THE ANALYSIS OF THE ACCUMULATION RATE IN CHINA

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ABSTRACT

The purpose of this paper is to identify the main important variables and quantities which interact with the accumulation and accumulation rate, and then to analyze the intrinsic relations among them which are important in accumulation rate decisionmaking. Especially we concentrate on the relations among the accumulation rate and energy, total consumption and effectiveness of accumulation.

1. GENERAL DESCRIPTION

In China, the national income is divided into two parts: consumption and accumulation for final usage. Accumulation rate is usually used to mark the scale of accumulation annually corresponding to a certain economic development level. China has a planned economy, in which the government plays a decisive role to determine the accumulation rate or the accumulation. The accumulation is mainly allocated for two purposes: one is to expand the production capacity, the another is to increase the non-production assets and the reserves.

1.1 HISTORICAL REVIEW

In reviewing past history, we have found that the accumulation rates in China experienced severe fluctuations from 1958 to 1980.

From Figure 1, we can see that in the first "five planning years" (between 1953 and 1957), the accumulation rates were fixed at appropriate levels, with an average of 24.2%. As a result, the economy developed quickly. But, in the next "five planning years" (from 1958 to 1962), the accumulation rates soared to an average level of 30.8%, with a highest level of 43.8% . As a result of this overaccumulation, the economy was frustrated, then accumulation rates dropped precipitously. Between 1960 and 1963, the average accumulation rates were adjusted to 22.7%. However, during the following three "five planning years", the accumulation rates were again raised up to a high average level of 30.8%.

Having related the changes in accumulation rates with the resulting economic development and frustration, we learnt that when the accumulation rates were fixed at proper levels which could be accepted by the capacity of the economy, the economy could grow healthily with a balanced development of the capital product and consumption product industries. Thus a steady improvement in the prople's real living standard and a high effectiveness of accumulation can be obtained. But if the accumulation rates were fixed

too high for the capacity of the economy, the result would be just the opposite. The maintainance of high accumulation rates would stimulate the capital product industry to grow too quickly, hinder the development of consumption product industry, and cause the industrial structure to become unbalanced.

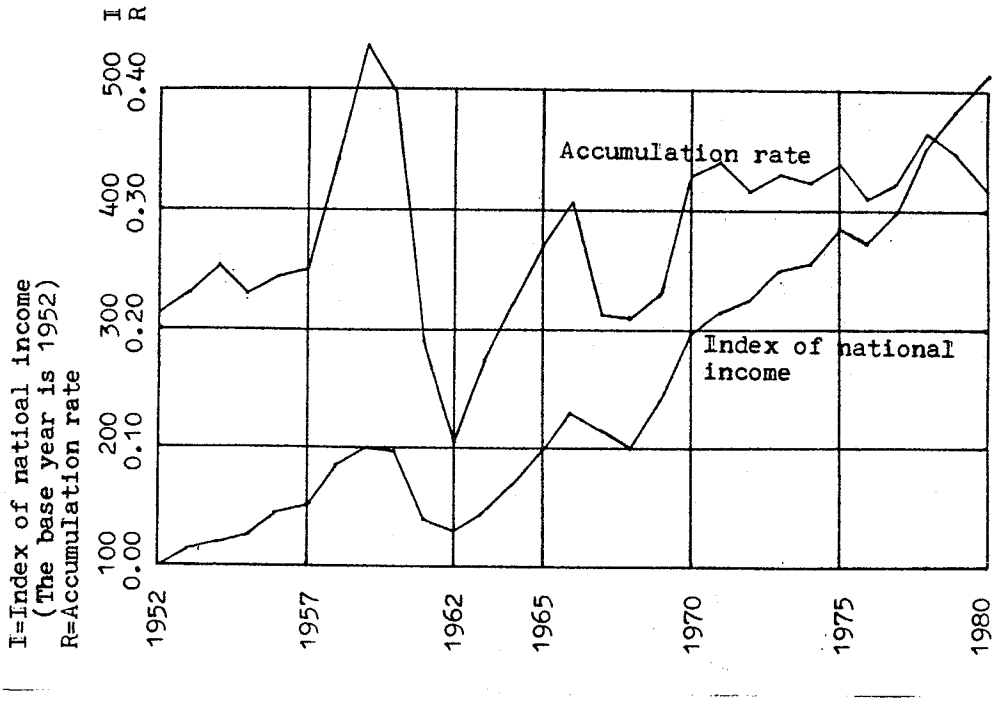


Figure 1. Accumulation rates in history

Taught by history, people came back to reconsider the accumulation problem.

