SYSTEM DYNAMICS SIMULATION FOR THE MANAGEMENT OF A COLLEGE

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ABSTRACT

This paper constructs a system dynamics model on macroscopic management of a college which is based upon an actual system operation of the college. The students, staff, fixed capital, finance, teaching and research as sectors are included in the model. Facing several important problems influencing the development of the college various policy experiments are operated on the model. The experimental results show what the key factors influencing the system and what the possible approaches solving these problems are.

I. INTRODUCTION

This is an exploration to use the System Dynamics Model on University Management (SDUM) to an actual system which is a management college in Beijing, China.

This college was set up in 1983. It is 70km far from the civic center. It's main task is giving the staff who are working in the Chinese Academy of Sciences the training as continuing education. Each period of the training could be 1-3 months. Generally, there are one thousand students a year. In the meantime, there are four hundred students whose study period is

two years long in the Department of Politics or the Department of Management Engineering at the college. They, graduated from high schools, come from different parts of the country and have more than 5 years working experience.

Recent years the source of quantity of the students are not stable and there is a decrease tendency. Another problem is the lack of the finance. Therefore, the managers are very concerned with what the correct and available strategy is for development of the college.

II. MODEL PURPOSE, VARIABLES AND TIME HORIZON

1. Model Purpose

The most important thing for a new college is how to develop stably untill the scale of it is appropriate. Therefore the model purpose is, at first, to represent the dynamic behavior in development of the scale of the college under present conditions and to find out what the real problems are, and then the policy experiments are operated in order to get key factors and the approaches solving these problems.

2. Model Variables

The main variables of the model are:
number of the students
number of teaching and administrative staff
fixed capital
the rest in finance
There are closer relationships between these variables and the scale of the college. The attention has been paid to the other factors also but not much such as the quality of students, the academic level of teachers,research work done by the teachers, the capital construction, buildings and facilities of the college and so on because they are not so important as the former four factors for a college which is being the initial stage of it.

The first three variables show the change of scale of the college. The fourth one is concerned with the income and the expenditure. It shows whether the college can obtain the enough financial support for the regular operation and the further development.

3. Time Horizon

The college will pass it's initial stage in ten years. The data investigated is available only from 1985. Therefore the time horizon is decided from 1985 to 2000 (year).

III. MODEL STRUCTURE

The model consists of 5 sectors including students, staff, fixed capital, finance, teaching and research. The sectors are interconnected by coupling of the variables and the interactions of the variables construct the feedback structures of the model.

Figure 1 gives the causel-loop diagram of the system. There are a number of structures including some positive and some negative feedback loops. Some factors are helpful to the development of the college, some are not.

It is worth while to pay attention about that some features of this college appear in the model, for example, there are plentiful dormitories for students in the campus and the college has invited or appointed a quite number of visiting teachers who work for the college sometimes but not belong to the college.

IV. BASIC OPERATION OF THE MODEL

Suppose the external environment and the internal relationships of the college will not be changed basically. All of the data begin from 1985. The results of calculations show that the maximum value of the relative errors between the value actual in history and the value calculated is less than 5%. The results

calculated are shown in figure 2 and figure 3. They show that the scale of the college is unstable and the financial deficit will be 600 million yuan by 2000 year, i.e. the stable development of the college is very difficult.

V. POLICY EXPERIMENTS

The external environment and the internal relationships have been changed in the policy experiments.

Experiment 1

The ratio of the staff to students has been adjusted to 1:2.5. The results show that the number of the staff should be 230-250, see figure 4, and the rest in finance would be increased satisfactorily, see figure 5.

In fact, the number of the staff is 280 right now and it is difficult somehow to decrease. However the results have broadly hinted that since now it should be careful to give the new positions to whom they are not suitable working in this college and it is necessary to improve the working efficiency of the staff.

Experiment 2

Cut down the expenses of the college especially in administration. The deficit will decrease from 600 million yuan to 500 million yuan by 2000 year, see figure 6.

Although this way can not change the behavior of the system much but it is still important for the management of the college.

