Hi-tech Impulse: A new coordinative development pattern of social Economy-Technology-Education system

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Abstract

The development of high-tech changes not only the internal structure of economy, education and technology subsystem, but also the multual relations among them. This paper analyses the new mechanism of the interactions among the three subsystems with the development of high-tech thoroughly. Based on that, this paper develops a system dynamic model to simulate the suitable growth rate of economy, education and technology in China.

Introduction

As known, the economy, education and technology are three important subsystems in a society. The multual impact relations among them make the society develop in a conplex systematic way. In order to achieve the coordinative and sustainable development of the social system, one of the three subsystems should make some corresponding adjustment to adapt to the developing need of the other one.

With the tremendous change brought out by high-tech, the technology ia changing in a ever fast rate, accompanied with the mode change in innovation process. Then a new social development pattern has emerged, ie., their interaction shifts from a 'loose coupling' mode to a 'close coupling' mode, in which high-tech plays an important role as a core part. In the new pattern, technology is changing faster and faster, while the role of technology upon economic growth in economy subsystem has changed from outside impulse to instinct push power. One of the main reason is the development trend of high-tech industry. And also, this change has greatly challenged the traditional education inatitution than ever. There is an urgent need for education reformation to adapt to the social development. By tracing the pattern change of social development, we can see that the three factors, ie., high-tech innovation, engineering education and high-tech-talents, play an essential role as axis in linking education, S&T and economy together.

Mechanism Analysis

'High-tech' is a new and dynamic concept. In general, the complete connotation of high-tech includes both economic and technical implications(Jingwen Li & Hanzhong Fang 1990). And also, High-tech has many unique characteristics, such as: knowledge - intensive, high growth rate, high value-added, more risk, more investment, high efficiency, strong infiltration, high requirement, high synthesis, etc(Deli Fu 1993)

Because of these characteristics, high-tech has given profound impact on economy, edducation and technology subsystem.

First, as a active conponent of technology subsystem, high-tech influences technology subsystem in several respects as followed: (1) interdiscipinary research(Roy 1992); (2) change of the mode of technical innovation(Richard 1993); (3) shifts of the emphasis of basic research.

Second, high-tech plays a positive role on the economic growth in following ways: (1) the emergency of innovation policy; (2) change of the growth pattern of economy(Hyung 1993); (3) effect on productivity improving; (4) effect on the structural change of industry; (5) change of the core-heart strategy of economic competition.

Third, high-tech influences education subsystem in the folloeing respects: (1) engineering education and the cooperative efforts among industries, universities and research institutes(Joel 1987); (2) continuing education(eg. lifelong education) and retraining(Takeshi 1990); (3) change of the contents, means and methods of education; (4) enterpreneureship cultivation.

Furthermore, high-tech changes the interrelations and interactions among economy, technology and education subsystem. It makes any subsystem of the three link with the other teo closely. Therefore, their interaction shifts from a 'loose coupling' mode to a 'close coupling' mode. In the new pattern, high-tech is the core factor. It influences the social economy-technology-education system through three ties, i.e., technical innovation, engineering education, and high-tech talents.

The process of evolution of the mechanism of economy-technology-education system is illstrated in Figure 1.

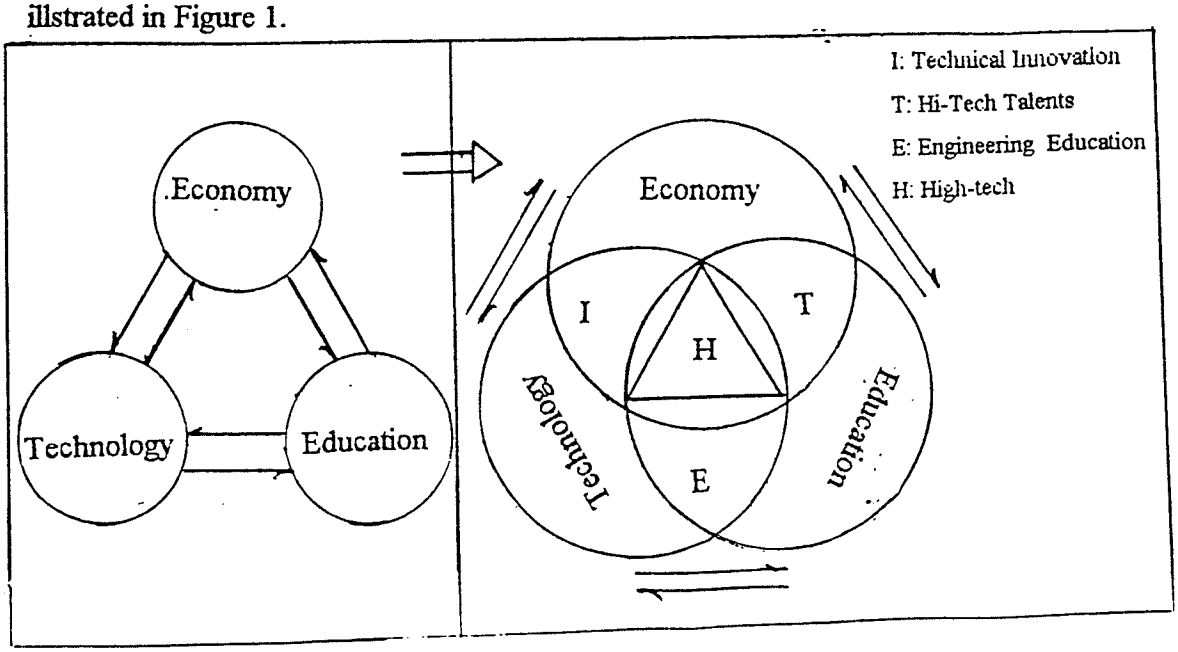

Fig. 1 Evolution of Mechanism

Model Structure

The interrelations among economy, technology and education can be showed as three positive feed-back loops which are interrelated.