1.2 THE PURPOSE OF THE PAPER

Recently, the accumulation problem has drawn considerable attention from the economists of our country. The research in this aspect has been fruitful, both in depth and in breadth of work, with many research papers published. These papers have approached to the problem on two sides. From one side, they have analyzed the relations among accumulation rate and the other macroeconomic variables, such as national income and its increase rate, consumption and its increase rate, the effectiveness of accumulation, the energy availability and so forth. From the other side, they have analyzed the relations among the accumulation usage and the other economic variables. Most of these analyses were qualitative, only few were quantitative. Because of certain limitations in their methods, none of their analyses have analyzed the problems in a national-wide systematic way, or have considered the long term behavior of accumulation rate in economic development. And none of the quantitative analyses papers have considered various factors related to the problems or feedback interactions among the variables.

It is well known that most economic variables of a country interact with one another, among which the accumulation rate is one of the most important ones. It closely ties with economic strength and growth, and it changes along with the development of the economy in its own dynamic behavior mode. As the first stage of our research, therefore, we analyzed the relations and interactions among the accumulation rate and other macro-econimic variables; and identified and analyzed the long term dynamic behavior of accumulation rate. Then taking one step further, based on policy tests, we identified a suitable accumulation rate policy for the future development of our country.

From the history, we have found that when the accumulation rate was high, the industrial structure would consequently become unbalanced, causing the people's living standard to decline and finally frustrating the development of the economy. To identify the quantitative relations, how the industrial structure and the availability of consumption product are affected by accumulation rate at different levels is examined. We also analyze how the whole economic development would be influenced by accumulation rate at different levels and how the accumulation rate should be adjusted as the economy develops. In the paper, the performance of energy in the economy is considered. The energy shortage is a world-wide problem; therefore, the effect of different accumulation rates on energy dynamics, and the effect of possible future energy situations on economic development are considered.

In recent years, many quantitative analysis methods dealing with socio-economic problems have been introduced into and developed in our country. These include econometrics, system dynamics and others, with which we can delve into the problems even further and obtain valuable results that can be used to reform and adjust the existing economic situations. Systems dynamics is a more powerful tool than the others for analyzing the socio-economic problems through simulating the dynamic behavior of systems. Therefore, a system dynamics national model of China (SDNMC) has been under creation since early 1984. The SDNMC is intended to show how the policies made by the government generate the socio-economic behavior in this country. With the model, the accumulation rate problem is preliminarily examined. Because of time limitation, our efforts just concentrate on the relations among the accumulation rate and other macro-economic variables.

2. STRUCTURE OF THE MODEL

The SDNMC consists of 12 sectors (or subsystems) : population, agriculture, capital and consumption product production, energy, transportation, technology, national income and its allocation, capital accumulation, education, pollution sectors and others. The model's sectors and their major interactions are shown in Figure 2.

2.1 THE OVERVIEW OF THE MODEL

Figure 2 shows the main information and physical flows that relate

the sectors to each other. Many of the flows on the figure are self-explanatory. The emphasis of the following description is on those sectors which closely relate to the accumulation rate problem.

