A HYPOTHETICAL PROJECTION OF THE CHINESE ECONOMY: 1966 TO 1981*

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I. INTRODUCTION

THIS ARTICLE will outline a projection of the Chinese economy which I have attempted recently by choosing 1966 as the base year and the fifteen years between 1967 and 1981 as the years for projection.[1] There are, however, several important qualifications and limitations which must be made. They can be described as follows:

1. 1966 appears to be the year by which, broadly speaking, the aggregative production activities of the Chinese economy had recovered from the economic setback following the period of the Great Leap Forward (1958–1960) and attained the previous peak level.[2] As is well known, however, since 1961 the Chinese government has discontinued the publication of practically all statistical information about the Chinese economy. Therefore, despite our selection of 1966 as the base year for the projection, the interrelations among the variables in the projection model and the values of pre-determined variables and parameters, all of which must be effective as of the base year, are based more or less on conjectures. This is the most important factor among those which make this projection a hypothetical one, as indicated in the title.
2. Turning to a broad characterization of the Chinese economy in 1966, we are relatively more sure that China as of 1966 was still in the grip of a series of structural imbalance problems, such as "the food problem," "the problem of underemployment," and "the problem of the foreign exchange gap." By a

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1 This projection constitutes a revised version of the previous ones which were published in [6, 7]. A detailed description of this new revised version will appear in Japanese in [11, Chapters 1 and 2]. The writer wishes to express his appreciation to Institute of Developing Economies for the assistance and encouragement they have extended to this project for the past seven years.

2 Cf., Figure 3 below, which indicates that regardless of whatever versions indicated there are used, all the estimates show that by 1966 the *NDP* had attained the previous peak level. When one considers more disaggregative indicators, the recovery situation becomes much less clear. This is especially the case with regard to certain individual products of national importance, such as steel, electricity, cement, and textiles.

structural imbalance problem we mean a situation in which a dynamic force for economic development, even when it emerges in the modern industrial sector, tends to recede and disappear as a consequence of the operation of specific depressors acting on the emerging modern sector from outside that sector. Typical examples of these built-in depressors are population explosion, technological stagnancy of agricultural production, and inelastic demand and various controls in the overseas export markets of primary and light industrial products.[3] With these basic developmental problems of the Chinese economy in mind, a structural model for the economic projection has been formulated in such a way as to be able to describe possible changes in the Chinese economy in terms of these structural problems. This, however, necessitates placing a new qualification on this projection.

The structural model assumes that during the projection period there is no likelihood that the structural problems will be solved by exogenous factors such as entirely new technical inventions, an unexpectedly drastic reduction in the growth rate of the population, and an unexpectedly favorable change in the overseas export market conditions. As a result, if and when any one or more of the structural problems happen to disappear due to such exogenous factors during the projection period, this projection is not capable of describing that process. Moreover, regardless of whether it occurs by exogenous or endogenous factors, once a phase of economic development comes about in which these structural problems disappear, the model will become inapplicable unless serious modifications are made.

3. Another qualification of this projection is necessary because of certain institutional characteristics of the Chinese economy. In the first place, as is common to all socialist economies, the Chinese planners retain in their hands the decision-making power with respect to the allocation among industries of investible resources in the modern sector and with respect to certain economic activities in other fields. Decision-making in regard to the supply of labor and to disposition of personal income is more or less left to private individuals. Yet, the Chinese experience strongly suggests a possibility that the parameters reflecting the private individuals' behavior will shift in value as a consequence of government efforts at "persuasion," though such persuasion would only be effective if it were brought about by institutional and organizational reforms.[4] Side by side with this institutional characteristic, it is possible that

[3] In my article [10], I have discussed the determinants of economic growth in China by way of analyzing these structural problems in greater detail.

[4] In the discussion of socialist economics, it seems customary to assume a sharp division of the economy into two sectors: (1) the sector in which the centralized decision of the planners prevails, and (2) the sector in which the decentralized decisions of the consumers are dominant. Moreover, the behavior of private individuals is considered fundamentally similar to that of private individuals in capitalist economies. In a more general theory of socialist economics, a reconsideration would seem to be necessary with regard to these points. To my knowlegde, Professor A. K. Sen's article [15] is the pioneering work in this respect in that it takes into account the possibility in which the labor supply of the member farmers of the cooperatives will be governed by the utility function with some positive values placed on other members' welfare.

the objective of the Chinese economic policy may differ for the projection period from the usual one in all socialist economies, which puts paramount priority on the physical growth of the economy. This possibility appears to be suggested especially in connection with a policy to eliminate the "Three Big Differentials" (i.e., the differentials between towns and villages, between industrial and agricultural labor, and between physical and mental labor), a policy which brought to the fore during the Great Cultural Revolution as the core of Mao Tse-tung's economic thought.[5] Our projection model is devised in such a way as to be able to reflect these institutional and possible policy characteristics. That is, the decision-making powers of the government are made explicit in the form of *planners' variables*; and the economic policy aim can be expressed as the *planners' objective function*; the possibilities that the parameters reflecting private individuals' behavior will shift in value as a result of the government's institutional and persuasion efforts are explicitly brought out by relating them to *institutional variables,* although it is assumed that the alteration of the values of institutional variables is not as easy as that of planners' variables. However, because of the uncertainties with respect to the specific coefficients of the institutional variables and with respect to the specific form of the economic policy objective, the projection should necessarily be made for several alternative cases. Yet, for some practical reasons, we have taken up only the cases in which the objective function of the planners puts paramount priority on the physical growth of the economy. With regard to the possible changes in the coefficients of institutional variables, we have considered the cases in which only one variable is involved. Hence, if some other cases of institutional and policy changes emerge in the projection period, particularly as a consequence of the Great Cultural Revolution, the findings of this projection will have to be modified or altered accordingly.

II. A PROJECTION MODEL

The model of this projection consists of four sectors: the planned sector, the non-planned sector, the foreign sector, and the labor-force sector. The planned sector corresponds to what is usually called the modern sector in the literature on economic development. It consists predominantly of state-owned enterprises and government agencies. The non-planned sector consists of the Peoples' Communes, production cooperatives for non-agricultural activities, and unorganized private producers. In these production sectors, each respective sector

[5] The policy to eliminate the "Three Big Differentials" is aimed at raising the "subjective activity of human beings" and thereby lessening the force of constraints coming from "objective rules." This policy, which also lies behind the idea of changing the behavior of private individuals, appears to have already taken shape in concrete form in measures which are peculiarly Chinese in pattern; namely, measures for the planning of new industrial centers, measures for the reform of wage and salary scales, and measures for the temporary exchange of personnel between different posts and localities. There are also some official statements suggesting that the basic aim of the economic policy may not necessarily be physical growth.

is further subdivided into a consumer goods sub-sector and an investment goods sub-sector according to the usual method of sectoral division in development economics.[6] Transactions of the economy with the foreign sector are made only through the planned sector. Hence, in the model the foreign sector appears only in connection with the activities of the planned sector. The labor-force sector is separated from the production sectors in order to make clear the overall balance of demand for, and supply of, labor in the economy.

The model assumes that prices are constant throughout the projection period, as they were in 1952 (the base year for the fixed prices used in the first Five-Year Plan period). This is a device to prevent the model from becoming too complicated, but it inevitably involves a sacrifice in regard to the accuracy of the projection.

In the following, the projection model is given:

Symbols:

X_1: Net output of the investment goods sub-sector of the planned sector (measured in 1952 fixed prices; the same applies below when the variable is measured in value terms).

X_2: Net output of the consumer goods sub-sector of the planned sector.

Y_x: Net domestic output of the planned sector.

V_1: Marginal capital coefficient of the investment goods sub-sector.

V_2: Marginal capital coefficient of the consumer goods sub-sector.

P_1: Value of capital stock for producing X_1 (exclusive of capital stock existing when $t=0$; permanent assets).

P_2: Value of capital stock for producing X_2 (exclusive of capital stock existing when $t=0$; permanent assets).

I_x: Net domestic investment of the planned sector.

γ: Fraction of I_x allocated to the investment sub-sector: *planners' variable.*

θ: Fraction of I_x allocated to exports.

λ: Fraction of I_x allocated to the non-planned sector: *planners' variable.*

M_1: Value of investment goods imports.

N_x: Number of workers employed in the planned sector.

l_{x1}: Net output per worker in the investment goods sub-sector.

l_{x2}: Net output per worker in the consumer goods sub-sector.

w: Wage earnings of a worker in the planned sector.

a: Labor earnings of a laborer (measured in an efficiency unit) in agriculture, i.e., a member farmer of the People's Commune.

k: Ratio of w to a.

C_x: Private consumption in the planned sector.

G: Government consumption.

[6] The division of each of the already divided sectors into the investment goods and the consumer goods sub-sectors may introduce a peculiar difficulty into the operation of the model when there occurs an exchange of the intermediate goods between the sectors. This problem is discussed in Chapter III.

b: Ratio of G to Y_x: *planners' variable.*

$\bar{b}$: Same ratio when the expenditures for defence and foreign aid are deducted from G.

A_x: Required amount of agricultural products of the planned sector from the non-planned sector.

X_a: Amount of supply of the planned sector products made available to the non-planned sector.

A_{xe}: Amount of exportable agricultural products (measured by the Chinese domestic prices; the same applies to the following variables related to foreign trade).

A_{xm}: Demand for agricultural products from abroad.

ε_x: Engel coefficient for private consumption.

M_2: Demand for consumer goods from abroad.

E_2: Amount of exportable consumer goods.

E: Total amount of exportable goods.

M: Total amount of import demand.

D: Net borrowing from (or lending to) abroad.

E_1: Amount of exportable investment goods.

m_2: Minimum required amount of imports of industrial consumer goods as ratio to X_{2t}.

e_2: Trends in the growth rate in real value of imports of industrial consumer goods in the foreign market.

e_3: Trends in the growth rate in real value of imports of agricultural products in the foreign market.

m_3: Rate of decrease in the import of agricultural products from abroad.

A: Net output of the agricultural sub-sector of the non-planned sector.

L: Area of cultivated land.

