Investment for a Technology Future

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Introduction

Currently, the intellectual world is on the threshold of a great new revolution. In the field of propagation of knowledge, the Internet is the third most important advance in human history. The first was the invention of writing, with printing being the second revolution. Writing enabled students to learn from teachers who were faraway in distance and in time. Printing made education democratic by bringing down the cost of books a thousand times; making ideas of scholars available to the ordinary public. Even then, to search what one needed depended on memory and a tedious system of cross references. Even twenty years ago, literature search was a laborious, time consuming and highly inefficient exercise. Internet has revolutionised search. It is no longer necessary for a scholar to store innumerable reprints and memorise what each reprint contained or even where it was.

Nowadays, not only is the entire world of information at the disposal of every student, even lectures delivered by the greatest authorities of the World, as far away as the US or Europe, are now becoming available. University teachers are no longer competing with those in neighbouring institutions but with the best the world.

What Internet has done is to change the statistics of the distribution of access to knowledge[1]. Normally, access to quality education is confined to few, very few, institutions. By the 80:20 rule, a majority of learning would usually be confined to the top 20 per

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[1] Anderson, Chris, *The Long Tail: How Endless Choice is Creating Unlimited Demand,* Random House, London, 2006.

cent institutions. In research programmes, the selectivity would be even greater: Most academic research in India is confined to a dozen or so institutions out of thousands of colleges. Internet will make that skewed distribution almost flat. What the economists call marginal cost has become virtually zero for information access. Now, millions can access the best scholars of the world. Knowledge selectivity has all but vanished. That is the new world that all universities will have to cope with in the future.

Culture as an Impedance To Technology Development

Olson[2] has analysed the reasons why some countries get rich and why others remain poor. According to Olson, basically, there can only be two reasons why some countries are rich and others are poor. The reason could either be differences in factor endowments (namely, land, labour, capital and technology), or differences in environment. At first sight, it might appear that rich countries have *innately some advantages* in factors of production compared to those of poor countries. Olson explains that is not true; the cultural environment is the crucial factor.

According to Olson, factor endowments cannot be crucial when we consider that neighbouring countries with similar endowments – the United States and Mexico, South and North Koreas, or erstwhile West and East Germany – differ widely in economic performance. He argues that wealth and poverty are not the result of differences in factor endowments but due to faults in political policies and institutions.

For instance, South Korea has rapidly risen since the 1960s from the status of a developing country, no better than India, to become an advanced country, so advanced that it is now accepted as a fully developed nation. All that progress has been engineered primarily

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[2] Mancur Olson Jr., *Big bills on the sidewalk: Why some countries are rich and others are poor,* The Journal of Economic Perspectives, 1996.

by investing in technology. Olson estimates that for every dollar paid out by South Korea for importing technology, the country's GDP increased by 60 dollars. He concludes: (a) the kind of technology needed for the enrichment of a poor country is purchasable in the international market and (b) the cost of such purchase is minuscule compared to the wealth that can be generated as a consequence.

India too has purchased considerable amounts of technology but has not utilised it as productively as South Korea has done. South Korean culture has been superior to ours in absorbing imported technology, and improving it further.

It may be argued that South Korea has done better because she was richer, had more capital. That is not true. In the 1960s, when South Korea set out on the growth path, she was no richer than India. Yet, South Korea progressed faster. As Olson explains, the more profitable avenues for investment are already exhausted in rich countries leaving behind only less profitable ones. On the other hand, in poor countries many profitable avenues remain unexploited. Hence, poor countries offer much better pickings for capitalists than do rich ones. Therefore, the natural flow of capital is always from rich countries to poor ones, not the other way around. Poor countries should have little difficulty in attracting capital *provided their culture does not discourage inflow of foreign capital*.