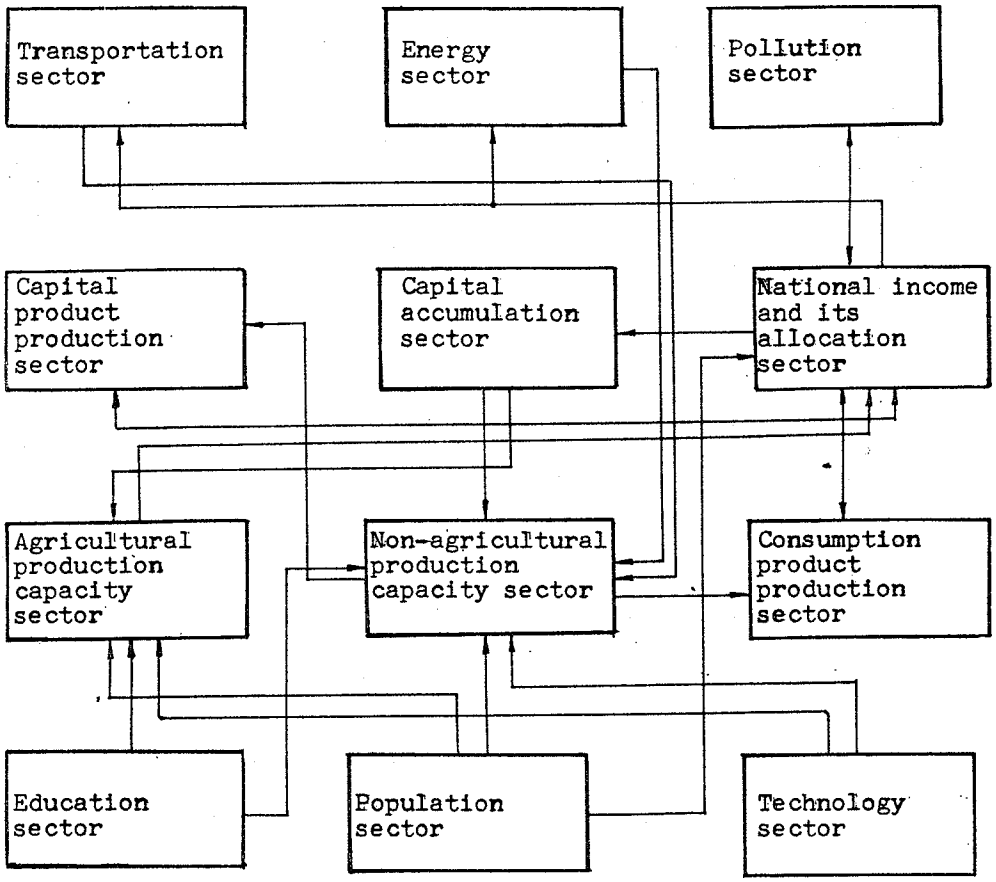


Figure 2. The structure of SDNMC

The accumulation rate is determined in the national income and its allocation sector. This sector has direct or indirect interactions with all the other sectors. From the consumption product production sector, capital product production sector and agriculture sector, come all the resources of the national income. Pollution severely reduced the real national income. The allocation and use of the national income influence the education sector, technology sector and population sector, which gain funds from the national income and its allocation sector. The feedbacks of any changes in these sectors are transfered to the agriculture and non-agriculture production capacity sectors and afterwards capital product and consumption product production sectors. As a result, the national income is influenced. This is just one kind of feedback loops, but there is another kind. The use of national income brings changes to the capital accumulation sector, the transportation sector, the energy sector and pollution sector. These

changes are then transfered to the agriculture and non-agriculture sectors and others to form the other kind of loops. Obviously the national income and its allocation play an important role in adjusting the money flow in these loops. Therefore, we would stress that the national income and its allocation sector is very important in the SDNMC.

2.2 THE NATIONAL INCOME AND ITS ALLOCATION SECTOR

Figure 3 provides a brief overview of the national income and its allocation sector. The national income is derived from the total product of society, which is equal to the sum of agriculture and non-agriculture outputs. The non-agriculture output is equal to the sum of the capital product and consumption product production outputs.

