consumers show little regard for the outside appearance of products. However, the question must be addressed as to whether or not production lines can accommodate subtle differences in material quality (that is combinations of quality characteristics that can not be detected with analysis equipment).

Note: [1] High tensile strength steel is one example. Applications that used to require 3 mm plates can now be satisfied with 1 mm plates, which are less expensive.

(3) Trends in Imports and Exports

In making predictions of steel imports and exports, we must first take into consideration the trade environment for steel on the world market. Looking at the steel trade balance throughout the world, we see that overall world export volume in 1985 was 97 million tons on a crude steel basis. Of this figure, Japan exported 30 million tons, the EC countries exported 28 million tons, and the newly developing steel countries Brazil, Taiwan and

South Korea exported 38 million tons, in net exports (exports minus imports). As for net importing countries, the US imported 29 million tons, China 26 million tons, and the developing countries 42 million tons.

To determine the steel trade balance in the medium term, it will therefore be useful to get a grasp on the trends of the six groups just mentioned. A simple model of supply and demand balance can be expressed as follows.

$$\sum_{i=1}^{6} T_i\ (D_i,\ C_i,\ \theta_i,\ \lambda_i) = 0 \qquad (1)$$

i=1: Japan, i=2: EC countries

i=3: newly developing steel countries

i=4: US, i=5: China, i=6: Developing countries

T_i: i-country's net exports

D_i: i-country's domestic demand (apparent consumption)

C_i: i-country's supply capacity

θ_i: i-country's international competitiveness

λ_i: i-country's economic policies

θ_i is a variable expressing international competitiveness on the steel market. One approach makes price a representative variable. However, non-price factors (quality, supply time,

customer services, conformation to standards, etc...) all play a major role so that this is not easy to calculate (refer to Yagi and Komatsu (1989) for details on international competitiveness). The variable λ_i expresses government policy in response to the steel industry such as restrictions on imports.

There are formed the following relations among the variables:

$$\frac{\delta Ti}{\delta Di} \leq 0 \qquad \frac{\delta Ti}{\delta Dj} \geq 0 \qquad (i \neq j) \tag{2}$$

$$\frac{\delta Ti}{\delta Ci} \geq 0 \qquad \frac{\delta Ti}{\delta Cj} \leq 0 \qquad (i \neq j) \tag{3}$$

$$\frac{\delta Ti}{\delta \theta i} \geq 0 \qquad \frac{\delta Ti}{\delta \theta j} \leq 0 \qquad (i \neq j) \tag{4}$$

$$C_i^{t+1} = f\,(D_i^t + T_i^t)\ ;\ \frac{\delta f}{\delta x} \geq 0 \tag{5}$$

$$D_i = g\,(IIP_i)\ ;\ \frac{\delta g}{\delta x} \geqq 0 \tag{6}$$

t: time

IIP_i: i-country's industrial production

While it is theoretically possible to make a linear approximation of this model and use econometric methods to compute the balance of steel trade on the world market in fiscal 1995, it is actually very difficult since there are limitations on data and uncertainties concerning such factors as the policies of the individual governments. However one can imagine a situation consistent with this model.

Looking at trends among net importing nations, we see first of all that the US will recover its competitive strengths in manufacturing industries such as automobiles and machinery. As a result, domestic demand for steel will probably increase. However, this demand could be met by U.S. steelmakers, who will have improved their labor productivity and become more competitive. It is therefore possible that U.S. imports of steel will not increase. In addition, if the voluntary restraint arrangements (VRA) that have been adopted by U.S. trading partners such as Japan, the EC countries, and South Korea, should continue, U.S. imports are not likely to increase.

In China, continued modernization policies will lead to a rise in domestic demand, but an expansion of supply ability is also possible, so there will probably not be much of an increase in imports. In particular Japanese exporters to China have been emphasizing larger profit margins since the appreciation of the yen, so that the actual amount of exported steel is likely to

decrease.