Experiment 3

Enrol new students whose study period is 4-5 years for Bachelor degree. It is helpful to the scale of the college, see figure 7, but helpless to improving the situation in finance, see figure 8.

Experiment 4

Increase the financial support from the Government or from some companies. If the increase rate is more than 2.5% a year, the deficit will vanish. This approach can improve the curve of financial behavior of system obviously.

Experiment 5

Enrol the students for Bachelar degree, in the meantime cut down the expenses which are not very important for the college. This is an approach combined that in Experiment 2 with that in Experiment 3. It is helpful to the operation of the system even the behavior curve has not been improved enough.

VI. CONCLUSION

In accordance with the experimental results the following suggestions can be provided:

1. Enrol students for Bachelar degree to keep certain development scale of the college.

2. Control the quantity and the quality of the staff at the college.

3. Make efforts to get an increasing financial support anyway.

4. Cut down some expenses which are not very important for development of the college.

VII. CONCLUDING REMARKS

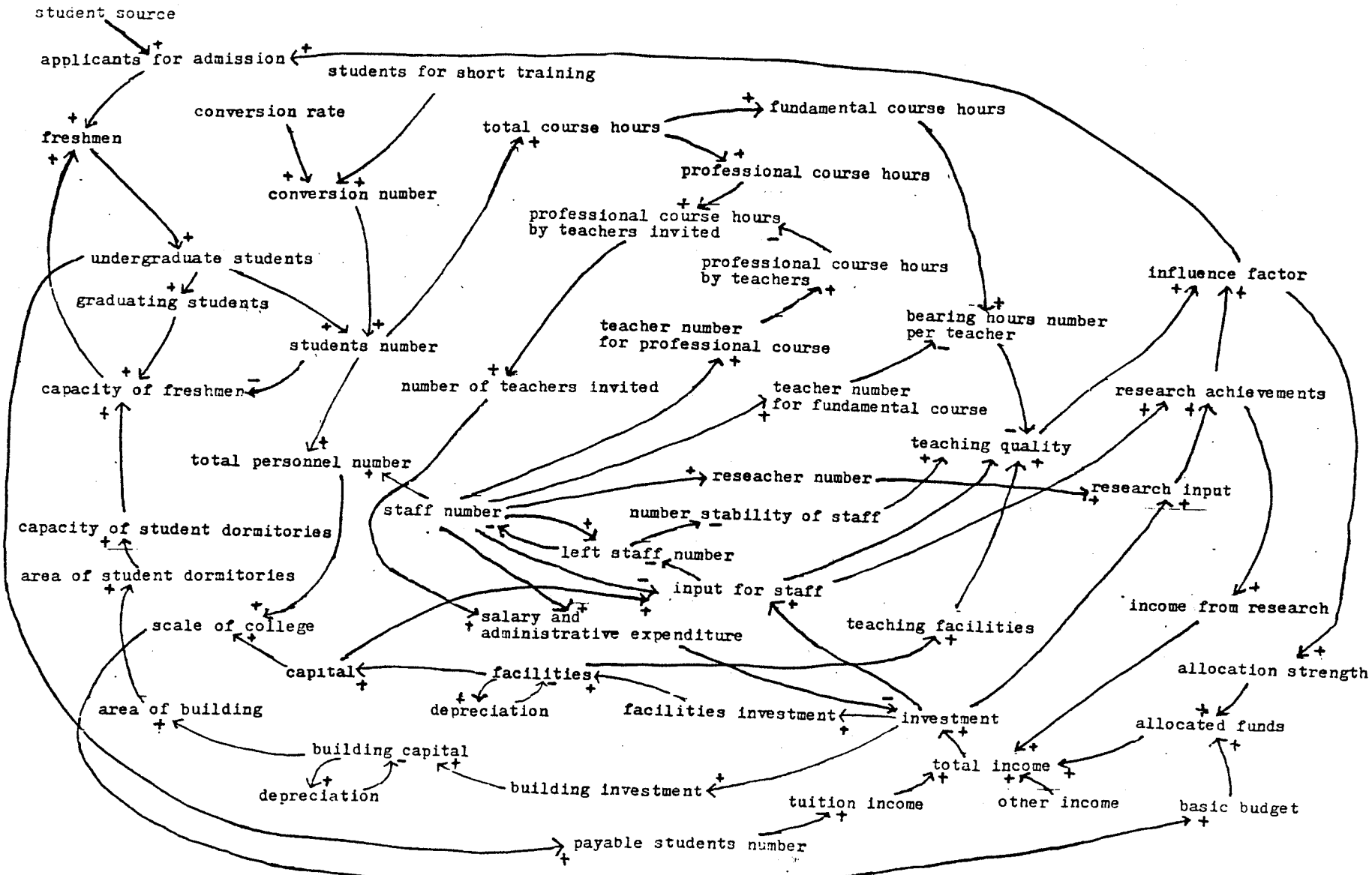
This is the first time to use the System Dynamics Model on University Management to an actual college system. The results are valuable and exciting. Next step the research work will go