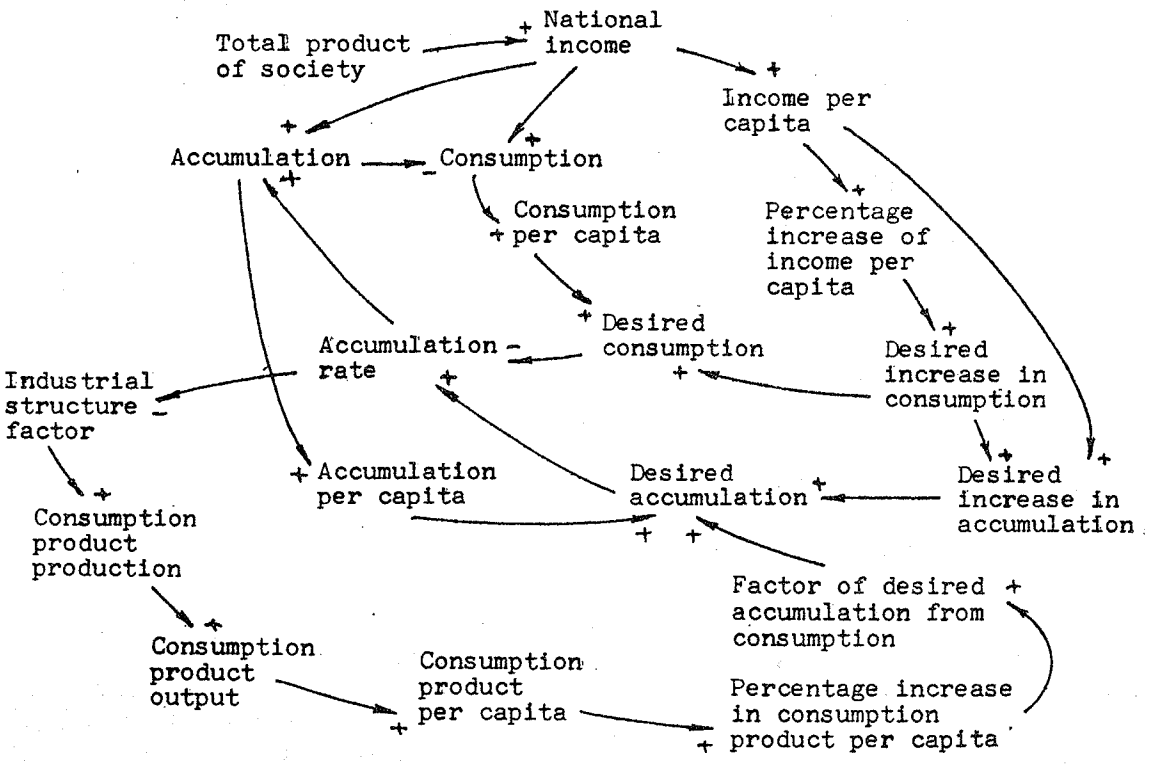


Figure 3. Structure of the national income and its allocation sector

The allocation of national income between consumption and accumulation is determined by the accumulation rate. And the accumulation rate is further determined by the desired consumption and disired accumulation. The desired consumption bears the following relation with the consumption per capita and the desired increase in consumption:

DTCONS.K=BCONPC.K. x (1+INCONS.K)

where

DTCONS --- Desired Total Consumption (Yuan)
DCONPC --- The Consumption Per Capita of Last Year (Yuan/Person)
POP --- Population (Person)
INCONS --- Desired Increase in Consumption (Dimentionless)

Similarly, for the desired accumulation, we have

DACCU.K=BACCPC.K x POP.K x (1+INACCU.K) x FDACC.K

where

DACCU --- Desired Accumulation (Yuan)
BACCPC --- The Accumulation Per Capita of Last Year (Yuan/Person)
POP --- Population (Person)
INACCU --- Desired Increase in Accumulation (Dimentionless)
FDACC --- Factor of Desired Accumulation From Consumption (Dimentionless)

Here the FDACC is a factor to adjust the desired accumulation. The adjustment is fulfilled through the negative loop. (See Fig.4)

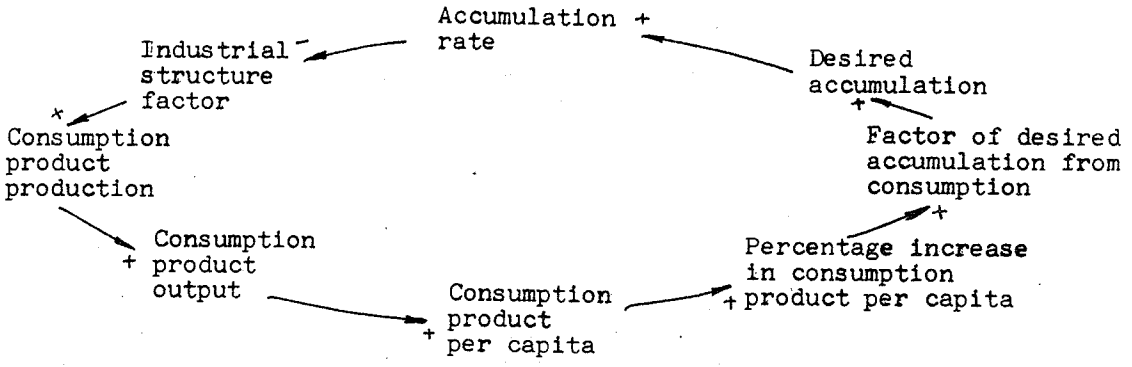


Figure 4. The negative loop of accumulation rate adjustment

When the accumulation rate is kept at an unusually high level as the case in the history, the industrial structure will change. The unusually high accumulation rate means unusually high capital investment, which will consequently cause the overgrowth of capital product production. As a result, the production capacity of capital product will expand beyond the level that the economy can support. To put it in another way, with limited resources, the overuse of resources on the capital product production and capital investment will depress the consumption product production, and will cause the output of consumption product to decrease, then cause the consumption product per capita to decrease if the population does not decrease at the same time. We assume that from the interests of whole economy people expect the consumption product per capita to grow constantly. Of course, to fulfill this, it will require a bigger synchronous increase in consumption production and the consumption product per capita than the increase of the people's living standard. When their increases become zero or even negative

the economy will react to it by adjusting the accumulation rate automatically. The decrease in the consumption product per capita will lower the real living standard of the people. Improvement in the people's living standard is an important criterion in evaluating government policy. If a constant high accumulation causes a reduction in consumption product per capita, it points to a failure of the accumulation rate policy. This information will feed back to the decisionmakers, the regulations will be made to change the undesirable situation.