Turning to the net exporting nations, the newly developing steel countries such as South Korea are planning to increase supply capacity beyond their respective domestic demands. They will also increase their international competitiveness. Consequently their share of the market will grow, thus putting considerable pressure on other net exporting countries, Japan and the EC nations.

Considering the scenario sketched above and the recent state of imports and exports in Japan (Figures 4-2 and 4-3), Japan's net exports in FY 1995 will probably be about 19 million tons on crude steel basis.

(4) Trends in Crude Steel Production

As the above shows, Japan's domestic demand for steel and net exports of steel are predicted to decrease. How will this affect the production of crude steel? Examining trends over the past ten years, we see that the development and proliferation of new technologies such as continuous casting increased yield rates for steel materials from 85% in 1975 to 93% in 1985 (Figure 4-4). This is one of the factors behind the recent decline in crude steel production (Figure 4-5).

On the other hand, rapid developments over the past 10 years have resulted in a basically mature steelmaking technology. Thus, instead of new developments, innovations now will be limited to improving existing technologies. Improvement in the yield rate will also not be as rapid as before (see Murase and Matsuyuki (1989) for details concerning the technological innovations).

Assuming present yield rates, the amount of crude steel produced in FY 1995 for domestic use will be about 71 million tons.

Net exports on crude steel basis will be about 19 million tons. Thus, total production of crude steel in Japan during FY 1995 will be about 90 million tons.

5. CONCLUSIONS

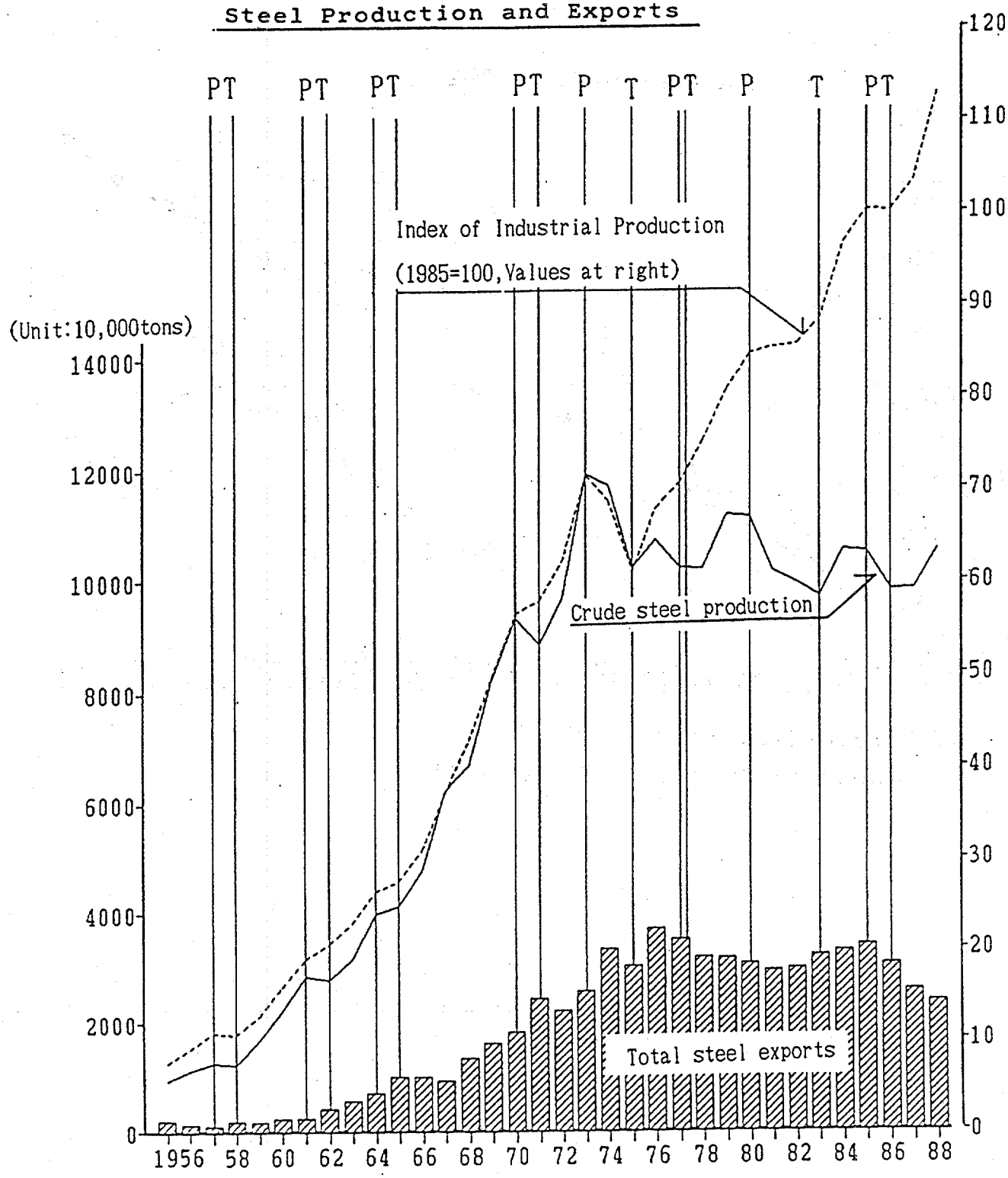
It is forecasted that domestic steel demand in Japan will fall because of changes in the industrial structure to reach approximately 71 million tons on crude steel basis in fiscal 1995. Net exports will also fall because of the strengthening of international competitiveness in newly developing steel countries to reach about 19 million tons on crude steel basis in fiscal