N_a: Number of laborers employed in current agricultural production, measured in efficiency units.

Q: Capital stock employed in agriculture (permanent assets).

α_1: Elasticity of agricultural output with respect to cultivated land.

α_2: Elasticity of agricultural output with respect to labor.

p: Rate of (neutral) technological progress in agricultural production.

I_a: Total amount of investment in agriculture.

T: Net output of the non-agricultural sub-sector (T sector) of the non-planned sector.

T_1: Output of investment goods in the T sector.

T_2: Output of consumer goods in the T sector.

δ: Coefficient of allocation of T_1 to the agricultural sector.

N_{aI}: Number of laborers in efficiency units employed in capital investment works in agriculture.

d: Ratio of N_{aI} to N_a.

μ: Ratio of the net output of current agricultural production which is distributed as labor returns: *planners' variable.*
f: Rate of increase in cultivated land.
σ: Required rate of growth of a_t.
N_T: Number of laborers in efficiency units employed in the T sector.
l_T: Net output per laborer in efficiency units of the T sector.
g: Ratio of T_1 to T.
β: Elasticity of (N_{Tt}/N_{xt}) with respect to (N_{at}/N_{xt}).
C_a: Amount of private consumption in the non-planned sector.
c: Ratio of labor earnings in the T sector to a_t.
$\bar{A}_x$: Amount of supply of agricultural products available for the planned sector.
$\bar{X}_a$: Required amount of planned sector products for the non-planned sector.
W: Size of working-age population in the economy.
r: Rate of increase in W.
W_x: Size of working-age population residing in the X sector.
m: The labor participation ratio of W_x.
N_z: Size of the labor force residing in the non-planned sector.
n: The labor participation ratio of N_z.
N_u: Size of underemployment measured in terms of the number of laborers in efficiency units.
$\bar{N}_u$: Minimum size of underemployment socially and politically permissible.
a': C_a/N_z.
$\bar{a}$: Minimum subsistence level.
t: Time, measured in years.

Model:

(1) Planned Sector

(Current production)

$$X_{1t} = X_{10} + \frac{1}{V_1} P_{1t} \tag{1·1}$$

$$X_{2t} = X_{20} + \frac{1}{V_2} P_{2t} \tag{1·2}$$

$$Y_{xt} = X_{1t} + X_{2t} \tag{1·3}$$

(Capital stock and capital formation)

$$P_{1t} = \gamma \sum_{j=0}^{t-1} I_{xj} \tag{1·4}$$

$$P_{2t} = (1 - \gamma - \lambda - \theta) \sum_{j=0}^{t-1} I_{xj} \tag{1·5}$$

$$I_{xt} = X_{1t} + M_{1t} \tag{1·6}$$

(Employment and wages)

$$N_{xt} = \frac{1}{l_{x1}} X_{1t} + \frac{1}{l_{x2}} X_{2t} \tag{1·7}$$

$$w_t = k \cdot a_t \tag{1·8}$$

(Consumption)

$$C_{xt} = w_t N_{xt} \tag{1·9}$$

$$G_t = bY_{xt} \tag{1·10}$$

(Relations with the non-planned sector)

$$A_{xt} = \varepsilon_x C_{xt} + A_{xet} - A_{xmt} \tag{1·11}$$

$$X_{at} = \lambda I_{xt} + X_{2t} + M_{2t} - (1 - \varepsilon_x)C_{xt} - E_{2t} - G_t \tag{1·12}$$

(Relations with the foreign sector)

$$E_t + D = M_t \tag{1·13}$$

$$E_t = E_{1t} + E_{2t} + A_{xet} \tag{1·14}$$

$$E_{1t} = \theta I_{xt} \tag{1·15}$$

$$E_{2t} = E_{20}(1 + e_2)^t \tag{1·16}$$

$$A_{xet} = A_{xeo}(1 + e_3)^t \tag{1·17}$$

$$M_{1t} = M_t - M_{2t} - A_{xmt} \tag{1·18}$$

$$M_{2t} = m_2 X_{2t} \tag{1·19}$$

$$A_{xmt} = A_{xmo}(1 - m_3)^t \tag{1·20}$$

Note: The identity indicating the domestic output and the expenditure of the planned sector is derived from equations (1.6), (1.12), (1.11), and (1.14) as:

$$Y_{xt} = C_{xt} + G_t + (1 - \lambda - \theta)I_{xt} - (A_{xt} - X_{at}) - (M_t - E_t) \tag{1·21}$$

(2) Non-planned Sector

(Current agricultural production)

$$A_t = A_{t-1}\left[\alpha_1 \frac{L_t}{L_{t-1}} + \alpha_2 \frac{N_{at}}{N_{a \cdot t-1}} + (1 - \alpha_1 - \alpha_2)\frac{Q_t}{Q_{t-1}} + p\right] \tag{2·1}$$

(Capital stock and capital formation)

$$Q_t = Q_o + \sum_{j=0}^{t-1} I_{aj} \tag{2·2}$$

$$I_{at} = \lambda I_{xt} + \delta T_{1t} + a_t N_{aIt} \tag{2·3}$$

$$N_{aIt} = dN_{at} \tag{2·4}$$

(Employment and labor earnings of current agricultural production)

$$N_{at} = \mu \frac{A_t}{a_t} \tag{2·5}$$

$$a_t = a_o(1 + \sigma)^t \tag{2·6}$$

(Cultivated land)

$$L_t = L_o(1 + f)^t \tag{2·7}$$

(Non-agricultural production)

$$T_t = l_T N_{Tt} \tag{2·8}$$

$$T_{1t} = gT_t \tag{2·9}$$

$$T_{2t} = (1 - g)T_t \tag{2·10}$$

$$N_{Tt} = N_{t-1}\left[\beta \frac{N_{at}}{N_{a\cdot t-1}} - (1 - \beta)\frac{N_{xt}}{N_{x\cdot t-1}}\right] \tag{2·11}$$

(Consumption)

$$C_{at} = a_t N_{at} + c \cdot a_t N_{Tt} \tag{2·12}$$

(Relations with the planned sector)

$$\bar{A}_{xt} = A_t - \varepsilon_a C_{at} \tag{2·13}$$

$$\bar{X}_{at} = I_{xt} + (1 - \varepsilon_a)C_{at} - T_{2t} \tag{2·14}$$

(3) Labor Force Sector

$$W_t = W_o(1 + r)^t \tag{3·1}$$

$$W_{xt} = \frac{1}{m} N_{xt} \tag{3·2}$$

$$N_{zt} = n(W_t - W_{xt}) \tag{3·3}$$

$$N_{ut} = N_{zt} - N_{at} - N_{aIt} - N_{Tt} \tag{3·4}$$

$$N_t = N_{xt} + N_{zt} \tag{3·5}$$

$$a'_t = C_{at}/N_{zt} \tag{3·6}$$

(4) Consistency Conditions

$$X_{at} = \bar{X}_{at} \tag{4·1}$$

$$A_{xt} = \bar{A}_{xt} \tag{4·2}$$

$$N_{ut} \leqq \bar{N}_u \tag{4·3}$$

$$a'_t \geqq \bar{a} \tag{4·4}$$

Since the meaning of most of the equations and identities constituting the above model seems self-evident, the following explanation will be confined to points that are relevant in connection with the ideas described in items 2 and 3 of the introductory chapter.

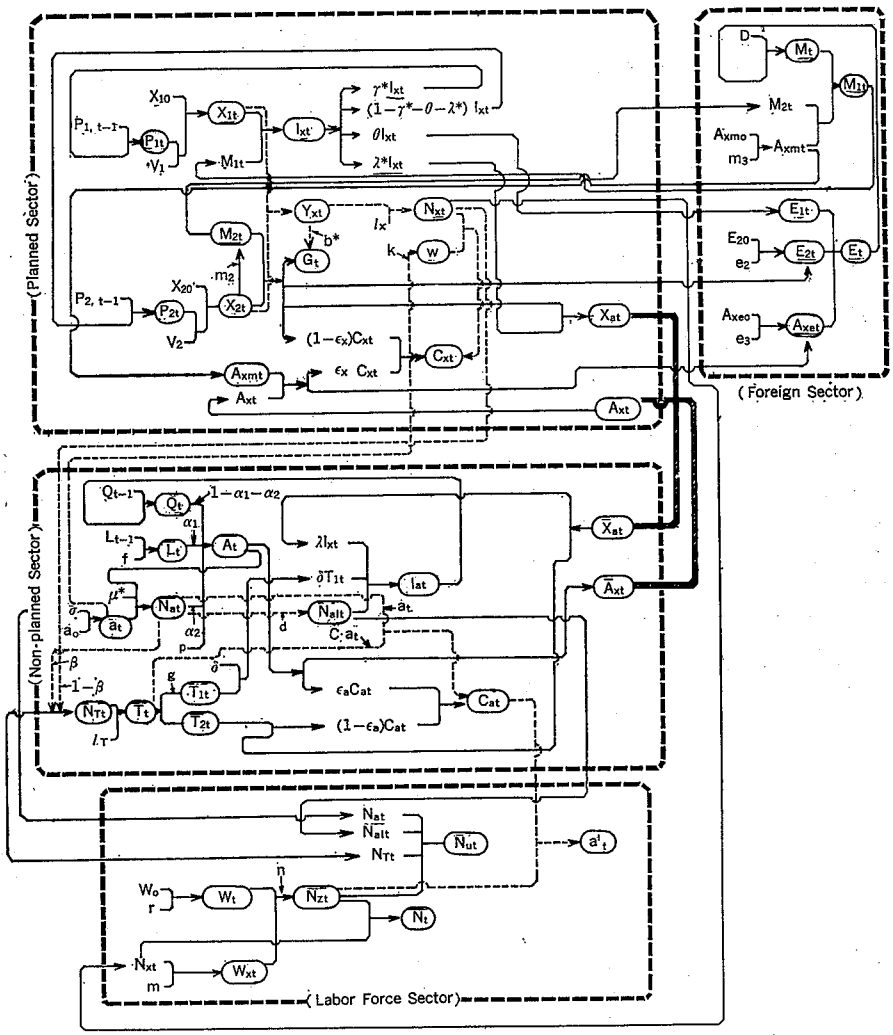
1. The planners' variables selected for this model are four in all, namely, the coefficients of allocation among sectors of the investment goods available for the planned sector: γ and λ;[7] the coefficient of government consumption, b

[7] In this model, θ is treated as a constant, since in this stage of development of the capital goods industry, international competitive power is still not strong enough to make it possible for the Chinese to manipulate the amount of exports on their own initiative. When the stage is reached in which such manipulation is possible, the foreign trade problem as a structural problem will be almost overcome.