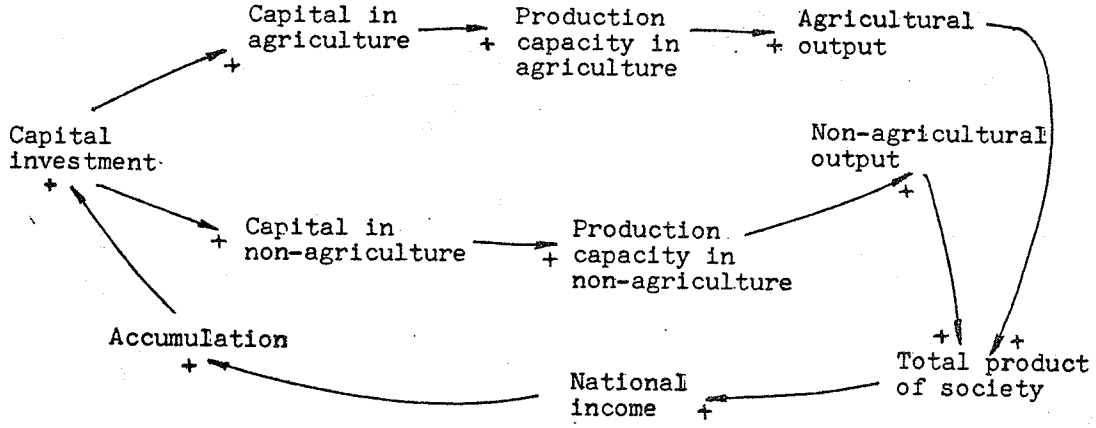


Figure 5. Other loops connecting more than two sectors

When the accumulation rate is determined, the accumulation funds are determined by the formula:

Accumulation Funds= (National Income) x (Accumulation Rate)

The accumulation funds are used to expand production capacity and increase public facilities.

The total consumption funds can be derived from the formula:

Total Consumption= (National Income) x (1-Accumulation Rate)

The total consumption funds are divided into two parts: the personal consumption fund and the social consumption fund. These funds are allocated to the consumption sectors, such as education sector and population sector.

Many other loops, which connect more than two sectors, are not shown in Figure 3. Some of them are shown in Figure 5.

The loops shown in Figure 5 link the national income and its allocation sector with the capital accumulation sector, agriculture and non-agriculture sectors, consumption product and capital product production sectors. These loops reflect the relations among the sectors.

3. BASE RUN RESULT

We put the national income and its allocation sector into the

SDNMC, then run the model. The simulation time starts in 1965 and ends in 2065. In the following paragraphs, we discuss the main results of the base run.

3.1 CHANGING MODE OF ACCUMULATION RATE

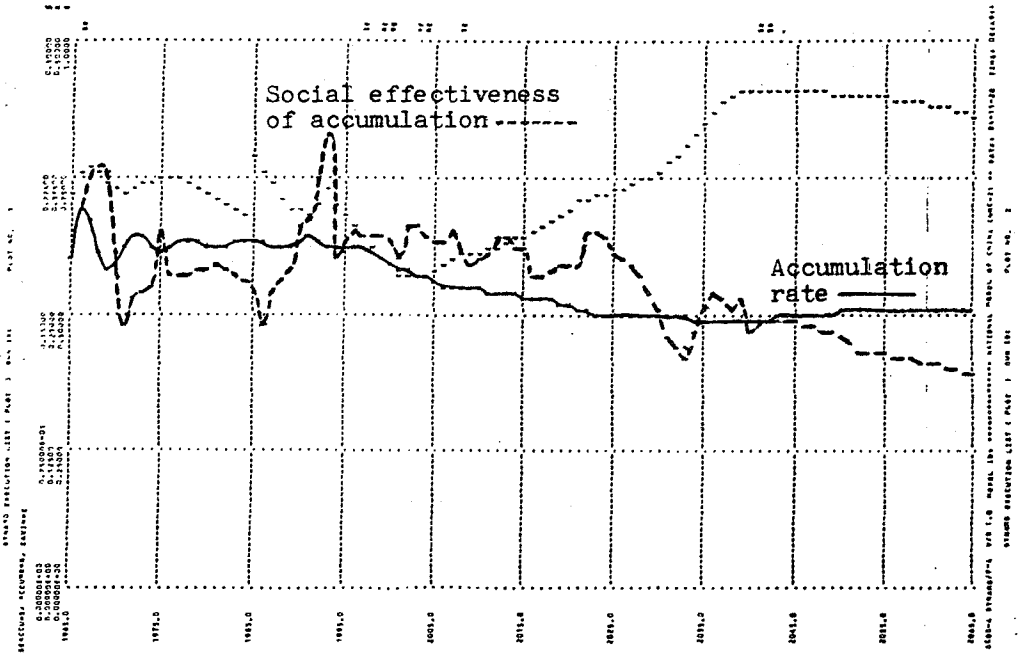


Figure 6. Simulation results of accumulation rate and effectiveness of accumulation

As the simulation time extends to 2065 A.C., the dynamic behavior mode of accumulation rate is shown in Figure 6.