1995. As a result, it is forecasted that crude steel production in Japan will be around 90 million tons in fiscal 1995.

This is one of the conclusions in our paper. However our paper has a more important purpose: to review the steel demand forecasting methods which have been traditionally used and to develop a new forecasting method that reflects supply-and-demand relationships in steel to the extent possible. With respect to domestic demand, the forecast by our model was fairly well supported by the results of interviews with steel users. Our model is so broad, however, that it is necessary to simplify it according to whether the objectives of the forecasts are short- or long-term in nature, for example.

Figure 2-1

Steel Production and Exports



Note: "Peak(P)" and "Trough(T)" refer to highs and lows in economic conditions.

Sources:

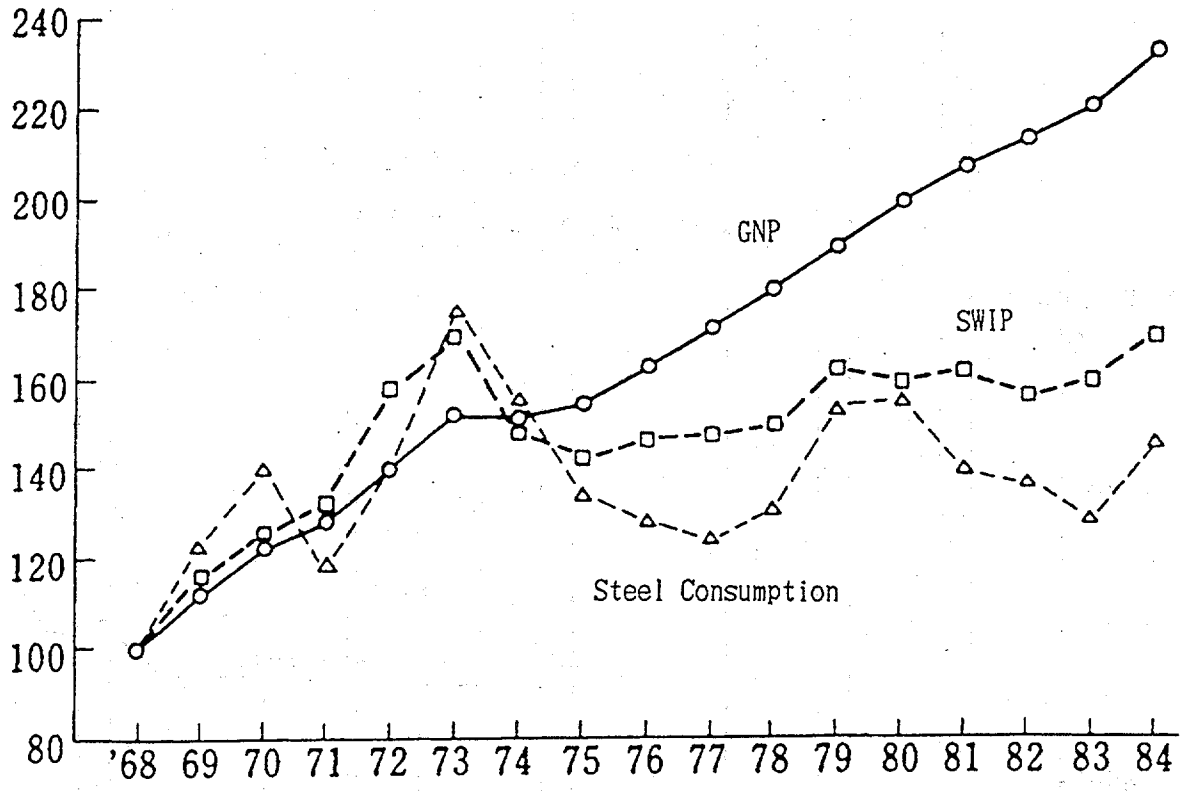
"Yearbook of Iron and Steel Statistics," MITI;

"Indices of Industrial Production," MITI;

