

THE SOCIAL FUNCTION OF SCIENTIFIC AND TECHNOLOGICAL ACTIVITIES IN LDCs

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ملخص:

كان المتفق عليه في السابق هو أن " رأس المال هو محرك النمو " وأن المشكل الأساسي الذي تعاني منه الدول النامية نقص هذا العامل الحيوي، إلا أنه ومع نهاية الستينات بدأ الاهتمام ينصب حول عامل التكنولوجيا نظرا لأهميته في عملية التنمية والنمو من جهة ونظرا إلى زنه حتى الدول النامية التي لا تعاني من نقص في رأس المال وجدت صعوبات كبيرة في تحقيق عملية التنمية نظرا لتخلفها التكنولوجي . ورغم المشاكل التي تعانيها الدول النامية نتيجة لتخلفها التكنولوجي كان الاعتقاد السائد في بداية الزمر نصب على كيفية استيراد التكنولوجيا المتوفرة في الدول المتقدمة نظرا إلى أنه عن طريق ما هو متوفر من التكنولوجيا يمكن لهذه الدول أن تلتحق بالدول المتقدمة اقتصاديا وتكنولوجيا إذا ما توفر رأس المال.

إلا أن هذا الاعتقاد تعرض بعد فترة لانتقادات من جهات وخاصة من طرف مدرسة التبعية، ونتيجة لذلك بدأ الاهتمام ينصب على كيفية توفير الشروط المؤسسية والمالية لتنشيط العمل التكنولوجي في الدول النامية. ولقد كانت النظرة في البداية متفائلة جدا وتركز على الجانِب القني والمالي لكيفية تنمية الأنشطة العلمية والتكنولوجية في البلدان النامية بدلا من الاهتمام بأسباب التخلف العلمي والتكنولوجي في هذه البلدان مما أدى إلى الكثير من الأخطاء في تطبيق هذه السياسات في الدول النامية.

وتحاول هذه الدراسة البحث في أسباب التخلف العلمي والتكنولوجي في البلدان النامية من خلال دراسة الوظيفة الاجتماعية لهذه الأنشطة في كل من البلدان المتقدمة والبلدان النامية. كما تحاول أن تقدم حلا أوليا لمشكلة تخلف وتهميش هذه الأنشطة في الدول النامية. وتتلخص هذه السياسة في أن تتبع الدول النامية سياسة اختبارية تجاه استيراد التكنولوجيا من جهة وسياسة تحفيزية للأنشطة التكنولوجية المحلية من جهة أخرى على أن تتركز هذه الأخيرة على المؤسسة الاقتصادية في الدرجة الأولى نظرا لأنها هي التي من المفروض، تعرف احتياجاتها وتضمن تطبيق النتائج المتوصل إليها من أنشطة البحث والتنمية؛ وبالتالي العمل على القضاء على تهميش الأنشطة العلمية والتكنولوجية في هذه البلدان.

ABSTRACT :

Conventional wisdom in the past has had it that "capital is the engine of growth". There has, however, been a growing recognition of the pervasive role of science and technology in the process of development. This article deals with the social function of scientific and technological activities in LDCs and explains why these activities are either underdeveloped or often marginalized.

What is the solution? It is argued that the solution lies in the adoption of a combination of selective policies towards technology imports, and promotion of local scientific and technological activities.

THE SOCIAL FUNCTION OF SCIENCE AND TECHNOLOGY IN RETROSPECT:

Science and technology are as important to the development process and as essential an aspect of the process of investment as the accumulation of financial resources. Thus, even if a country's productive system could generate a surplus on which to base a viable economic growth strategy it would be necessary to count on the capacity to transform this surplus into reproducible capital

goods with the appropriate technical characteristics. This capacity, in turn, is determined by the country's scientific and technological level, and by the effective combination of both. Without this capacity:

1 - The accumulated surplus must be used to import capital goods and know-how from DCS. Two main problems are often associated with LDC'S reliance on imports of technology from DCS. The first is a short term problem : the leakage of the multiplier effect which in turn results in reducing the surplus available for reinvestment. The second problem is that the mechanisms that are used to transfer technology may limit what is called "technological external economies" : if technologies are imported in such a way that limit the opportunity for learning on the part of the recipient, the economy may forego some of the important "external economies" which are often used to justify the policy of industrialisation in LDCs. Thus if technology is transferred in a way that substitutes for local potential suppliers of goods and services, the chances of coming to terms with the short run problem will be reduced.

2 - The country cannot make independent technological choices operate efficiently, adopt and improve upon imported technics and products, and generate new ones.

Attitudes towards the role of science and technology in the development process have evolved over the last decades in LDCs as well as UN agencies. In the 1950's and early 1960's this role in the strategy of national development was largely underestimated. As time proceeded it emerged that the indiscriminate flow of technology and heavy reliance academics called for regulation of the flow of technology and promotion of an indigenous technological capability.