(the variation of which has a close relation to the variation of defence expenditures); and the coefficient of the relative share of labor in the net output of current agricultural production, μ.

2. The institutional variables selected for this model are σ, d, $\bar{N}_u$, $\bar{a}$, and k. σ is considered an institutional variable for the reasons (i) that the supply price of labor by member farmers of the People's Communes which is (as will be explained in paragraph 4) identical to a_t, tends to rise with the increase in net output per unit of labor, or simply with the passage of time under the

Fig. 1. Interrelationship of Variables in the Hypothetical Projection Model of the Chinese Economy



Note: Variables marked with * are planners' variables. Variables encircled denote endogenous variables.

situation where collectivization is enforced on farmers whose labor earnings are near subsistence level;[8] but (ii) that the magnitude of σ could be maintained at a level which is lower than it normally is, depending on government efforts for institutional reforms and persuasion. d is the proportion of labor input for current agricultural production (N_{at}) to labor input for agricultural investment activities (N_{ait}), which is provided by farmers without compensation, a traditional Chinese method of public or communal construction for agricultural production. As long as the magnitude of d remains at the conventional level, the farmers seem to be willing to engage in such non-compensatory labor. An increase in its magnitude may be possible only as a result of an increase in government institutional and persuasion efforts. $\bar{N}_u$ (the minimum size of underemployment permissible), $\bar{a}$ (the minimum subsistence level), and k (the coefficient of wage differential between the planned and agricultural sectors) may possibly be subject to variation due to similar government efforts.

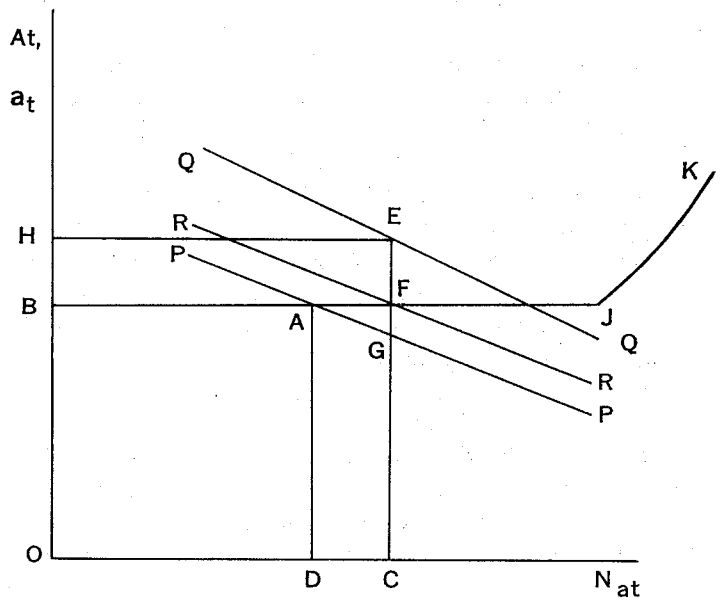
3. The dynamic force of the system in the physical sense is the amount of investment goods available for the planned sector, which, under the restrictive conditions of foreign trade, is largely dependent on the determined value of γ [eqs. (1.1) through (1.5)]. The basic interrelations between the growth paths of the planned sector and the value of γ (with the value of λ given) are explainable by the familiar Fel'dman-Domar model of growth.[9]
4. The food and agriculture problem arises fundamentally from the low productivity level of agricultural production, which makes inelastic the response of the agricultural sector to the increase in demand for agricultural products arising in the course of expansion of the planned sector. This productivity condition is expected to be describable in the model by (i) a production function [eq. (2.1)] of the Cobb-Douglas type with product augmenting technological progress, and (ii) a series of equations determining factor inputs. As one of (ii), eq. (2.5) is the equation which determines the amount of labor input to current agricultural production (N_{at}). Behind this equation is implied, first, a labor supply function of the type Professor A. K. Sen discussed in regard to peasant agriculture in developing economies [16], a function resulting in a supply curve which, in the realm where total per-capita income is very low, is perfectly elastic with a certain positive price (in Figure

[8] In this model σ is not related to changes in labor productivity for the sake of simplicity. However, as the amount of a_t increases significantly, it will become more unrealistic simply to relate the function of σ to the latter reasoning. Meanwhile, the amount of a_0 is assumed in this projection to be 152 yuan. In terms of per labor-day remuneration in People's Communes, this is equal to 0.6 yuan. The actual number of labor days per member-farmer is estimated at 200 days. In comparison, per labor-day remuneration in 1957 was recorded as 0.7 yuan in a 1957 National Survey of Receipt and Expenditure of Agricultural Production Cooperatives, and the number of labor days for collective farming as 161 days. In a similar national survey for 1955, the corresponding figures were 0.92 yuan and 96 days, respectively. These figures suggest that in between these years there occurred a significant downward shift in the labor-supply curve, perhaps caused by exogenous factors.

[9] [1, Chapter 9]. Regarding an analysis of the growth problem of China in terms of this model, refer to Ishikawa [4].

2, the straight line section *BJ* of the total supply curve *BJK*), and which begins rising in the northeast direction after per-capita income level rises above a certain level (section *JK*). In the present and foreseeable future, the section of the labor supply curve which is effective in China is assumed to be in the straight line *BJ*. Secondly, the implied labor demand function is indicated in Figure 2 by the curve *RR*. There is no institutional necessity that *RR* is identical to the marginal productivity curve of labor, *PP*.[10] The curve *RR* is identical to the curve *PP* multiplied by (μ/α_2).[11] The amount of capital stock applied to the current production function is determined by eqs. (2.2) and (2.3), and the area of cultivated land by eq. (2.13).

Fig. 2. Determination of Labor Input in Current Agricultural Production



A direct indicator of the food and agricultural problem is the amount of $\bar{A}_{xt}$ [eq. (2.13)] relative to that of A_{xt} [eq. (1.11)]. The model indicates that assuming a given amount of A_{xt}, the variables which affect the food problem are p, σ, d, μ, and λ. The impacts of the respective variables, however, are not uniform. When these variables are manipulated to increase agricultural output, this produces the reverse effect of increasing the amount of self-consumption of agricultural products; the net effect varies with the difference

[10] In this figure, *OB* measures the real supply price of labor for the section *BJ* of the supply curve, and is equal to a_t. Although a_t is measured on a yearly basis, it is a return to a labor unit measured in efficiency units. Thus it is quite possible to consider that Figure 2 indicates the relation in terms of daily or hourly labor.

[11] As for the discussion of the subjective equilibrium conditions of a kolkhoz or a cooperative farm in socialist economies, refer to [2] and [14], in addition to A. K. Sen's article [15].

of the variables. The amount of X_{at} relative to $\bar{X}_{at}$ is also an indicator of the food problem, since, for example, attainment of a balance between A_{xt} and $\bar{A}_{xt}$ by reducing A_{xt} will not solve the problem, if it is accompanied by a shortfall of the supply of X_{at} relative to $\bar{X}_{at}$. The final indicator is the equilibrium amount of X_{at} relative to that of A_{xt}. When the former significantly exceeds the latter, this presents the case of a net resource transfer from agriculture to modern industry, which seems to be a manifestation of low productivity in agriculture as a typical initial condition of contemporary economic development (cf. [8, Chapter 4]).

5. *The problem of underemployment*

Underemployment, if it exists, arises in the unplanned sector, because the production units constituting this sector are more or less of the nature of cooperative family enterprises. Since we have treated the labor supply function of this sector according to Sen's model, the magnitude of underemployment must be measured theoretically by the length of the section *FJ* of the labor supply curve in Figure 2. It is empirically difficult, however, to locate the turning point *J*. As a practical alternative, this projection resorts to the following device to measure the amount of underemployment: To assume first a certain socially desirable number of days for which a laborer works in a year, and the difference between this number of working days and the actual number of working days is defined as the degree of underemployment.[12] N_{ut} is a measure of this underemployment. It is expressed by dividing the economy's total degree of underemployment thus measured by the socially desirable number of working days for a laborer.

6. *The problem of foreign exchange gap*

This problem is reflected in the model in that the rate of growth in exports of primary and light industrial products, which still occupy a dominant position in the total amount of exports of the economy, is conditioned not by the capability of the economy to export, but by the rate of growth of demand in overseas markets [eqs. (1.16) and (1.17)]. The effort to increase the import of capital goods is limited accordingly by the same exogenous factor [eqs. (1.18) and (1.17)].