"Trade Statistics," Ministry of Finance

Figure 3-1

GNP,SWIP,and Steel Consumption

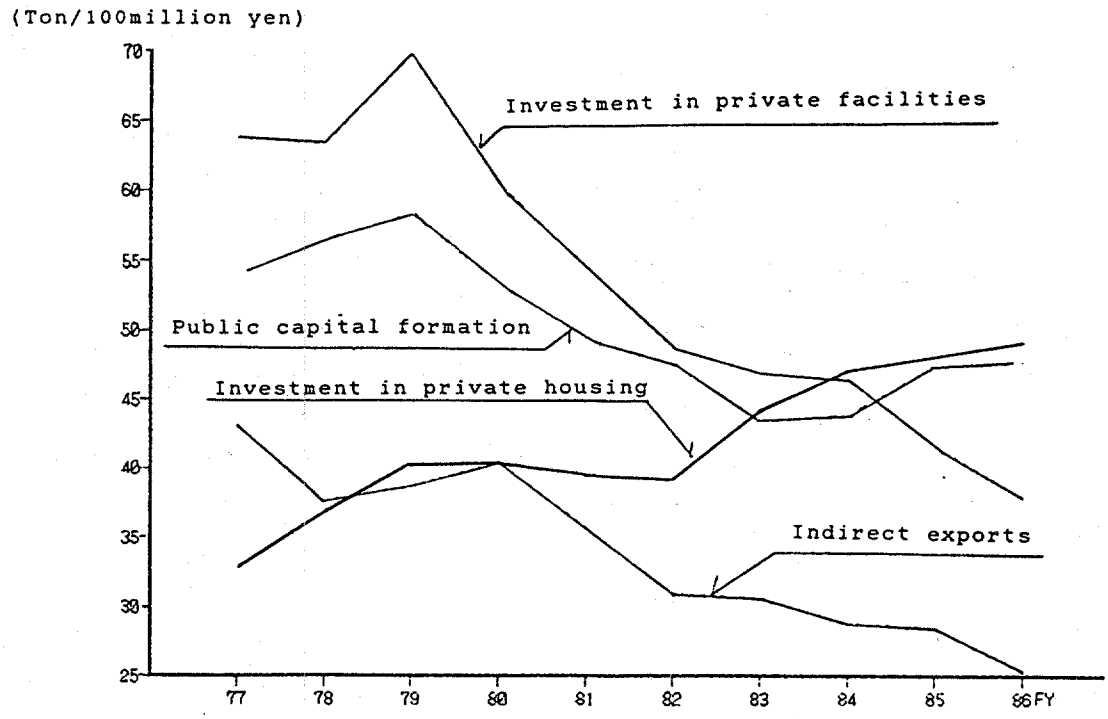


Note:1968=100

Source:"Steel,"by Kenzo Tada

Figure 4-1

Steel Intensity



Note:Steel Intensity relative to each final demand sector means tons of steel consumption per 100 million yen of the sector here.

Source:Japan Iron and Steel Association

Table 4-1

Trends in Domestic Demand for Steel Materials

(Final Demand; 1980 Constant Prices, Trillion Yen)

	FY 1979		FY 1985		FY 1995	
	Final demand	Ordinary steel materials (10,000 tons)	Final demand	Ordinary steel materials	Final demand	Ordinary steel materials
Private final consumption expenditure	141	495	163	482	212	594
Investment in private housing	17	677	14	679	15	728
Investment in private facilities	36	2486	54	2242	77	2286
Public capital formation	23	1372	21	986	22	880
Exports (Indirect exports)	32	1230	54	1559	62	1178
Others	▲16	—	▲13	—	▲13	—
Gross Domestic Expenditure (GDE)	233	6262	293	5946	375	5666
Special steel materials (10,000 tons)		795		984		937
Total (10,000 tons) (Ordinary steel + Special steel)		7058		6929		6603

Note: "Nikkei Macroeconomic Model" (Nihon Keizai Shinbun Newspaper) and "1985 Input-Output Table " MITI, were used for the forecast.

Source: "National Accounts" Economic Planning Agency; Japan Iron and steel Association.