Loop I indicates the interrelation between economy and education which is a close feed-back loop showed as following: national income - investment in education - labor resources - labor productivity - national income.

Loop II indicates the interrelation between economy and technology which can be showed as: national income - investment in technology - technical achievements - labor productivity - national income.

Loop III indicates the interrelation between education and technology which is a close feed-back loop showed as: labor resources - technical talents - technical achievements - efficiency of education - labor resources.

In these three feed-back loops, there are many common knots which connect these loops. The structure of these loops and knots is showed in the simple causal diagram of economy-technology-education system(see Fig. 2).

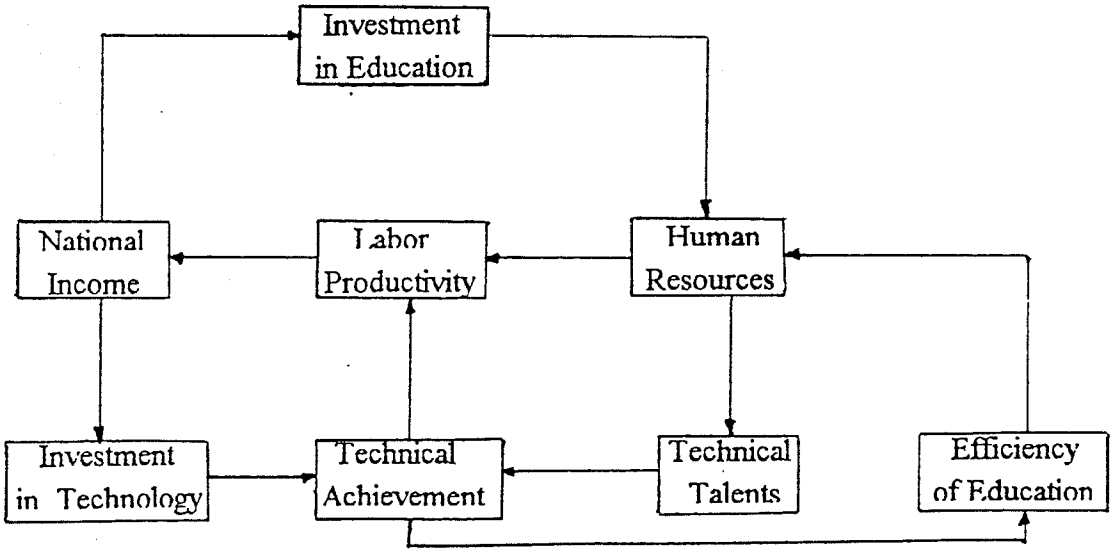

Fig. 2 Simple Causal Diagram

Based on above analysis of the overall structure, this paper probes into the internal causal relations of every subsystems. Because population is a key factor which influences the development of economy,technology and education, it is necessary to include population subsystem into social system. Therefore, the whole system includes four subsystems: economy, technology, education and population. The internal structure of population and

Education subsystem can be divide into three levels: primary education, secondary school education and higher education. Higher education can be further divided into under-graduate education and postgraduate education.

With the development of high-tech, the position of research and development of high-tech is more and more important. Meanwhile, in order to be convenient for discussion and quantification, this paper divides technology subsystem into two blocks: basic research and research and development(R&D). The R&D block also includes teo sections: R&D of general technology; R&D of high-tech. In general,the R&D of high-tech can be divided into two stages: the research of high-tech and pilot. .

Conclusions

In view of present research on coordinative development among economy, technology and education in China and abroad, this paper probes into the mechanism and pattern of coordinative development among them with systematic and comprehensive method. Based on this, a system dynamic model is used to explore policies of coordinative development among economy, technology and education in China.

With the simulation results, we can conclude that:

(1) Before 2050, the growth of high-tech industry in China which links education and technology closely should select the S pattern which develops slowly first and rapidly later. Before 2010, the high-tech industry in China should develop with a low speed and the ratio of output value of high-tech industry to GNP will amount to 10% in 2010. After 2010, the speed of development of high-tech industry should be accelerated and the ratio amount to 22%.

(2) In the process of coordinative development among economy, technology and education, education should develop in advance. That is to say, the investment in education should be increased at first. Before 2050, the growth of investment in education in China should select the S pattern which develops rapidly first and slowly later. Before 2020, the investment in education should be increased with a speed exceeding the growing speed of investment in technology. By 2020, the ratio of investment in education to GNP should amount to 7%. After 2020, it should lower the growing speed of investment in education and the ratio will amount to 8.3% by 2050.

(3) From the perspective of allocation structure of investment in education, the investment in education should emphasize on primary education and middle school education in a short time. In 2010, the ratio of primary education will reach the peak value about 37%. In 2020, the ratio of middle school education will reach the peak value about 47%. After 2020, China should develop higher education rapidly. By 2050, the