7. *Consistency and optimality*

In the planned sector, the non-planned sector, and the labor force sector, respectively, the number of equations and that of endogenous variables are identical. From economic logic, however, the system does not hold unless the consistency conditions of eqs. (4.1) through (4.4) are met. Eqs. (4.1) and (4.2) state that the demand for, and the supply of, both agricultural products and products of the planned sector must be equalized. Eq. (4.3) states that the amount of underemployment should not exceed a socially and politically permissible maximum ($\bar{N}_u$) and eq. (4.4) that per-laborer consumption level should not fall below the minimum subsistence level ($\bar{a}$). Consolida-

[12] In this projection, the socially desirable number of working days is assumed to be 250 labor-days on the basis of a government planner's proposal made in 1957. Cf., the article by Wang Kuang-wei published in *Chi-hua Ching-chi* [Planned economy], No. 8, 1958.

tion of all conditions gives the following results:

Sub-model	Number of Equations	Number of Endogenous Variables	Number of Planners' Variables
(1)	20	20	3
(2)	14	14	1
(3)	6	6	0
(4)	2 (and inequalities 2)	0	0
Consolidation	42 (and inequalities 2)	40	4

This means that unless either two of the four planners' variables are converted to the endogenous variables and, moreover, the limiting conditions of two inequalities are satisfied, the consistency of the system will not be maintained. Analysis of the roles of those four planners' variables indicates that each has its specific role in addition to its common effect on overall growth. Hence, it is not relevant to separate any two planners' variables to be treated as endogenous variables. The procedures to be followed for identifying the growth path which is both consistent and efficient are thus as follows:
(i) To derive a reduced form of equations describing the interrelation among the four planners' variables and, on the basis of it, to define a certain section of plane (or space) assuring the consistency of the system; (ii) to define further a feasible area (or space) by using the two inequalities, and (iii) to identify an efficient point in this feasible area, which corresponds to an optimum combination of the values of γ, λ, b, and μ, respectively, according to the specified objective function of the planners. What this objective function is a matter of conjecture, but, subject to the qualification described in Chapter I, this may be assumed to take the following shape:

$$\begin{aligned}
\max\ & U = a_1U_1 + a_2U_2 + a_3U_3 + a_4U_4 \\
\text{where}\ & U_1 = U_1(Y_{15}),\ U'_1 > 0,\ U''_1 < 0; \\
& U_2 = U_2(Y_{x\cdot 15}),\ U'_2 > 0,\ U''_2 < 0; \\
& U_3 = U_3(b - \bar{b}),\ U'_3 > 0,\ U''_3 < 0; \\
& U_4 = U_4(1 - \mu),\ U'_4 > 0,\ U''_4 < 0; \text{ and } a_1,\ a_2,\ a_3, \text{ and } a_4 \text{ are non-negative constants.}
\end{aligned}$$

III. DATA

Broadly speaking, three different approaches are used for deriving the values of pre-determined variables and parameters (for 1966) of the model. Brief comments will be made on these derived values by approach:

1. The values of the components of the net domestic product are taken from estimates derived from Professor Ta-Chung Liu's model, which was constructed to estimate annual changes in Net Domestic Product and Net Domestic Investment during the years 1959–1965, for which statistical information on such aggregative figures are not available [12]. This model, in fact, consists of

twenty-two econometric equations (derived by using the data for the period of the First Five Year Plan) and identities which describe the interrelationships between four pre-determined variables (food grains, cotton, crude-steel, and population) on the one hand, and *NDP* and *NDI*, on the other.[13] Since for the years 1959 and after there are available a few estimated annual series for each of these products and the size of population, the application of any one of those for the four pre-determined variables will yield estimated values of *NDP* and *NDI* and, in the process of computation, those of several other related variables as well. I have taken the liberty of applying to the Liu model a few other sets of estimated annual series of the four pre-determined variables. In doing so, the estimated series, including that adopted by Liu, are extended to cover 1966.[14]

In Table I are shown some of the available estimated annual series. Of these, Professor Liu's estimate applied *FO* (1), *CO* (1), *ST* (1), and *P* (1). Version 1 of alternative estimates applied *FO* (2), *CO* (2), *ST* (2), and *P* (2), and Version 2, *FO* (3), *CO* (2), *ST* (2), and *P* (2). The results of these estimates are shown in Figure 1, together with some comparable figures for the First Five Year Plan period. For the purpose of this projection, I have used the Version 1 estimates.

It should be mentioned, however, that due to the use of the wage rate of the planned sector workers, the ratio of X_1 to Y_x and some other coefficients for 1957,[15] the resulting estimates of components of net domestic expenditure in the base year differ more or less from those of Version 1 estimates in the above. In particular, the value of G_o, which is derived more or less as a residual, is considerably greater than the latter. The difference occurred mostly in personal consumption, in particular that of the non-planned sector. There is no decisive evidence to determine which estimates of the two are

[13] The Liu model itself consists of sixteen equations and identities. The values of pre-determined variables in this model are in fact derived from estimated values of food grain, cotton, crude-steel, and estimated size of population. The procedures of this derivation can be represented in the form of six equations:

$$A = 1.452\,(CO + FO)$$
$$A'_{-1} = CO_{-1} + FO_{-1}$$
$$M' = 0.564 + 0.436\,ST$$
$$P_{(1958+t)} = 652\,(1.015)^t$$
$$G_{(1958+t)} = 5.0\,P_{(1958+t)}/652$$
$$C_{g\,(1958+t)} = 9.41\,P_{(1958+t)}/652$$

where symbols on the left-hand side of the equations are Liu's, and those on the right-hand side are the same as shown in Table I (but converted to value terms as for *FO*, *CO*, and *ST*).

[14] Note that the Liu estimate is extended by extending the estimated annual series of *CO*, *FO*, *ST*, and *P* which he himself used to 1968 in the way indicated in the note to Table I. In this extension, we have replaced equation (15) in his article by

$$X = 0.12 + 0.04\,NDP_{-1}\,,$$

because the published equation contains evident misprints. While the replaced one is estimated from sample data published in his article, the result of the computation with this equation differs from the one published by Liu.

[15] See especially note 5 of Table II, which is related to the estimation of a_o.

TABLE I

ALTERNATIVE ESTIMATES OF FOOD GRAIN, COTTON, CRUDE-STEEL, AND POPULATION: 1958–1968
(units: million metric tons and million persons)

	Food Grain (*FO*)			Cotton (*CO*)		Crude-Steel (*ST*)		Population (*P*)	
	(1) Liu	(2) Jones	(3) Swamy	(1) Liu	(2) Dawson	(1) Liu	(2) Kojima	(1) Liu	(2) Jones
1958	194	215[b]	215.2	1.7	2.10	6.3	8.00	652	654
1959	168	193[b]	192.7	1.8	2.41	8.9	8.63	662	661
1960	160	150	161.3	1.4	1.41	8.4	12.00	672	668
1961	167	162	189.2	0.9	1.09	7.9	7.50	682	675
1962	178	174	203.8	0.9	1.13	7.5	8.00	692	683
1963	179	183	218.9	1.0	1.17	8.0	8.50	702	690
1964	183	200	237.8	1.2	1.24	9.0	10.20	713	705
1965	180	200	258.0	1.3	1.20	10.0	11.30	724	720
1966	178[a]	205[c]	220.0	1.26[a]	1.26	13.6	13.60	734[b]	736
1967	190[a]	216[c]	231.0	1.30[a]	1.30	11.0	11.00	745[b]	752
1968	182[a]			1.25[a]		13.0	13.00	757[b]	

Notes:
1. *FO* (1), *CO* (1), *ST* (1), and *P* (1) are taken from Liu [12] except for the figures marked with [a] which are taken from *Current Scene*, March 1969, (which publishes the estimates of the American Consulate-General in Hong Kong, the same source Professor Liu relied on) and those marked with [b] which are derivable from the Liu assumption.
2. *FO* (2) and *P* (2) are taken from Edwin F. Jones, "The Emerging Pattern of China's Economic Revolution," in JEC, Congress of the U.S., *An Economic Profile of Mainland China*, Vol. 1, p. 93. The figures marked with [c] are taken, however, from Dawson (see below).
3. *FO* (3) is taken from Subramanian Swamy, and Shahid Javed Burki, "Foodgrains Output in the People's Republic of China (1958–1967)," *China Quarterly*, January–March 1970.
4. *CO* (2) is taken from Owen L. Dawson, *Communist China's Agricultural Development and Future Potential*, Washington D.C., 1968, p. 191.
5. *ST* (2) is taken from an unpublished estimate Mr. Reiitsu Kojima of the Institute of Developing Economies.
6. In applying the output figures of *FO*, *CO*, and *ST* to the Liu model, they are converted to the value terms by using Liu's conversion rates: *CO* 84.9 yuan/picul, *FO* 123.3 yuan/metric ton and *ST* 600 yuan/metric ton.

more plausible. International comparisons of the ratio of G to NDP, however, suggest that the value of G_o estimated in this projection is probably greater than what it actually was.

2. With regard to the size of the working-age population in 1966 and its annual growth rate during the period for projection, we have used the average of the figures derived from the medium and high-fertility projections of the 1959 United Nations' future population estimates [18]. Working-age population is here defined as the population of those whose age ranges between 15 and 59 years old. The corresponding sizes of the total population are 742.8 million persons in 1966, 810.3 million persons in 1971, 887.1 million in 1976, and 970.9 million persons in 1981; the average annual rate of growth is 1.82 per cent, slightly smaller than that of the working-age population (2.0 per cent). Values of exports and imports for 1966 and those of related

parameters are taken from, or estimated from United Nations data.[16] Since the values of exports and imports obtained are in terms of foreign prices and since the domestic price system of China is as a rule cut off from the foreign price system, it becomes necessary for the purpose of projection to convert the values in foreign prices into values in domestic prices. For this conversion, I have used the results of a study by Professor Toshiyuki Mizoguchi on a comparison of wholesale prices in China with those of Japan in 1952–1957.[17] The assumption here is that the Japanese prices fully reflect the foreign prices that are viewed from the standpoint of China.

3. Most of the coefficients and rates are derived from, or based on, the estimates of the Chinese economy in 1957 or in the period of the First Five Year Plan. The following are comments on some of these derivations:

(i) Shortage of published data prevents us from attempting to make estimates of the production function of China's agriculture as a whole to obtain the values of α_1, α_2, and $(1-\alpha_1-\alpha_2)$ in eq. (2.1). Professor Anthony Tang's study on China's agriculture is relied on as a substitute. Tang attempted to compile an aggregative input index as well as an aggregative productivity index for 1952–1957 by assigning to labor, land, fixed capital, and current inputs the weights of 0.55, 0.25, 0.09, and 0.11, respectively. These weights were estimated principally on the basis of J. L. Buck's well-known prewar survey on China's agriculture. The resulting aggregative productivity index suggests that the rate of technological progress between 1952 and 1957 is zero or even negative [17]. The values of α_1 and α_2 are derived by reallocating the weight of current inputs to the other items. This reallocation takes into account data from two National Surveys on the Receipts and Expenditures of the Agricultural Production Cooperatives for 1955 and 1957.