Table 4-2

Trends in Domestic Demand for Steel by Industry

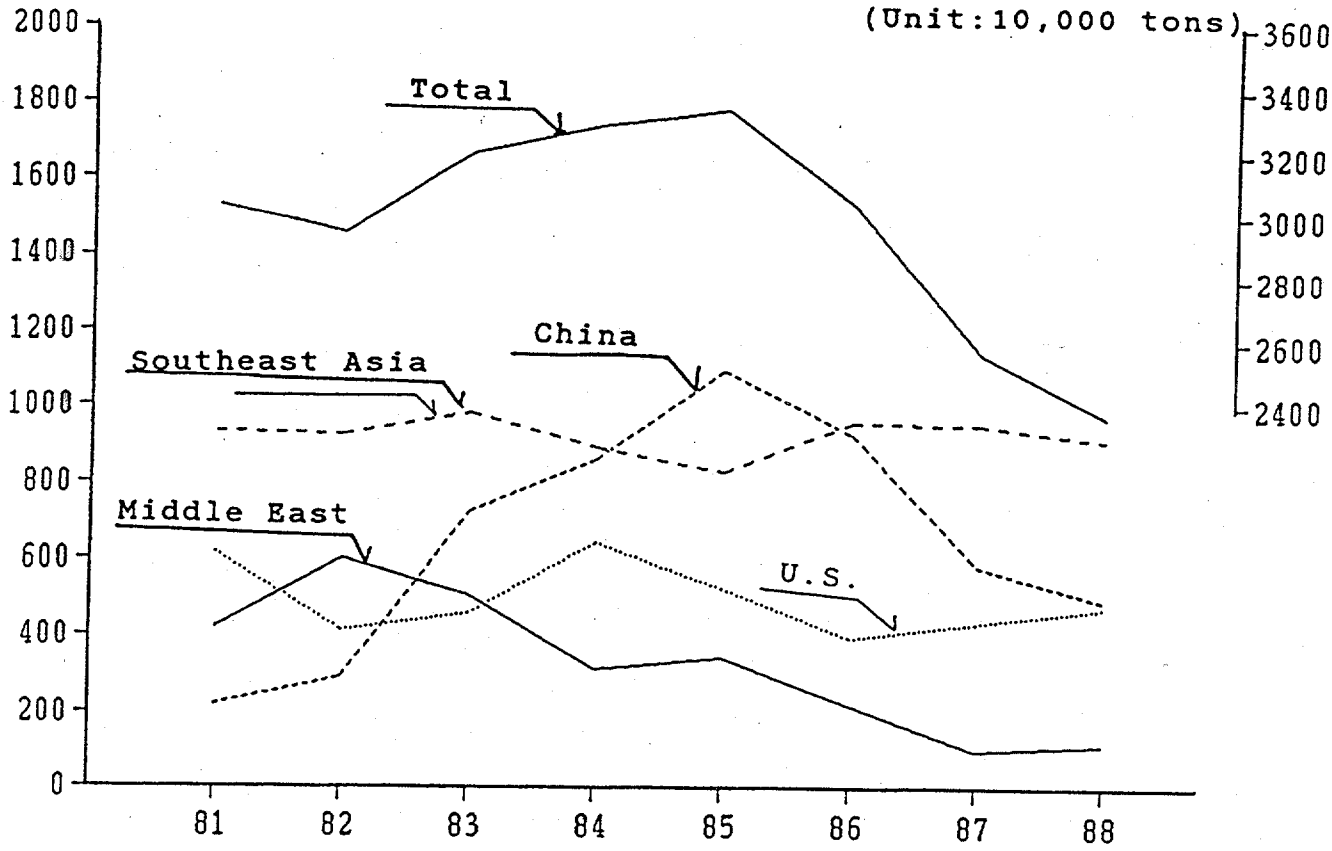
(Unit: 10,000 tons)

Industry \ Fiscal year	1979	1982	1983	1984	1985	Component Ratio
Building/Construction	1914	1612	1656	1810	1839	26.5
Civil Engineering	1147	929	823	789	792	11.4
Total for Construction	3061	2541	2479	2599	2631	38.0
Shipbuilding	343	309	329	365	338	4.9
Automobiles	1031	980	1012	1083	1159	16.7
Industial Machinery	525	503	470	534	545	7.9
Electrical Machinery	348	324	361	407	413	6.0
Secondary Products	468	392	399	423	411	5.9
Containers	204	187	195	207	205	3.0
Others	282	236	233	239	245	3.5
Total for Manufacturing	3201	2929	2998	3248	3315	47.8
Total for ordinary steel	6262	5470	5477	5846	5946	85.8
Total for special steel	795	799	874	956	984	14.2
TOTAL	7058	6269	6351	6803	6929	100.0

Source: "Interim Report of the Ad-hoc Committee on Basic Material Production Industries," MITI