This new attitude towards the role of science and technology in LDC'S had contributed to a mode of naive optimism among many science and technology advocates who viewed them as a panacea to "underdevelopment". Not only it seemed at the time that it is easy to introduce science and technology in LDCS, but it is also seemed that a bit of science and technology would both open new production possibilities and might even eliminate backwardness. The only difficult problem to solve was a merely technocratic one: how to establish scientific and technological institutions and train personnel to operate them? What is the amount of R & D expenditure required? And the like.⁽¹⁾ One cannot argue from the success of science based innovation in the DCs to the imperative of science and technology development in LDCs. The economic and social organization of the latter are different

from the former and consequently research institutions established in LDCs might serve rather different social functions from those of the DCs. Hardly any one at the time asked why science and technology are, in the first place, acutely backward in LDCs. In the 1970's a more critical approach to the role of science and technology in LDCs had emerged. It is argued that the establishment of research institutions, the training of labour force required to operate them and the allocation of financial resources to research activities do not necessarily ensure economic and social progress. This, they argue, is primarily due to the fact that socio-economic organization in LDCs inhibits the application of scientific knowledge to the productive sphere.

Furthermore, they argue that the particular form which scientific and technological institutions take in DCs, the way they are linked to production via network of machinery producers, engineering and consultancy firms and the like, and the type of research they carry out are contingent upon the process of historical development of the DCs. This notion played an important role in research on the social function of scientific and technological activities in LDCs.

A number of researchers on the subject argued that the driving force of the technological change has always been the

search for profit. Schumpeter demonstrated how competition in a free market economy leads to a sustained demand for "new innovations"⁽²⁾, and how such innovations confer quasi-monopolistic advantages over those who command them. This line of thought was further explored by Bernal who argued that "the Machinery of Industrial Revolution was not the simple gift of innovators ... but grew in response to the availability of capital and labour and the opportunities the market offered for profit "⁽³⁾

In other words the link between science and production is best stimulated by socio-economic organization and conditions conducive to technological development and economic demands.

MARGINALIZATION OF SCIENTIFIC AND TECHNOLOGICAL ACTIVITIES IN LDCs

A great deal of effort to explain why scientific and technological activities in LDCs have been underdeveloped and marginalized, has mainly come from South America. Essentially this approach uses particular aspects of the structuralist underdeveloped economy operate in such a way that local scientific and technological activities are alienated from productions. This

marginalization of science and technology, according to this approach, was the result of economic policies implemented in these countries.

The process of industrialisation through importsubstitution has been heavily influenced by the fact that income distribution is skewed in favour of a minority which therefore dominates consumer goods markets.

Since this affluent minority demand goods similar to those produced in DCs, industrialists (local and foreign) prefer to import technologies already in existence in DCs. Consequently foreign technology tended to be a substitute for technologies that might have been developed locally by science and technology activities.

Similar arguments apply to countries which switched to export-oriented industrialisation as their market are located in the DCs, which implies that productive techniques and know-how have to be imported to cater for the consumption habits, tastes and standard requirements of these markets. The result is that existing science and technology activities in these countries are alienated from the production system and consequently their orientation is in the main determined by the individual decision of research workers. Meanwhile engineering activities in these countries are either underdeveloped or underutilized as individual enterprises prefer to

use foreign technology and skills, which are proven commercially, than local variants of technology and skills, than local variants of technology and engineering skills.

“ Because the productive sectors of the economy exert little pressure on the local science and technology communities, scientists and researchers orient them selves toward the international community, choosing research topics in fashion, seeking to contribute to the advancement of science as an international undertaking, and disregarding the sepecific research needs of their countries’.⁽⁴⁾ Analyzing the reasons of this situation, the Indian scientist Rhman pointed to the existence of bias in the allocation of resources in favour of sectors that contribute very little to national income, and the availability of, and accessibility to , foreign technology.

This resulted in Indian scientists and engineers orienting them selves towards research topics that contribute to the growth of scientific and technological potential in the DCs with very little regard to the specific needs of the country ⁽⁵⁾. By not using their scientific and engineering potential LDCs are not helping to increase their wealth or expand employment while at the some time causing “brain drain” and continued reliance on foreign technology.

What is the solution:

The solution to the “marginalization” of scientific and engineering activities in LDs lies in the adoption of a combination of selective policies and promotial policies.

The relationship between the import of technology and the development of local innovative and engineering capacities is complex and involves complementarities and conflicts. Whereas local technological capacity may always be required to make effective acquisition and use of imported technologies, account must be taken of possible existence of substitutabilities and complementarities between local and foreign technological effort as the latter may stimulate it. Thus while the import of technology may be a necessary part of the learning process, nonetheless an unregulated and nonselective import of technology may severely marginalize local innovative and engineering activities and inhibit the learning process.

there are many types of policies likely to be conducive to local technological development in LDCs. These are:

- 1 - Policies which remove legal restrictions on local technological development and enhance the bargaining power of local enterprises. These apply particularly to patents and

trademarks. The patent system as it operates at present seems to work against the interest of LDCs, thus over 90% of patents issued to foreigners in LDCs are not exploited and thus tend to prevent competition and local technological innovation.⁽⁶⁾

Trademarks tend often to favour the well-established and reputable foreign suppliers, thus making it difficult for less well-known alternatives to compete. While the private benefits of acquiring trade-marks, in terms of market power, may be great, they are not socially beneficial in terms of both direct and indirect costs.