(ii) With regard to the value of β in eq. (2.11), it should be noted first that the underlying relationship is

$$N_{Tt}/N_{xt} = \alpha(N_{at}/N_{xt})^{\beta}, \quad \beta > 0 .$$

That this relationship is valid can be tested by cross-country and cross-region (within a country) data of contemporary Asian countries [8, pp. 402–403]. Fitting this equation to the Chinese data for 1952 to 1957, we can estimate the value of β as 1.8653.[18]

(iii) To the value of m_3 in eq. (1.20) is assigned 0.20, implying that the

[16] [19, 20]. The values of e_2, e_3, and m_2 are estimated by fitting a logarithmic curve to the quantum indexes of exports and imports of the entire developing area for the years 1953–1957.

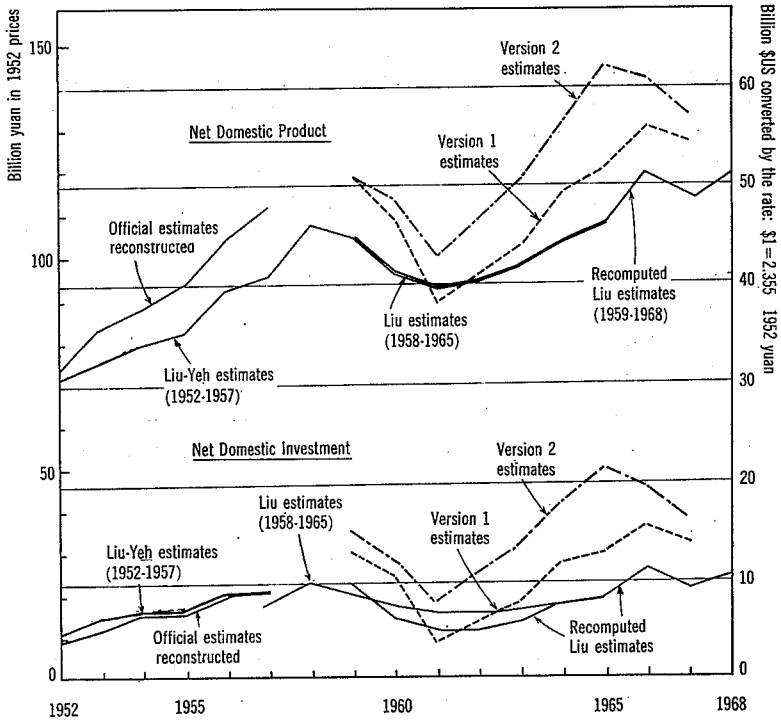
[17] [13]. A summary of the results is given in Ishikawa [5].

[18] The result is:

$$\log(N_T/N_x) = -1.9925 + 1.8653 \log(N_a/N_x) ,$$
$$(0.0720)\ (0.0640)$$
$$R^2 = 0.99415 \text{ (adjusted for the degree of freedom)} .$$

The data for N_x and N_a are taken from Ishikawa [6] (the data for N_a, however, are somewhat revised). The data for N_T are taken from [3, p. 371].

Fig. 3. Changes in the Net Domestic Product and Net Domestic Investment Estimated: China, 1952–1968



Notes: "Liu-Yeh estimates" are taken from Ta-chung Liu and Kung-chia Yeh, *The Economy of the Chinese Mainland—National Income and Economic Development 1933–1959*, Princeton University Press, 1965. "Official estimates reconstructed" are from Ishikawa, *National Income and Capital Formation in Mainland China*, Tokyo, Institute of Developing Economies, 1965, and Ishikawa [6]. The sources of the other estimates are given in the text.

amount of food imports will decrease from the base year at the annual rate of 20 per cent. Since 1961, China has been importing food grains (mostly of wheat) at around 5–6 million tons annually. Even as of 1959, no sign of a declining tendency can be seen. There are some interpretations outside China that this may be due to a partial modification of the foreign trade policy in favor of the Comparative Advantage doctrine: even after the recovery of per capita agricultural production, China is likely to continue to export wheat while at the same time exporting rice, the price of which is much higher in foreign markets than that of wheat.[19] The assumption of this projection is that this will not be the case and that the pattern of China's foreign trade in regard to food grains will fairly soon come back to the pattern prior to 1961.

[19] An analysis of this possibility is made in [9, Chapter 1].

TABLE II

ESTIMATED VALUES OF PRE-DETERMINED VARIABLES AND PARAMETERS

$X_{1\cdot0}$	23.80[4]	billion yuan	L_o	108[2]	million ha
$X_{2\cdot0}$	55.07[3]	billion yuan	f	0.006[2]	
Y_{xo}	78.87[1]	billion yuan	N_{ao}	233.10[11]	million persons (in efficiency units)
V_1	3.4[2]		Q_o	75.67[10]	
V_2	2.7[2]		α_1	0.27[16]	
I_{xo}	29.52[3]	billion yuan	α_2	0.62[16]	
$M_{1\cdot0}$	5.72[3,7]	billion yuan	p	0[16]	
N_{xo}	35.85[3]	million persons	I_{ao}	10.41[14]	billion yuan
l_{x1}	2200[2]	yuan	$T_{1\cdot0}$	7.58[3]	billion yuan
l_{x2}	2200[2]	yuan	$N_{aT\cdot0}$	23.31[3]	million persons (in efficiency units)
w_o	635[2]	yuan	δ	0.7[15]	
k	4.18[3]		d	0.1[12]	
a_o	152[5]	yuan	σ	0.028[13]	
C_{xo}	22.80[3]	billion yuan	l_T	900[3]	yuan
G_o	26.64[3]	billion yuan	g	0.6[15]	
A_{xo}	8.91[3,8]	billion yuan	T_o	12.63[1]	billion yuan
X_{ao}	12.25[3,8]	billion yuan	$T_{2\cdot0}$	5.05[3]	billion yuan
ϵ_x	0.38[9]		N_{T0}	14.1[11]	million persons (in efficiency units)
$A_{xe\cdot o}$	1.35[7]	billion yuan	β	1.8653[16]	
$A_{xm\cdot o}$	1.12[7]		C_{ao}	41.86[3]	billion yuan
$M_{2\cdot0}$	1.02[7]	billion yuan	c	3[6]	
$E_{2\cdot0}$	5.71[7]	billion yuan	ϵ_a	0.7[9]	
D	0.33[7]	billion yuan	$\bar{A}_{xo}$	10.51[3,8]	billion yuan
E_o	7.53[3,7]	billion yuan	$\bar{X}_{ao}$	10.46[3,8]	billion yuan
$E_{1\cdot0}$	0.48[7]	billion yuan	W_o	405.3[7]	million persons
θ	0.016[3]		r	0.02[7]	
e_2	0.07[7]		m	0.558[2]	
e_3	0.028[7]		n	0.905[2]	
M_o	7.86[7]	billion yuan	w_{xo}	64.25[3]	million persons
m_2	0.043[7]		N_{xo}	308.65[3]	million persons
m_3	0.2[16]		N_{uo}	38.46[3]	million persons
A_o	39.81[1]	billion yuan	N_o	344.51[3]	million persons
			a'_o	135.6[3]	yuan

NOTES:

[1] Taken from version 1 estimates using the T. C. Liu Model.

[2] Taken from the estimates for 1957 and/or the period of the First Five Year Plan. Cf. [6].

[3] The figures shown are derivable once the values of certain other pre-determined variables are given.

[4] Derived by multiplying the value of Y_{xo} by 0.302, the ratio derived from the 1957 estimates. Ishikawa [6].

[5] Estimated on the basis of (1) the figures for the period of the First Five Year Plan and (2) the values of A_o, N_{ao}, and μ (0.89 for 1966).

[6] Estimated on the basis of (1) the data of several surveys of Industrial Production Cooperatives and (2) comparisons between the values of l_1, l_2, l_T, A_o/N_{ao}, and k.

[7] Derived or estimated from the United Nations data. See text.

[8] Because of the errors in the estimation processes, A_{xo} and $\bar{A}_{xo}$ do not balance. The same holds with regard to X_{ao} and $\bar{X}_{ao}$.

[9] For this concept and the problems associated with it, see text. The estimation process is complicated, but the basic data relied on are Katsuji Nakagane, "Chūgoku no shōhi suijun to shōhi kōzō" [The level and composition of personal consumption in China for 1956], in *Chūgoku keizai no chōki tembō II* [Long-term prospects for the Chinese economy: II], ed. S. Ishikawa, Tokyo, Institute of Developing Economies, 1966; S. Ishikawa, *Factors Affecting China's Agriculture in the Coming Decade,* Tokyo, Institute of Developing Economies, 1967; United Nations, *Statistical Yearbook for Asia and the Far East,* 1968; and S. Ishikawa, "Resource Flow between Agriculture and Industry: The Chinese Experience," *Developing Economies,* Vol. 5, No. 1 (March 1967).

[10] First, the 1952 value of Q was estimated by use of the officially published value of $A_{(1952)}$ and an estimated value of Q/A for the same year. The latter was derived from Professor L. Buck's prewar data (*Chinese Farm Economy,* 1930); with regard to the value of irrigation facilities, an estimation of the Indian value was utilized (Tara Shukla, *Capital Formation in Indian Agriculture,* Bombay, Vorn & Co., 1965, p. 138). Since we have data on the net increase in capital stock in agriculture in the First Five Year Plan period, $Q_{(1957)}$ is derivable. For estimation of Q_o, we assumed that the value of Q/A in 1957 would remain unchanged in 1966.

[11] Estimated from the size of N_{xo} and the coefficient of N_a (and N_T) to N_x for the period of the First Five Year Plan. See note 2 and Chi-ming Hou [3].

[12] Estimated from (1) the data of the 1957 National Survey on the Receipts and Expenditures of Agricultural Production Cooperatives and (2) articles appearing in several issues of *Ching-chi Yen-chiu* [Economic research], 1964 and 1965, on the problem of what is called "accumulation by labor."

[13] See text discussion in Chapter IV.