Figure 4-2

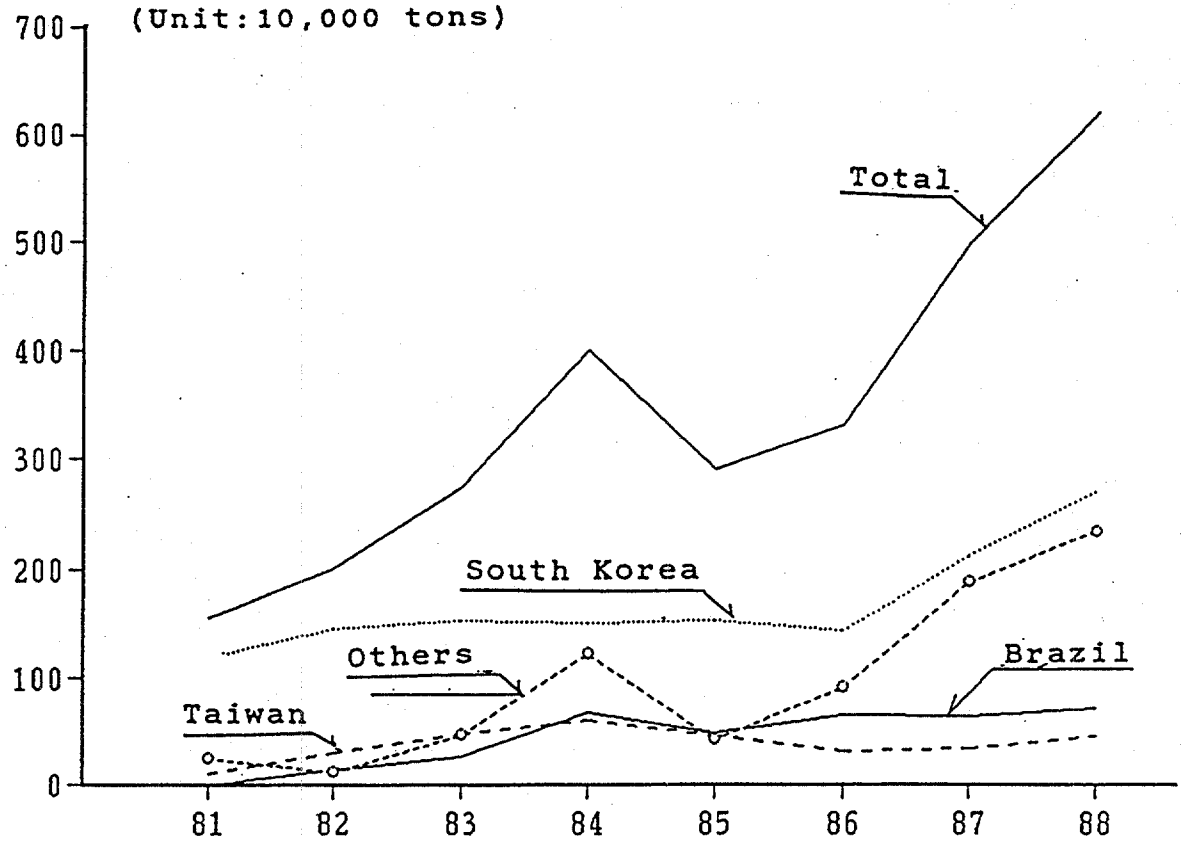
Japanese Steel Exports by Destination



Note:Based on total steel exports.
Values for total Japanese exports at right
Source:"Trade Statistics,"Ministry of Finance