on to the various management factors within a college and their interactions. We hope that it will be helpful to the managers of Universities and Colleges.

REFERENCES

1. Forrester,J.W. 1961. Industrial Dynamics. Cambridge:M.I.T. Press.
2. Meadows,D.H. at al, 1972. The Limits to Growth. New York: Universe Books.
3. Li,Yu 1988. Theory and Practice on Higher Education Management. Chongqin:Southwest Normal University Press.
4. Zhang,Yu & Zhang,Xiaoyong 1989. A System Dynamics Model on University Management. Stuttgart: Proceedings of 1989 International System Dynamics Conference, Vol.II.

Figure 1. Causel-loop diagram of the system



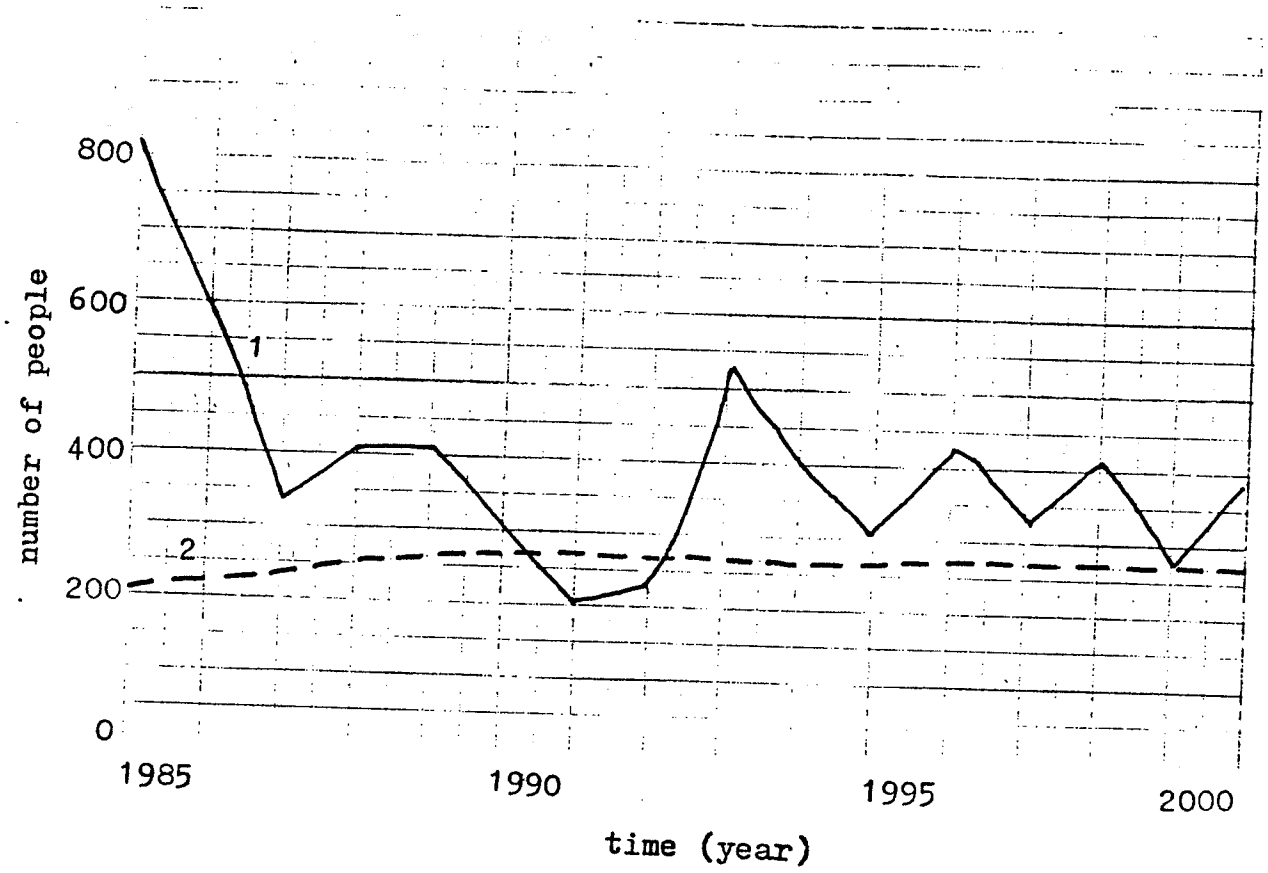


Figure 2. 1. number of undergraduate students for 2 years
2. number of teaching and administrative staff