The accumulation rate will gradually go down to 25% in 2020 A.C. Thereafter, the level will be maintained, with only very small deviations. This mode exhibits the unique features of our country's economic growth. During the period of 1985 to 2020, the growth is at high speed; the total product of society (TPS) increases quickly. After 2020 A.C., the economy will enter a period of gradual growth. Increase will become steady and slow. In the former period, through economic adjustment and reformation, the economic efficiency and benefit will increase significantly, stimulating the growth of the economy. In order to adjust the industrial structure and reform the conventional industries, a higher investment and accumulation is required to develop energy and transportation industries, establish new industries and make other needed improvements.

On the other hand, the absolute value of total national income is still not large during that period; therefore, the accumulation rates will be maintained at a high level. Later, as the economy develops quickly, the total national income will become larger and larger, and although the accumulation rate will be lowered, the absolute value of accumulation funds will continue to grow. After 2020 A.C., the economy will grow slowly and reach the

balanced development point. The accumulation rate will be maintained at the level of 25%.

Reviewing the accumulation rates in the period between 1953 and 1957, the average rate is 24.2%. In this period, the growth of the economy is reasonable and healthy. The growth among different industries is balanced and parallel on the whole.

Comparing these accumulation rates with other countries, especially with the Soviet Union and Hungary which have the same statistic system, we have found that, from 1946 up to 1978, the accumulation rates of Soviet Union were maintained at about 25%, and from 1961 to 1975, the accumulation rates of Hungary were also maintained at about the same level. Therefore, we believe that the 25% accumulation rate would be the most reasonable accumulation rate of China in the future.

3.2 DIMINISHING EFFECTIVENESS

In the model, one important variable called the social effectiveness of accumulation (SEACCU) is used to evaluate the economic result of accumulation.

SEACCU= (National Income This Year - National Income Last Year)/ Accumulation

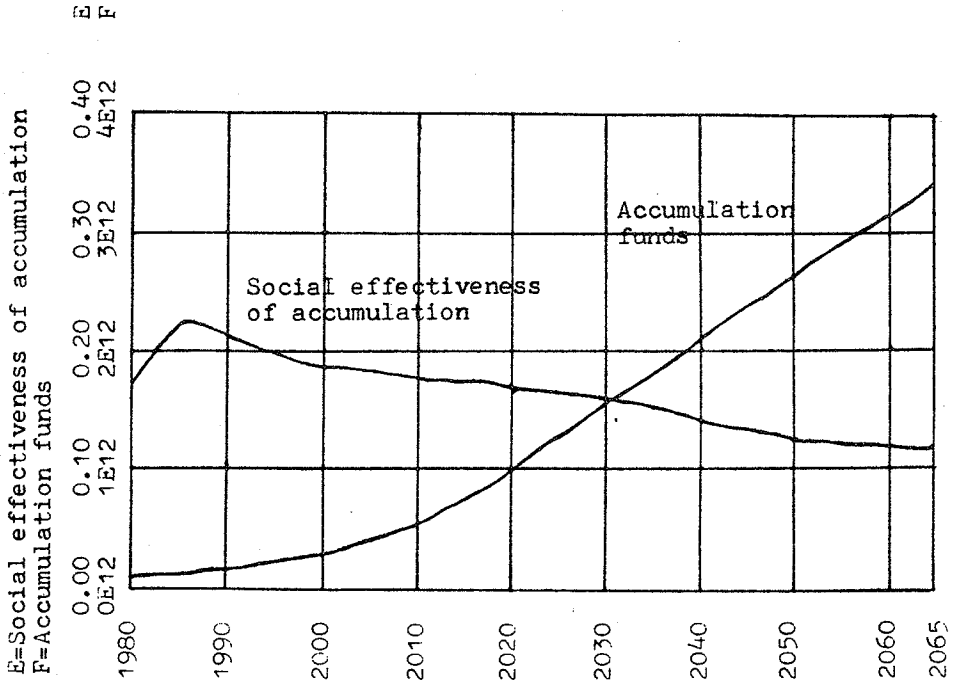


Figure 7. Simulation results of SEACCU and accumulation

Figure 7 shows the simulation results of SEACCU and accumulation. We have found that the result is very interesting. As accumulation grows larger and larger, the SEACCU decreases gradually. This trend becomes very remarkable after 2025, when the accumulation rate is maintained at about 25% and the accumulation funds are

kept increasing rapidly.