Figure 4-3

Japanese Steel Imports by Origin

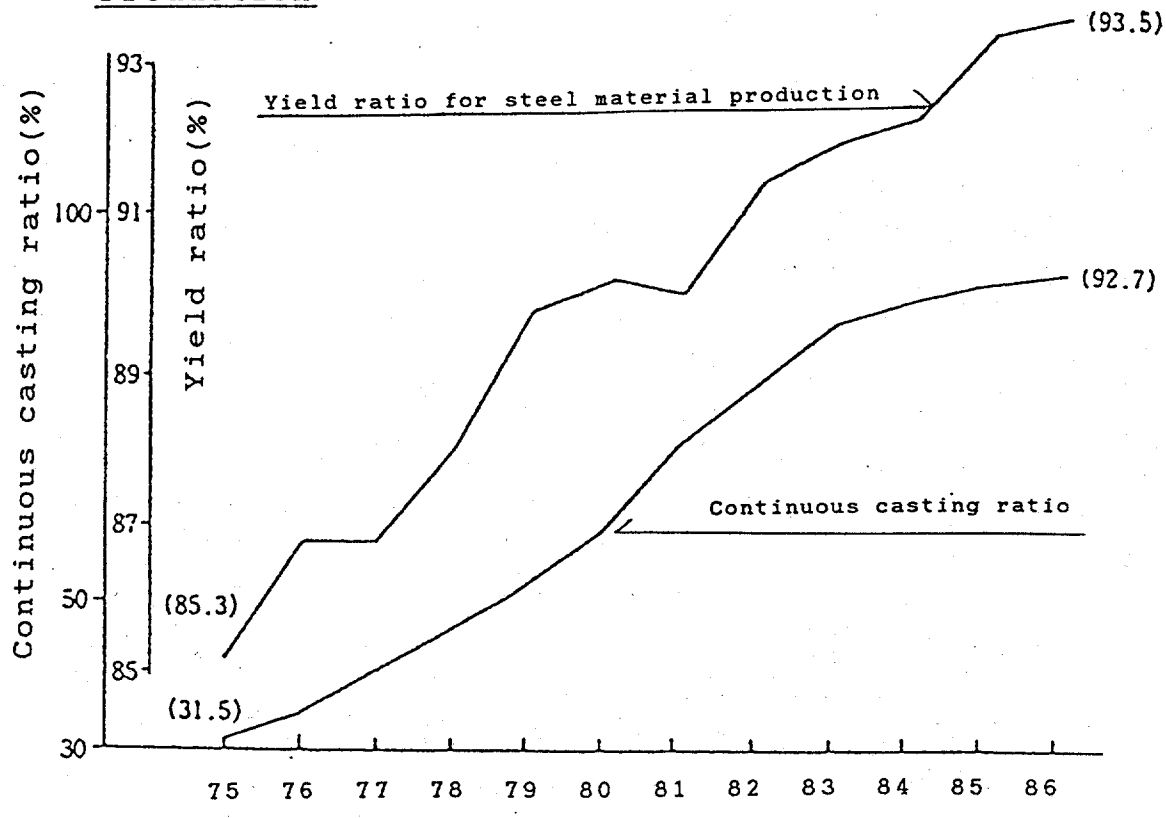


Note:Based on total steel imports.

Source:"Trade Statistics,"Ministry of Finance

Figure 4-4

Increase in Yield Ratio of Steel Material Production

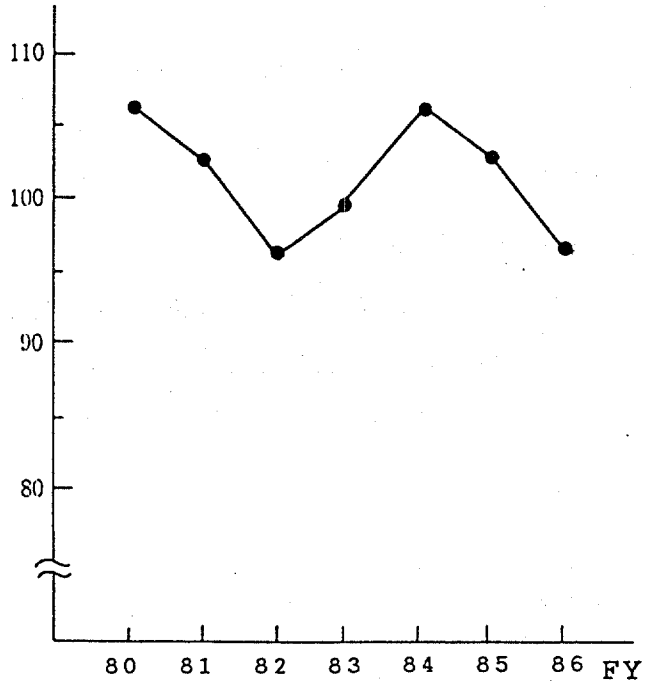


Source:Japan Iron and Steel Association

Figure 4-5

Crude Steel Production

(Unit: 1 million tons)



Source: "Interim Report of the Ad-hoc Committee on Basic Material Production Industries," MITI.

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