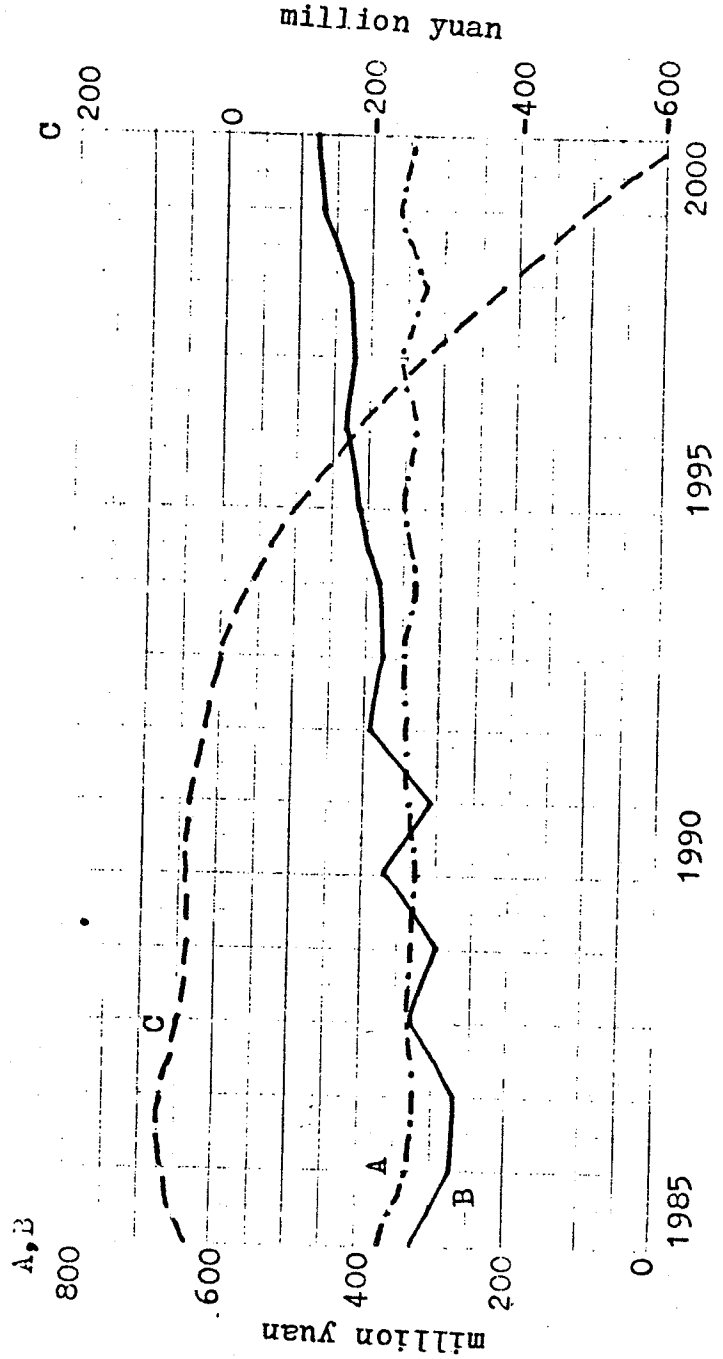


Figure 3. A. total income B. total expenditure
C. level of rest finance