[14] Derived by assigning to λ at $t = 0$ the value 0.1. The values of other pre-determined variables constituting I_{ao} are given in other places.

[15] Based partly on the data for manufacturing activities of the rural and urban People's Communes in 1959–1960, a study of Reiitsu Kojima appearing in his paper, "Nōgyō-kikai-nōgu-kōgyō" [Agricultural machinery and implements industry], in *Chūgoku keizai no chōki tembō III* [Long-term prospects for the Chinese economy: III], Tokyo, Institute of Developing Economies, 1967, and partly on conjecture.

[16] See text.

(iv) The sectoral division method used in this projection model requires a special treatment of the intermediate goods which come into intersectoral and international flows. In principle, they are treated as either consumer or investment goods according to the pattern of their final use. Comments are in order, however, with regard to equations (1.11), (1.12), (2.12), and (2.13) concerning commodity interflows between the planned and non-planned sectors. From these equations it will become clear that the concepts ε_a and ε_x are somewhat different from that of the conventional Engel coefficient.

(a) When the planned sector imports agriculturally produced raw materials from outside sectors, the value of those raw materials is to be counted as constituting part of $\varepsilon_x C_{xt}$ (in X_{2t} is incorporated only the processing costs of these raw materials).

(b) When the agricultural sector imports intermediate goods for agricultural production from outside sectors, the value of these is not to be counted in A_t, but directly in $(1-\varepsilon_a)\ C_{at}$.

(c) When the non-planned sector imports from the planned sector food which is processed from the food crops or which uses raw materials of non-agricultural origin (such as salt), the value of this food is counted in $(1-\varepsilon_a)C_{at}$.[20] The estimates of ε_a and ε_x are made with these conceptual characteristics in mind.[21]

In Table II are shown the values of the pre-determined variables and parameters thus estimated.

[20] We have assumed, however, that the portion of food grains which are procured by the government but which are rationed back to the agricultural sector (mainly in major producing areas of industrial raw material crops) is to be consumed directly in the agricultural sector.

[21] The estimated values of the components of $\varepsilon_x C_{xo}$ and $\varepsilon_a C_{ao}$ are as follows:

	Total Amount (Billion Yuan)	Per Capita (Yuan)
A. $\varepsilon_x C_{xo}$	8.66	74.01
1. Value at farm prices of the agricultural products constituting part of food expenditure of households	6.41	54.80
2. Value at farm prices of agriculturally produced raw materials imported by the planned sector		
a. The portion consumed in the planned sector	1.43	12.22
b. The portion channeled back to the agricultural sector	0.82	7.00
B. $\varepsilon_a C_{ao}$	29.30	47.18
1. Value at farm prices of the agricultural products constituting part of food expenditure of households	33.22	53.49
2. Value at farm prices of the agriculturally produced raw materials contained in foods imported from the planned sector	−2.26	−3.64
3. Value of the intermediate goods for agricultural production imported from other sectors	−4.95	−7.97
4. Value at farm prices of the agriculturally produced raw materials which are processed in the non-agricultural sub-sector of the non-planned sector	3.29	5.30

IV. THE PROJECTION AND ITS RESULTS

Due to computation problems, the projection at this time has been made by applying to *planners' variables* b and μ certain pre-determined values. In this case the degree of freedom allowed for the planners in the projection model disappears; the purpose of the projection is changed to the identification of a consistent set of values of the remaining planners' variables γ and λ and thereby obtaining one plausible path of growth during the projection period. Several projections have in fact been made, however. Among them four variants are taken up here for discussion. The features of these four variants are shown as follows:

Variant	p in eq. (2.1)	σ in eq. (2.6)	b	μ
I	0	.028	.34	.89
II	.01	.028	.34	.89
III	0	0	.34	.89
IV	.005	.014	.34	.89

Variant I is exactly the projection into the future of what seems to be the state of the economy in the base year.[22] Variant II stands for the case in which Variant I is altered simply in regard to the rate of technological progress of agricultural production. The assumed rate of .01 is broadly identical to the performance of Japanese agriculture in the period from the 1890s to the 1930s. In Variant III alteration of Variant I is made simply in regard to the value of σ, one of the institutional variables. This represents the case in which, as indicated in Chapter I, the member farmers of the People's Communes and the workers in the planned sector exhibit a highly cooperative attitude to the national cause as a consequence of government institutional and persuasion efforts. Variant IV represents a blending of Variants II and III.

Due also to computation problems, simulations of each respective variant were made by a trial and error method, i.e., by repeating computations on the basis of multiple sets of arbitrarily assigned constant values of γ and λ and thereby determining a consistent growth path. (Note that the consistent values of γ and λ tend to vary from year to year. Hence, if this variation is significantly large during the projection period in using this method one may not be able to find even an approximately consistent growth.) The first-step computations were made in regard to the following thirteen cases:

Case	γ	λ	Case	γ	λ
1	.1	.2	8	.3	.2
2	.1	.3	9	.3	.3
3	.1	.4	10	.3	.4
4	.2	.2	11	.4	.1
5	.2	.3	12	.4	.2
6	.2	.4	13	.4	.3
7	.3	.1			

22 The value of b is derivable from the values of G_0 and Y_{x0} in Table II.

These cases were selected mainly on the basis of the performance during the First Five Year Plan period and evaluation thereof. In the following are shown (i) the actual values of γ, λ, and the related variables in the period of the First Five Year Plan and (ii) the corresponding values of the growth paths obtained in the relatively favorable and the relatively unfavorable variants of my previously attempted long-term projection of China's economy for 1957–1982.[23] The contrast of these two kinds of figures indicates that as of the end of 1957 the industrial structure attained by that time principally by such an investment allocation pattern as shown should have been modified realistically in order to overcome the resulting intersectoral imbalances.

	γ	λ	Annual Growth Rate of *NDP*	Annual Growth Rate of A_t
1. Actual performance during the First Five Year Plan	.46	.09	8.9%	4.1%
2. Growth paths of a previous projection by the writer				
a. Relatively favorable variant	.23 →.27	.16 →.14	7.4%	6.8%
b. Relatively unfavorable variant	.11 →.17	.38 →.26	4.3%	4.1%

In view of these, selection of the values of γ and λ for the first-step computations falls within the range of a combination of the "not very unusual" values of γ and λ.

For checking the results of these computations in terms of the consistency conditions from eq. (4.1) to eq. (4.4), however, the following three points should be made.

(1) As for eqs. (4.1) and (4.2), the estimated values of component variables for 1966 involved, as indicated in Table II, considerable estimation errors:

$$A_{xo} - \bar{A}_{xo} = -1.60 \text{ billion yuan}$$
$$X_{ao} - \bar{X}_{ao} = 1.79 \text{ billion yuan.}$$

In this projection, we have decided to make allowance of $\{-3.2 \sim 1.6\}$ for $(A_{xt} - \bar{A}_{xt})$ and of $\{-1.8 \sim 3.6\}$ for $(X_{at} - \bar{X}_{at})$, the unit of each respective figure being 1 billion yuan.

(2) The magnitudes of $\bar{N}_u$ and $\bar{a}$ in eqs. (4.3) and (4.4) have not yet been specified. While these represent institutional variables and, hence, the magnitudes tend to vary according to the institutional conditions, we assumed here arbitrarily that $\bar{N}_u = 100$ million persons in efficiency units and $\bar{a} = 120$ yuan.

(3) As was suggested above, the use of constant values of γ and λ makes it difficult to evaluate in terms of the consistency conditions the results of the computation for the entire projection period, if and when the real equilibrium values of γ and λ show considerable variation over time. It is quite probable that the same identical case is consistent in the early years but not in the

[23] [6]. The relatively favorable variant corresponds to the case of III2H_{II} there, and the relatively unfavorable variants to the case of III2L_{II}.

later years. In view, however, of the purpose of this projection, which is to derive a broad picture, we have decided to consider the case "not consistent" in which the above conditions are not satisfied for the period $t \leqq 5$.

A growth path which is found consistent according to these criteria should, therefore, be called "a nearly consistent growth path." Results of the checking are as follows:

(1) In Variant I, it seems impossible to attain such a nearly consistent growth path no matter what case is selected for the first-step computations.

(2) In Variant II, it is possible at $t = 5$ to find a nearly consistent growth path for the case of $\gamma = .2$ and $\lambda = .4$, but this growth path ceases to be consistent at $t = 10$.

(3) In Variants III and IV, it seems possible at $t = 5$ to find a nearly consistent growth path for the case of $\gamma = .3$ and $\lambda = .4$, but not at $t = 10$.

A more detailed examination with regard to the above results is made possible by drawing charts which show the interrelations between the changes in the values of γ and λ, on the one hand, and the intersectoral commodity balance, underemployment, and a'_t, on the other. Figure 4 as shown here refers only to the case of Variant III. On the basis of these results, the second-step computations were attempted with respect to the following cases.

Variant	Case	γ	λ	Variant	Case	γ	λ
I	1	.1	.6	II	4	.15	.55
I	2	.15	.55	III	1	.25	.4
I	3	.15	.6	IV	1	.2	.45
II	1	.1	.5	IV	2	.2	.5
II	2	.1	.55	IV	3	.25	.4
II	3	.1	.6				

Results of the second-step computations indicate that:

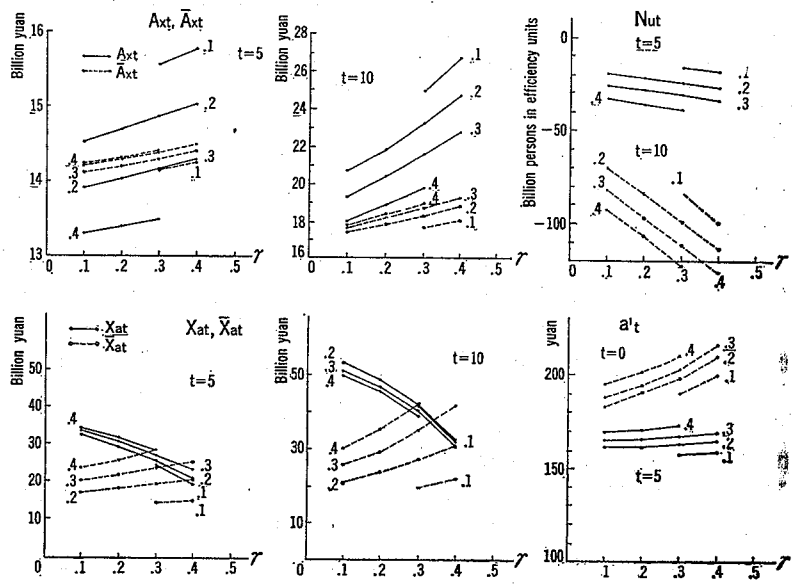
(1) In the early years of the projection period it is possible to identify a nearly consistent growth path for all of the variants. In Variants III and IV in particular, such growth paths appear to exist within the range of combinations of the γ and λ coefficients which is not necessarily very narrow.