According to its usage purpose, the accumulation can be divided into two parts: production and non-production usages. The first part is the part that will contribute to the increase of national income. But this part has the same increase pattern as the total accumulation. Therefore, in order to specify what causes the effectiveness of accumulation to dimish, we have to consider other economic factors which might be effective.

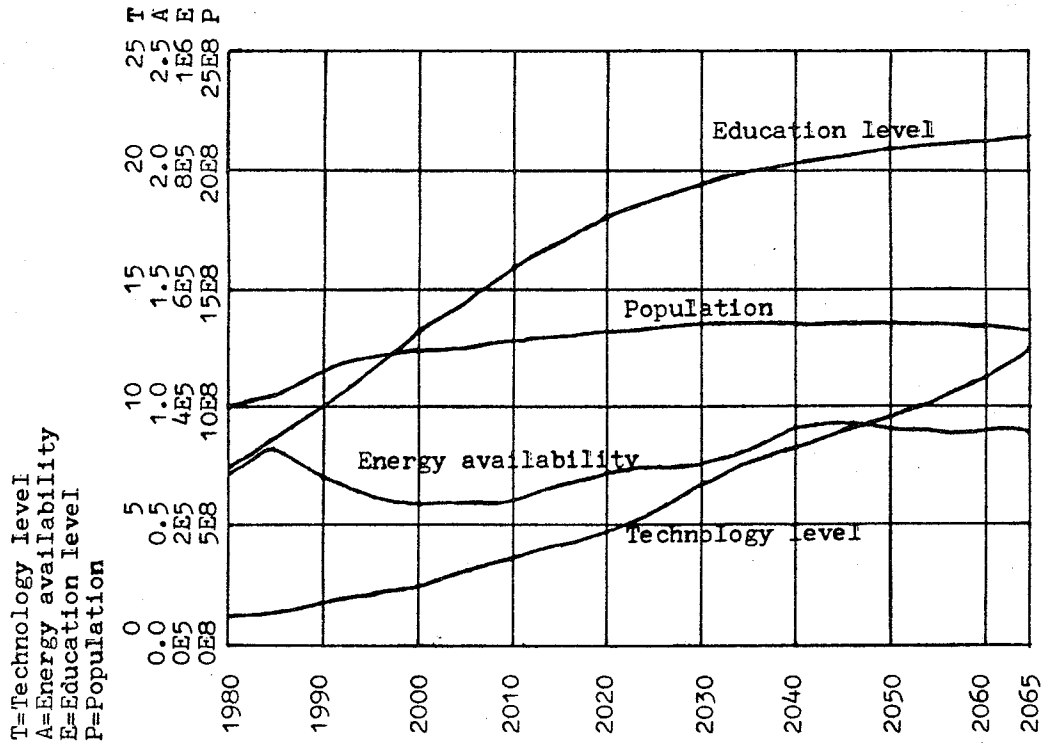


Figure 8. Other economic factors development trends

Figure 8 shows us the other important economic factors changing trends. Energy availability will increase after 2035, and in the years from 2040 to 2065 decrease a little. The total population increase rate will be very small. Its rate of increase will decrease from 0.24% in the year 2020 to 0.01% in 2045, becoming negative in later years. This will lead to a decrease in the labor force. The technology level increases very quickly in the period from 2020 to 2065. Through analysis, we have found that, after 2025, technology plays a more and more important role in production, and the cost of technological development and its transfer into production becomes more and more expensive. Therefore, the same amount of increase in technology and production capacity will require more capital investment than before. This

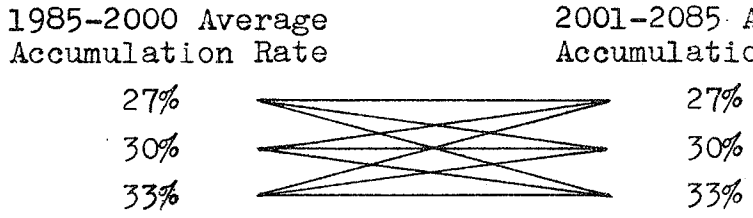
will cause the effectiveness of capital investment to decrease gradually. Because the effectiveness of investment is the key factor influencing the SEACCU, it is obvious that its decrease will cause the SEACCU to decrease also. This is the main cause of the diminishing effectiveness of accumulation. The decrease in labor force and small decrease in energy availability will also cause the SEACCU to decrease, but the effects are much smaller. This result tells us that a higher accumulation rate will not result in a larger value of SEACCU in the future. We will discuss this further in section 4.3.