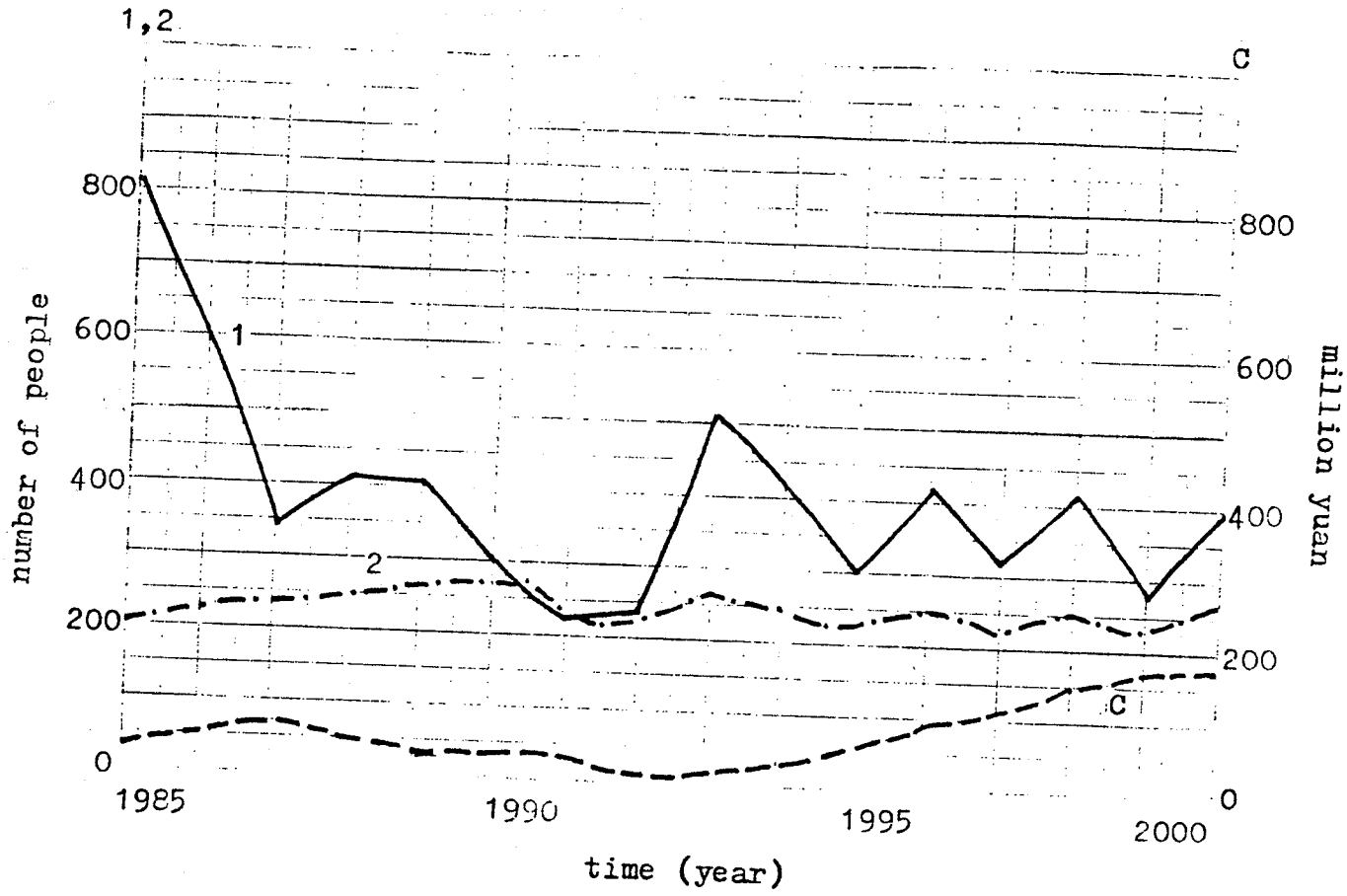


Figure 4. 1. number of undergraduate students for 2 years

2. number of teaching