(2) In the later years of the projection period, it becomes increasingly difficult to find a nearly consistent growth path. At $t = 10$, for example, we cannot find any case in Variants I and II in which a nearly consistent growth path exists.

In view of these, we have decided to take from each respective variant only one case which yields a nearly consistent growth path for a relatively longer period; namely, the case of $\gamma = .1$ and $\lambda = .6$ in Variant I, the case of $\gamma = .1$ and $\lambda = .6$ in Variant II, the case of $\gamma = .25$ and $\lambda = .4$ in Variant III, and the case of $\gamma = .2$ and $\lambda = .5$ in Variant IV. Selected indicators of each of these nearly consistent growth paths thus arrived at are shown in Table III, as well as in Figure 5.[24]

[24] In the table and figures, new symbols Y_t and I_t appear. They are defined as:
$Y_t = Y_{xt} + A_t + a_t N_{at} + T_t \qquad I_t = (1 - \theta) I_{xt} + a_t N_{at} + T_{1t}$.

Fig. 4. Interrelations between the Changes in γ and λ and the Values of A_{xt}, $\bar{A}_{xt}$, X_{at}, $\bar{X}_{at}$, N_{ut}, and a'_t (in Variant III)



Note: The numerical figures attached to each line in the diagrams indicate values of the λ coefficient.

TABLE III

NEARLY CONSISTENT GROWTH PATHS PROJECTED

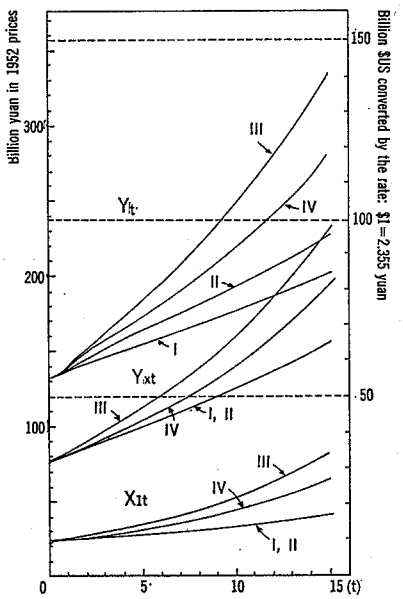
(Unit: billion yuan in 1952 prices)

	t	$NDP(Y_t)$	$NDI(I_t)$	Agricultural Output (A_t)	Export (E_t)
1966	0	131.3	35.0	39.8	7.5
			Variant I (γ=.1, λ=.6)		
1971	5	156.3 (2.6)	43.6 (2.4)	43.6 (0.8)	10.1 (6.2)
1976	10	176.6 (2.5)	49.5 (2.9)	42.4 (−1.1)	13.7 (6.3)
1981	15	202.3 (2.9)	58.5 (3.7)	39.1 (−1.8)	18.7 (6.4)
			Variant II (γ=.1, λ=.6)		
1971	5	165.4 (3.7)	45.7 (3.2)	49.5 (3.4)	10.1 (6.2)
1976	10	193.9 (3.1)	52.8 (2.9)	54.9 (1.5)	13.7 (6.3)
1981	15	225.9 (3.2)	62.1 (3.5)	57.7 (0.8)	18.6 (6.4)
			Variant III (γ=.25, λ=.4)		
1971	5	186.0 (6.4)	56.1 (7.5)	53.2 (5.4)	10.2 (6.4)
1976	10	250.6 (6.1)	78.8 (6.9)	65.9 (3.9)	13.9 (6.5)
1981	15	337.2 (6.2)	110.1 (7.0)	77.9 (3.2)	19.1 (6.5)
			Variant IV (γ=.2, λ=.5)		
1971	5	175.6 (5.1)	52.1 (5.9)	51.5 (4.5)	10.2 (6.4)
1976	10	221.9 (4.7)	68.3 (5.5)	60.6 (2.7)	13.9 (6.5)
1981	15	280.5 (4.9)	89.9 (5.8)	67.8 (2.0)	19.0 (6.5)

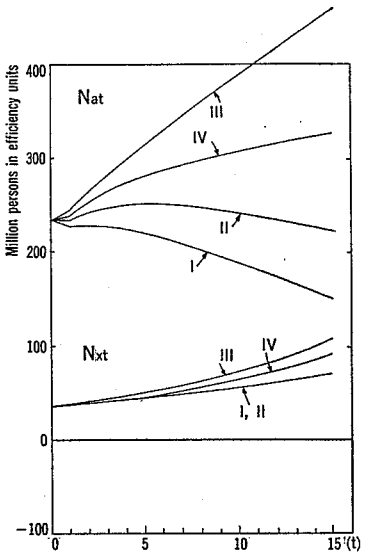
Note: Figures in bracket indicate the annual growth rate (%) of the variables concerned in the year indicated.