It may be argued that poor countries are poor because their people are unskilled. It appears reasonable to argue that people in developed countries are more capable, better skilled, better educated, better trained and so on. According to Olson, that argument too is not tenable. He points out that immigrants from poor countries outperform natives of rich countries. That is true whether they seek employment, or become entrepreneurs themselves. For instance, whether in United States or in Britain, the Indian immigrant community is wealthier or earns more than natives do. So, India has *an excess of more talented people than she is willing support, while the United States has less than what she wants. That is why brain drain is always from poor inhospitable countries to the rich, more hospitable ones*.

Thus, we notice that technology is purchasable, capital is available, and the supply of high quality labour is more than the demand. That leaves only one more factor of production, namely, land and mineral wealth. It is true that there is greater pressure on land in India than in the USA. On the other hand, many other countries like Japan, Holland, Belgium, and England have even higher population densities, and less mineral wealth than we have. In any case, in developed countries, land accounts for no more than 2-3 per cent of a nation's wealth. Hence, differences in endowment in land, even arable land, are not crucial.

Further, after a foundation of capital-led growth, East Asian countries have turned to R&D and higher education for more growth. They are looking forward. We Indians have a tendency to look backward with longing to a pre-historic "Golden Age" of Ram Rajya. Nostalgia for our past glory is a cultural burden. It prevents us from modernising, from advancing knowledge in a scientific spirit.

Lack of Scientific Entrepreneurship

These days, we Indians are proud of the way our economy is growing. At the same time, our share in scientific research is dwindling. In technology, we are mechanics to the world; not the trailblazers. According to Mokyr[3] (pp. 11-12), the following three

[3] Joel Mokyr, *The Lever of Riches: Technology, Creativity and Economic Progress, New York, Oxford University Press, 1990.*

conditions should be satisfied before a culture will support innovation and development:

- A cadre of ingenious and resourceful innovators, who are both willing and able to challenge their physical environment, should be available.
- Economic and social, institutions have to encourage potential innovators by presenting them with the right incentive structure.
- Diversity and tolerance should prevail in the society to enable technological creativity overcome entrenched vested interests that might incur losses if innovations are introduced.

In other words, innovation and technological progress are unlikely in a society in which people are intellectually malnourished, are superstitious, or are extremely traditional. In brief, what any country needs most is scientific spirit.

Thomas Kuhn[4] has explained how Western science has remained ahead of all others, and has maintained that lead successfully for several centuries. That success he attributes to certain features of Western intellectual culture. Just like scholars the world over, Western scientists too believe in received wisdom. They too accept certain theories to be true. But unlike us, they do not stop there. As Karl Popper[5] has explained, they consider the purpose of science is not to propagate faith. It is the opposite, to disprove – not prove – existing theories.

Scientific enquiry consists of pushing the frontiers of the accepted paradigm farther and farther. For that purpose, scientists set, and attempt to solve, newer and newer puzzles. In that process, sooner or later, anomalies occur where the paradigm fails to predict results

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[4] Thomas S. Kuhn, *Structure of Scientific Revolutions,* University of Chicago Press, 1970.
[5] Karl R. Popper, *The Nature of Scientific Discovery,* New York, 1959.

accurately. When it becomes impossible to explain those anomalies, a second process takes over. A concerted attempt is made to discover a new paradigm that performs more satisfactorily than the old one. When a better paradigm is found, a third step follows. The old paradigm is consigned to the dustbin, and the new one becomes the received wisdom. This third step is a scientific revolution, a revolution that is no less ruthless than any political one. For instance, not long ago, within the living memory of many of us, radio valves were the bread and butter of science and technology. Nobody hears of them these days. They are all dead as dodo. In Western science, once a paradigm fails to deliver, it is discarded without pity. That too is an essential ingredient of the scientific spirit.

The iconoclasm that dominates Western science does not prevail in India. Not only engineers, even scientists and hard-headed businessmen, tend to cling to myths. For instance, the Ambassador car is still ubiquitous in India. It started as the 1958 model of Morris Oxford. In forty years, the Ambassador car has not changed in essentials even though automobile technology has gone through several revolutions in the meanwhile. In Japan, Datsun procured the identical technology from Morris Motors and at the same time too. Unlike in India, Datsun adopted Western culture of science; it modified the received design continuously. It discarded designs the moment they became obsolete.