and administrative staff

Figure 5. C. level of rest finance

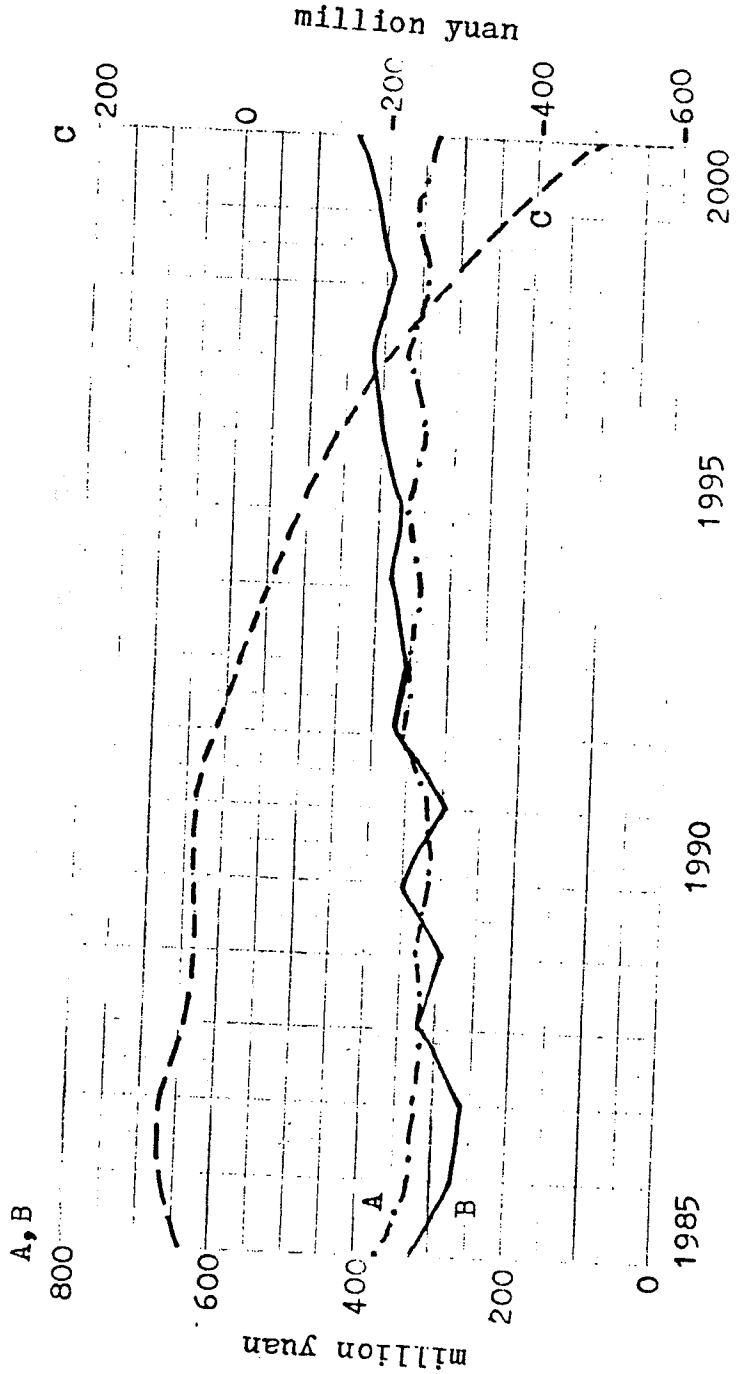