Fig. 5. Nearly Consistent Growth Paths by Variants

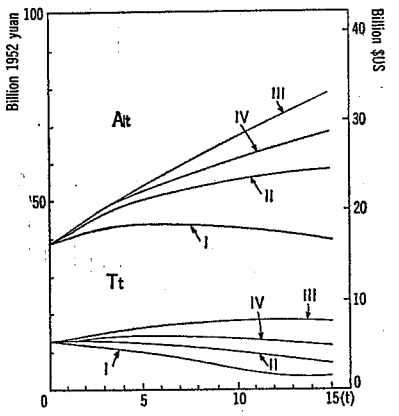
1. Y_t, Y_{xt}, X_{1t}



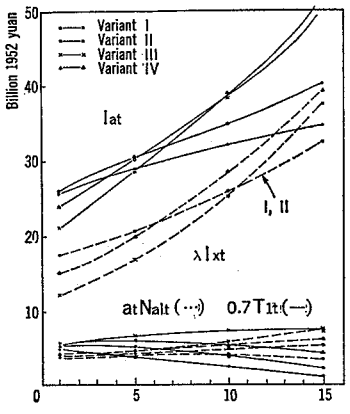
4. N_{at}, N_{xt}



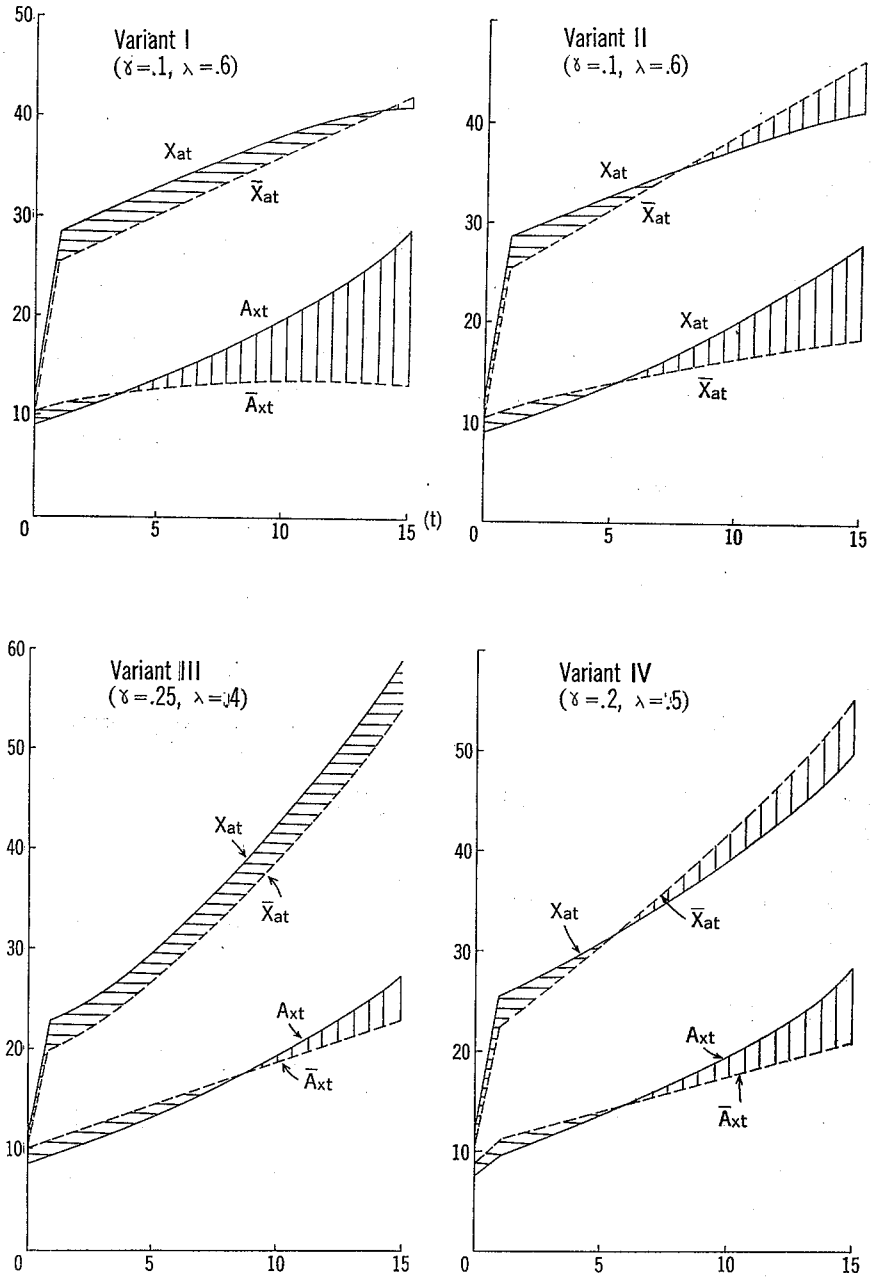
2. A_t, T_t



5. I_{at} and its components (λI_{xt} 0.7_{1t}, $a_t N_{alt}$)

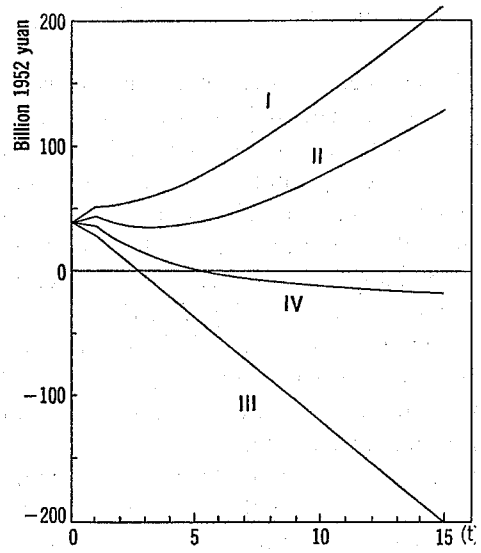


3. Interrelations between A_{xt} and $\bar{A}_{xt}$ and between X_{at} and $\bar{X}_{at}$ (Billion 1952 Yuan)

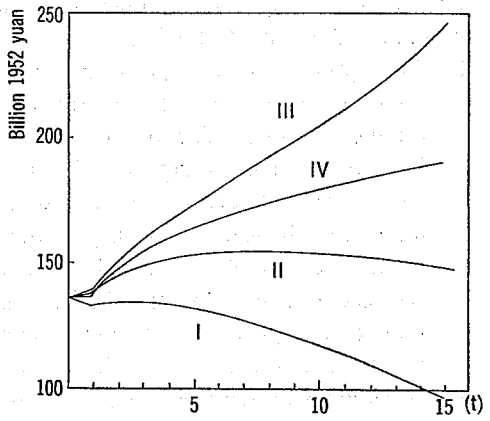


Note: The horizontally hatched area indicates the excess supply and the vertically hatched area the excess demand.

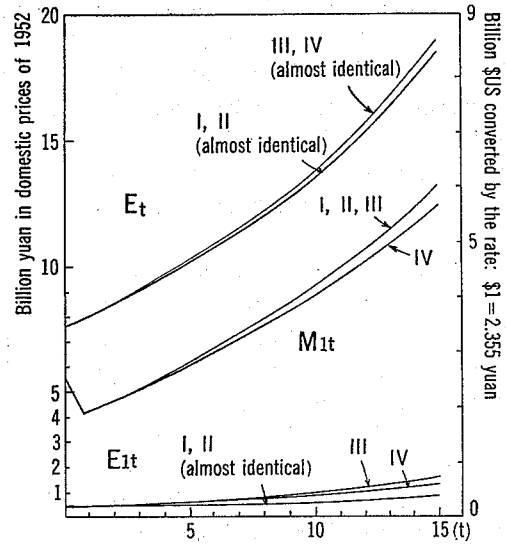
6. N_{at}



7. a'_t



8. E_t, E_{1t}, M_{1t}



V. FINDINGS AND IMPLICATIONS

The main findings and implications that are derivable from this projection are summarized in the following:

1. The annual growth rates in *NDP* of the "nearly consistent growth path" identified in the above way ranges between 2.5 and 6.4 per cent, depending on the variants. The nearly consistent growth paths of Variants III and IV, however, reach a stage of disappearance of underemployment at $t = 3$ and $t = 6$, respectively. The new stage would require a labor-replacing investment and, hence, the raising of the value of λ over and above that indicated by the results of computation. The uppermost level of the range of nearly consistent growth paths will be somewhat lowered. It should also be noted that these growth paths are "nearly consistent" only until about the year $t = 6$ in Variant I, $t = 9$ in Variant II, and $t = 10$ in Variants III and IV.
2. A remarkable feature which is common to all of these nearly consistent growth paths is that the underlying values of γ are unexpectedly low and that of λ unexpectedly high. When these growth paths cease to be "nearly consistent," the restoration of the "nearly consistent" growth paths requires that the values of γ be further lowered and the values of λ be further raised. The most important reason for this seems to be that the structural problems described in Chapter I are strongly in operation. Yet this strength seems to have been accentuated by certain temporary characteristics of the Chinese economic structure as of the base year; namely, (1) as a result of the priority order of investment allocation among sectors and sub-sectors which was effective during 1953–1959, the output structure is significantly skewed toward the planned sector and its investment goods sub-sector, in particular, and (2) due further to the population increase during the period of economic setback, the expenditure structure is unfavorable to private consumption. This may suggest that the Chinese economy during the projection period is still in a phase which requires structural readjustment toward a more agricultural and more consumer-goods oriented direction.[25]
3. The projection results suggest that the most serious structural problem in the projection period will be the food problem. The food problem is most clearly indicated in generally low rates of growth of agricultural output (in Variant I the rate of growth is even negative) despite the major share of centralized investment funds allocated to the agricultural sector, a picture in which the classical law of the diminishing return of land is in force. Since the assumption of this projection forbids the marginal productivity of labor to fall below certain pre-determined levels, the law manifests itself in the diminishing marginal productivity of capital invested in agriculture. (This is the case even in Variants II and IV, in which p, the rate of neutral technological progress,

[25] As is clear from the study of the Fel'dman-Domar model in Ishikawa [4], the planners' choice of the value of γ which is smaller than the ratio of X_1/V_1 to $(X_1/V_1 + X_2/V_2)$ results in a structural readjustment in favor of the consumer goods sector.

assumes positive values. This means that the rates of technological progress to the magnitude assumed there are far outweighed by the force of the above law.) This is shown below, together with the behavior of some related variables (the figures are all derived from the data in our projection).[26]

Variant	t	Marginal Productivity of Capital $\left(\frac{A_t}{Q_t}\times 0.11\right)$	Marginal Capital Output Ratio $\left(\frac{I_{at}}{A_t - A_{t-1}}\right)$	Average Capital Output Ratio $\left(\frac{Q_t}{A_t}\right)$
I	0	0.058	—	1.901
	5	0.025	86.891	4.443
	10	0.014	−65.124	8.092
II	5	0.028	18.335	3.978
	10	0.017	42.991	6.493
III	5	0.032	10.445	3.414
	10	0.021	15.773	5.213
	15	0.015	21.559	7.202
IV	5	0.030	13.650	3.714
	10	0.019	23.953	5.928
	15	0.013	36.633	8.461

The lump sums for capital investment required in agriculture also raises, in fact, the question of whether the present Chinese agriculture has the capacity to absorb them, although this question is ignored in our projection by using the Cobb-Douglas production function for agricultural production.

4. With regard to the transition of the structural problems in the course of the above growth paths, the following comments are in order: (i) When the amount of underemployment begins to decrease significantly, we may consider that the underemployment problem begins to disappear. Yet in the cases in which an increase in employment is made possible with the marginal productivity of labor kept below normal (as in Variant III), a problem remains whether the underemployment problem can be considered to be really disappearing. (ii) As was mentioned earlier, the final indicator of the food problem is the equilibrium amount of A_{xt} relative to that of X_{at}. Part 3 of Figure 5 clearly indicates that for all of the four variants the amount of X_{at} ($\bar{X}_{at}$) greatly exceeds that of A_{xt} ($\tilde{A}_{xt}$) throughout the projection period. The prospects are still dim that the net resource flow from the planned sector to the agricultural sector in such tremendous amounts will become nil or reverse to a net resource from the agricultural to the planned sector. (iii) The important indicator of the foreign trade problem is the ratio of the amount of E_{1t} to E_t. In so far as this ratio remains very small, it is not possible to say that the economy has escaped from the grip of the restricting conditions of foreign export markets. This situation is common to all the variants through-

[26] The interest rate of the People's Bank short-term loan to the People's Communes has since May 1961 been 0.48 per cent a month, which is converted to 5.7 per cent a year, a rate which is almost equivalent to the marginal productivity of capital in 1966 ($t = 0$).

out the projection period, although it is derived from the assumption about the value of θ.

5. By contrasting the results of Variant I with those of other variants, it should be clear that, in order to attain the consistent growth paths under the conditions of structural problems, technological progress in agricultural production and institutional reforms assume roles of crucial importance. Institutional reforms, involving persuasion, are likely to result in downward shifts in the labor supply curves. In agriculture, this brings about an increase in output and total and per-capita income, although it reduces per-labor remuneration. It must be noted, however, that this course may involve a significant increase in labor intensity and, hence, institutional tension; in the nearly consistent growth path of Variant III, the number of labor-days a year is larger by 47 per cent at $t = 5$ and by 106 per cent at $t = 10$ than in the nearly consistent growth path of Variant I. The option of relying on technological progress in agricultural production may be an effective substitute for the above in the sense that it may be able to alleviate structural problems without involving institutional tension. The Chinese economic policy immediately before the Great Cultural Revolution might have been exclusively along this course. The performance of the nearly consistent growth path in Variant II, however, suggests that the rate of technological progress should be much greater than what is assumed in Variant II, or much greater than what is feasible from the technician's point of view if technological progress alone is relied on for the solution of the food problem.

The reader is warned that these findings and implications must, of course, be assessed against the fact that the present projection is a hypothetical one. Its hypothetical nature comes not only from the three basic reasons described in Chapter I. It has been accentuated by various procedual expedients which were used in the previous chapter to derive a single "nearly consistent growth path" from each respective variant. Yet, regardless of whatever realistic revisions and modifications are made with regard to the above findings, the following two points seem to be valid. (1) The possibility is not very great during the projection period for the Chinese economy to solve all the structural problems stemming from endogenous forces. (2) This prospect requires extraordinary efforts on the part of the Chinese government in both institutional and technological aspects.

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