2 - Policies which protect local technological and engineering development through selective technology imports. Most successful "late-comers" technologically have been selective in acquiring foreign technology⁽⁷⁾. The aim of selective policies is to import technologies that are both appropriate to local conditions and complementary, rather than substitutes for local ones so as to learn from them and eventually improve upon them. The success of this policy, from the technical point of view, depends largely on the recipient's ability to acquire technology in an unpackaged form so as to assess each element of the package and decide which parts are available locally and which are not. The acquisition of this capacity in turn depends on the degree of development, and promotional

effort to given the local consultancy firms, information centres, R&D institutions and capital goods industries.

3 - Policies to promote local technological capacities. They are an essential counterpart of policies towards technology imports. On the supply side, they include provision of general and technical education and training, promotion of consultancy and applied research activities as well as capital goods industries and information screening institutions. On the demand side, they include government procurement policies, tax incentives and direct subsidies to various kinds of technological effort. ⁽⁸⁾

Past experience reveals that the success of these explicit promotion policies depends on the following:

a) Whether or not they coincide with the general economic strategy; which often contain implicit technology policies, such as the question of "appropriate" technology, trading policies, investment allocation and the like.

b) The establishment of links between the production and the various educational research and engineering institutions. Such links may be created through various means including contractual arrangement and in-home training and applied research, as well as through informal relations. In the past, it was believed that these links would automatically take place. Subsequent evidence has

shown that this belief is misplaced.⁽⁹⁾

Some progress has been made during the last decade in describing the essential features of best-practice" local systems for the accumulation of technology⁽¹⁰⁾. The most important finding can be summarized as follows: given the specific and partly tacit nature of technology, most technology learning takes place in firms. Hence, failure to recognize the firm as the central player in the accumulation of technology has been a major the former centrally planned economies, where the design and R&D functions were geographically and organizationally separated from production units⁽¹¹⁾. Similar policies have been followed in some developing countries, including Algeria, where government-funded R&D laboratories were established in the mistaken belief that they produce practical and socially useful results. These policies were based on the mistaken assumption that technology which emerges from R&D is easily transmissible and applicable in production.

In Mexico, the near monopoly of a technologically successful local firm in the steroid hormone industry, which led in R&D worldwide, was broken as a result of pressure from US firms and government. As a result the industry was soon after dominated by foreign subsidiaries.⁽¹²⁾ In both Brasil and Srilanka, government plans to replace brand name drugs by generic drugs were deluted as

a result of strong political opposition which had powerful foreign support.⁽¹³⁾ Meanwhile, the Brazilian government's attempt to protect the local information industry has led to strong opposition from US firms and administration which succeeded as Brazil decided to lift control over some areas of the industry.⁽¹⁴⁾

Notes:

- 1) See e.g. UNISCO, (1969) : Conference on the application of science and technology to the development of Asia, final report, Paris, p.24.
- 2) Shumpeter, J. (1969), theory of Economic Development (New York OUP).
- 3) Bernal, J.D., (1968), Sciences in History, (Camb. Mass: MIT Press.
- 4) Sagasti, S., (1978), Technology, Planning and Self-Relinat Development, (New York, Proeger Publishers), p.10.
- 5) Rahman, "Problems of Scientific Policy", Citizen 12(1) , pp. 71-98 .
- 6) Vaitos, C., (Ed.), 1973 :Science ant Technology in LDCs pp.71 - 98 : and Delmore, J., in OECD, 1982 : North/ South Technology Transfer : The Adjusments Ahead, (Paris, OECD) pp. 88 - 167 .
- 7) See e.g. Rosenberg, N. , " Ther role of Science and Technology in American National Development", in Beranek, W., and Ranis, G., (Ed.) , (1978) : Science , Technology and Economic Development (New York, Praeger Publishers); 114 - 68, and UNICTAD (1978) : Case Studies in the Transfer of Technology, T.D./ C6/26.
- 8) Gereffi; G., (1978) : " Drug Firms and Dependency in Mexico : The Case of the Steroid Hormone Industry", International organization, 32(1) : pp. 237 - 286.

- 9) Agarwala, A. , (1978) : "UN Take a stand on drugs", New Scientist, (Nov. 9th) ; pp. 442 - 443.
- 10) Financial Times; Oct. 27th, 1986.
- 11) On the Japanese experience see Nakaoka, Tetsuro, 1987. " On Technological Leaps of Japan as a Developing Country" Osaka City University Economic Review 22:1-25 .
- 12) See Hanson, Philip, and Keith Pavitt, 1987. The Comparative Economics of Research, Development and Innovation in East and West: A Survey. Chur, Switzerland: Harwood Academic .
See also Marthin Bell and Keith Pavitt. " Accumulating Technological Capability in Developin Countries" in The World Bank. 1992. Proceedings of the World Bank Annual Conference on Development Economics.
- 13) See for example Nelson, R.ed. 1992 : National systems supportin Technical Advance in Industry, Oxford University Press.
- 14) Hanson and Pavitt, 1987, op. cited.