Figure 6. A. total income B. total expenditure
C. level of rest finance

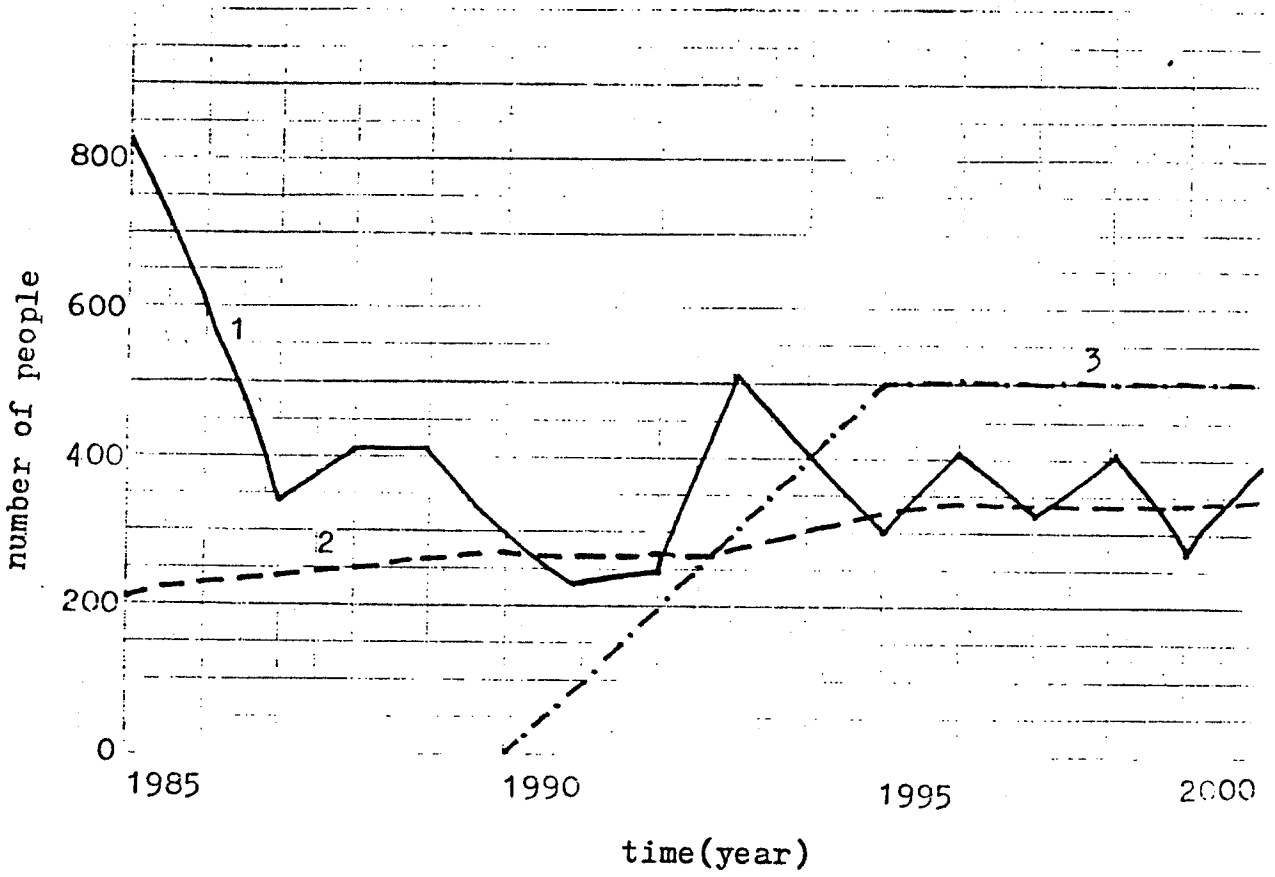


Figure 7.