4. POLICY TEST

4.1 ACCUMULATION RATE --- ENERGY TEST

Some economists in this country have supposed that a high accumulation rate is preferable to a low one. They believe the trend of accumulation rate will be at a high constant level, and the high rate of accumulation will result in faster economic development. But they might not notice the interactions among accumulation rate and other economic variables, and what will happen to the economy when the accumulation rate is kept at a high level. Now let's discuss it through policy tests in different accumulation rates.

We divide the simulation time into two periods. One is the period from 1985 to 2000 and the other is the period from 2001 to 2085. For simplicity, the average value of the accumulation rate is used for policy test, and the tests are designed as follows:



The simulation results show that the accumulation rate combinations of 27% - 27% and 30% - 27% have the best results. If the average accumulation rate is maintained at 27% from 1985 to 2085, the national income will increase at an average rate of 4.49% and the average consumption level per capita will increase at an average rate of 4.2%. If the average accumulation rate is maintained at 30% in the period of 1985 to 2000 and swiched to 27% between 2001 to 2085, then the national income will increase at an average rate of 4.47% and the personal consumption level will increase at an average rate of 4.2%. Other combinations are not idealwhen compared with these two. According to this, we suggest that the high accumulation rate not be preferable. Although the relatively low accumulation rate will cause slower economic development in the short term; in the long term the relatively low accumulation rate can

make the economy grow steadily and persistently, and it can postpone the exhaustion of conventional energy, leaving more time for the energy transition. If people pursue the high accumulation rate, the exhaustion of energy supplies will occur in 2045, about 30 - 40 years earlier than the base run. At that time, the energy transition might not be finished. Because of this, the formed production capacity will not be fully utilized; consequently, the total output will decrease.

4.2 ACCUMULATION RATE --- CONSUMPTION PRODUCT AVAILABILITY TEST

As we have mentioned before, when accumulation rates are kept at high levels, it causes the product structure to change. The capital product industry expands quickly and hurts the development of the consumption product industry. This unexpected result can emerge in the relatively short period of 5 to 10 years. We have found that if we have an average accumulation rate of 30% in the period from 1985 to 1990, the potential production capacity of consumption product is about 7990E8 (Yuan) in 1990, and the potential production capacity of capital product is about 6410E8 (Yuan). If the average accumulation rate is increased to 31.5%, the potential production capacity of consumption product is about 7710E8 (Yuan) in 1990, and the potential production capacity of capital product is about 6725E8 (Yuan). The production capacity of consumption product is about 4% lower, and the production capacity of capital product is 5% higher, (note: here the output of commerce industry is included in that of consumption product industry) The increase in the consumption product per capita in the first case is 6.8 yuan/person in 1990 and in the second case it is about 5.95 yuan/person in 1990, 0.85 yuan/person lower. The reason is that higher constant accumulation or accumulation rate will cause continuously high capital investment. This will stimulate the capital industry go grow and it will scramble for the available resources with the consumption product industry because of the limited supply. At last, the two industries will develop in an uncoordinated fashion. From the historical data, we can see that the higher constant accumulation rate, the greater the effect above will be. Finally it will make the people's real living standard increase very slowly or even decrease. Furthermore, although the social effects caused by this change are difficult to quantify, it might be a problem if we are not aware of it.

4.3 ACCUMULATION RATE --- ITS EFFECTIVENESS TEST

If we maintain the average accumulation rate at 25%, 27% and 30% after 2300 A.C., and eliminate the energy influence, we have found that the social effectiveness of accumulation rate corresponding to the 27% accumulation rate has the highest value among the three. It is 0.5% higher than that of the 25% accumulation rate, and is about 10% higher than that of the 30% accumulation rate. This is the result of the diminishing effectiveness of accumulation, which we have already discussed.

5. CONCLUSION

When formulating the accumulation rate policy, we should consider its short term effect on the economy. To avoid the uncoordinated development of consumption product and capital product industries, we should not set and maintain a high accumulation rate. A proper development speed of consumption product industry should be guaranteed so that we can improve the real living standard of people at a constant rate. Besides, the effect of accumulation rate on the economy in the long term and the diminishing effectiveness of accumulation should be considered. We should also consider the shortage of energy if the energy transition is not completed smoothly by 2045. Based on the above analysis, we suggest that the average accumulation rate of 27% be preferable. This rate, considering the above factors, can lead the economy to a healthy and constant development with considerable good economic results. Coincidentally, the average accumulation rate of the base run is just about 27%. The average rate is 27%, but in different periods of time, it should have different rates i.e., following the trend of base run. From 1985 to 2020, the accumulation rate should be kept at 30% in the early years, then decrease gradually to 25%. After 2020, it should be maintained at this level with some small deviations.

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