In the mean time, technology advances have been so substantial that the gap between the Ambassador and a modern car has become unbridgeable, and fresh import of technology has become necessary. Such repetitive import is the bane of Indian technology and a major reason why India’s technical education has remained stunted.

I have deliberately chosen the example of the Ambassador car in this Institution so generously endowed by its manufacturers for a specific reason. There is a general feeling among administrators, in business councils, even in universities that growth depends on the availability of financial capital. They could not be more wrong. While money is critical, it is not the most important contributor to a nation's growth; it is not even a major factor. Denison[6] has calculated (Table 1) the factors that contributed to the growth of the United States between 1929 and 1982. He found that as much as 64 per cent of that growth was attributable to advances in knowledge (that is, to R&D). Education came next with 30 per cent whereas the direct contribution of finance and capital was barely ten per cent. Management and economies of scale too contributed more than capital did.

Table 1. Components of GNP Growth in United States: 1929-82

Type	**Share**
Labour input except education	- 23
Education per worker	30
Capital	10
Advances in knowledge (R&D)	64
Better resource allocation (management)	19
Economies of scale	20
Land	- 4
Other determinants	– 20

India today is in about the same state the US was in 1928. For India to grow as well as the US did in the decades after 1928, India

[6]Edward F. Denison, *Trends in American Growth, 1929-1982,* Brookings Institution, 1985, p. 30.

too should invest in technology. In India, once a technology is inducted, it hardly benefits from further improvement. It becomes static. Even in Information Technology, India is concentrating on what Mr Vittal used to describe as “techno-coolies”. The University of the Twenty-first Century has to change that culture; make students more adventurous intellectually. The University should also build on the very best and the latest information.

No university can do that kind of transformation without the patronage of industry. Just as medical colleges need hospitals, modern technical universities need S&T parks. Some details of one of the most successful efforts of this kind are given below.

Research Triangle Park

Size: 7,000 acres; 8 miles long, 2 miles wide. 136 organizations including 106 research and development-related ones with approximately 50% of the employees working for MNCs

Research Areas: Biotechnology, Biopharmaceutical, Computer Hardware, Computer Software, Chemicals, Environmental Sciences, Information Technology, Instrumentation, Materials Science, Microelectronics, Pharmaceuticals, Public Health, Telecommunications, Statistics

Employees: Over 50,000 including about 5000 contract employees; 99.4 % in R&D related organizations; almost 40% in firms with less than 10 employees, and average salary of $54,145 per year.

Investment: Over 1.7 million square meters, $2 billion capital; estimated payroll 2.7 billion a year.

Linked to a consortium of three universities

What the Indian economy and the Indian industrialists need most is indigenous technology. Instead, Indian industrialists chase tax concessions. Tax concessions help in the short-term but technology innovation alone guarantees success in the long term. S&T Parks and universities may not help industries to design the next year's model of a car, or of any other product, but they will help them to develop profitable businesses of the future.

Conclusion

We are, as I said in the beginning, at the threshold of a new revolution in the transmission of information. In the wake of democratisation of information, education is becoming global: universities can no longer depend on a catchment area of their own. That calls for innovations in pedagogy that matches the facilities Internet offers. Technology universities will need in addition S&T Parks to connect them to the real world of technology.

In the current Technology Era, what nations need most is not financial capital; it is intellectual capital. That is where wise nations will invest. The country should also make scientists and engineers feel proud. In the words of Donald Christiansen[7]

A country that trains its engineers and technologists well, then rewards them with both real and *psychic income, should have little trouble competing in a world economy that thrives on trading high quality, high tech products over international boundaries.*

[7] Christiansen, Donald, Engineering Excellence: Cultural and Organisational Factors, New York, 1987, IEEE Press.