1. number of undergraduate students for 2 years
2. number of teaching and administrative staff
3. number of undergraduate students for 5 years

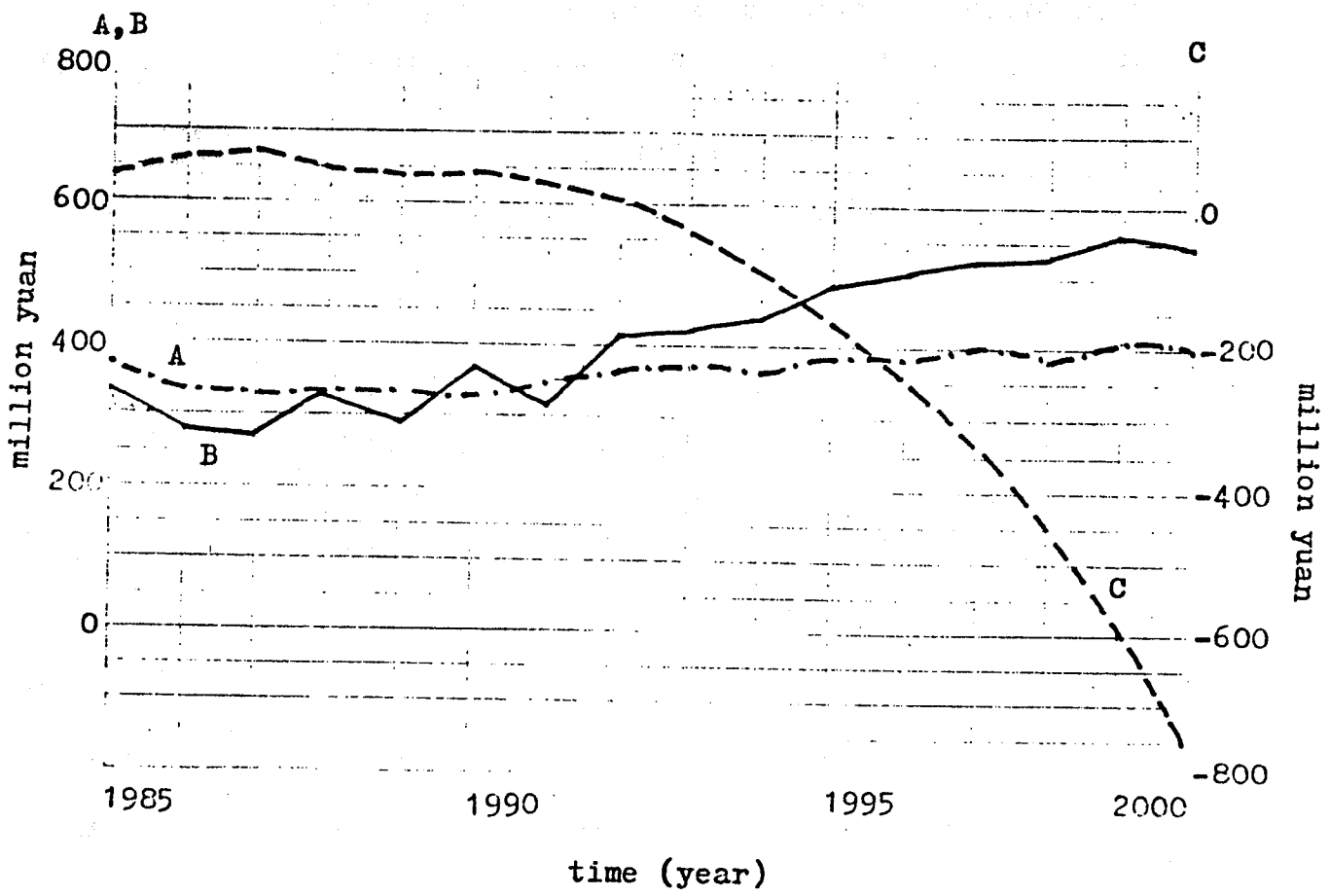


Figure 8.

A. total income B. total expenditure

C. level of rest finance