

“Technology chosen should yield the best benefit over cost ratios for the country.”

The Choice of Technology for Job Development in a Developing Country

by

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INTRODUCTION

The short – and obvious – answer to the question of how to choose technology for job development in a developing country is that the technology chosen should result in a real increase in the economic value of the output of the goods or services produced, when all the cost and price factors are taken into proper account.

The translation of the short – and obvious – answer into economically sound choices of technology, however, requires a full understanding of the purpose of technology, of how it fulfills its purpose, of the circumstances and factors bearing on its acquisition and use, and finally, an understanding of how to effectively influence the choice of technology in a given political-economic-social environment.

The many conspicuous case of technology choices by developing countries – whether the choices were in any way government-influenced or not – which, from a national point of view, fail the test of increasing the real economic value of goods and services produced, when all the cost and price factors are taken into account, would indicate a serious lack of understanding of how to choose technologies to best serve national development purposes. National development after all, is – or should be – the bottom-line consideration in the choice of technology or, for that matter, in the choice of any options concerned with economic activities.

BASE LINES

In order that we may address the topic of technology choice from a reasonably in-the-same-ballpark perspective, let me suggest a few base lines for us to keep in mind in our consideration of the topic:

- 1st—Technology enables man to do things he otherwise would not be able to do. And since technology is constantly pushing towards new frontiers, it is enabling man to do many more things, and to do better the things he is already capable of doing – to do things more effectively and more efficiently. Thus, technology enables man to travel faster and faster, as well as farther and farther – reaching destinations beyond the planet Earth. And it is technology that enables man to transport loads far in excess of his

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weight at speeds far in excess of the speed he can run, and with far less effort as well. Unfortunately, it is also technology that enables man to kill his fellow-men by the millions now, instead of one at a time.

The technology we are concerned with is the kind of technology which enables man to perform productive tasks more efficiently – with efficiency measured in real economic costs of inputs versus real economic values of outputs.

2nd—In discussing *choice* of technology in the context of a country, we imply recognition—and a degree of acceptance—of government intervention, the purpose of which presumably is to achieve social as well as economic objectives (although political objectives and extraneous considerations oftentimes intrude). A government's determination of the costs vs. benefits bottom line will necessarily consider factors that purely profit-oriented enterprises cannot reflect in their financial statements—and, therefore, cannot take into account in making business decisions. Although a government's cost and benefit analysis will probably cover a more extended time frame, we have to assume that in its choice of technology, a government will keep a bottom line test in mind.

3rd—How the costs vs. benefits equation for using particular technologies work out will, to a large extent, depend on the size of the economic system a country is operating in, or plans to operate in. A small country operating in a near-global arena can economically use technologies that a larger country operating in a more limited arena may not be able to use economically.

4th—The larger the market and the broader the resource base, the wider will be the range of choices or technologies that are more likely to match and reinforce a country's existing comparative advantages. Comparative advantages can, however, change very drastically and quite quickly: Japan is a good example of this.

5th—And finally, no matter how compelling the reasons are for governments to adopt technologies that will maximize employment, governments have to recognize that to the extent that cost penalties are imposed on enterprises because of technologies so chosen, the social benefits thus achieved will have to be paid for in some way by someone.

FACTORS BEARING ON CHOICE OF TECHNOLOGY IN A DEVELOPING COUNTRY

Most of the factors bearing on choice of technology in a developing country are common to those an industrialized country would take into account, although the emphasis and degree of relevance may differ greatly. Keeping in mind that creation of employment opportunities is a primary consideration in a developing country's choice of technology, it would still have to consider the following factors:

1. Cost vs. Benefit Equation

Since the employment of any technology involves costs – acquisition and/or development costs, application and usage costs, etc. – how the cost/benefit equation works out should be the first consideration. The employment of technology should result in value-added exceeding cost-added, with both value and cost measured in the international marketplace.

2. Infrastructures and Support Industries

Regardless of the willingness and the ability of a country to absorb cost penalties, the lack of infrastructures and the absence of support industries may make it impossible or prohibitively expensive to adopt certain technologies. The lack of infrastructures could severely constrain a plant's operation, e.g., uncertain and high cost of electric power supply. And the lack of support industries could mean prohibitively expensive vertical integration or costly dependence on overseas suppliers.

3. Usage Capability

Management and direct operators capability to effectively use a technology is an important factor that is often glossed over. Capability involves more than merely knowing what buttons to push and what wheels to turn. Capability involves understanding how the technology works as well as how the hardware involved works, and the care required to keep it working. Operating a fleet of trucks requires more than a crew of drivers who can merely start the truck engines and steer.

4. Turn-Key-Packaged vs. Function-Specific Technology

Too many developing countries favor buying technology in turn-key packages. Acquiring technology in turn-key packages denies the acquirer not only the opportunity to learn something of the why and how of the acquired technology but also the opportunity to do work that it is capable of performing. Furthermore, turn-key packages frequently include unsuitable or unnecessary hardware (in the context of local manpower costs, e.g., transfer machines), resulting in inefficient and uneconomic use of inappropriate technology, which, of course, translates into cost penalties. Unpackaged, function-specific technology may require more study and understanding, but developing countries would generally be better off buying technology in this manner, rather than taking the lazy choice of buying technology in turn-key packages.

5. Changing Comparative Advantages

Changing comparative advantages should be taken into account in the choice of technology. The comparative advantages of lower manpower costs can disappear very rapidly with development – and development, after all, is the basic objective of government intervention. Also, the comparative disadvantages of lack of infrastructures and support industries can disappear quite rapidly too, as a country develops. Wherever possible, technologies that can be gradually upgraded as conditions warrant should be chosen. For example, there should be provision for the introduction of transfer machines as manpower costs rise. Care should be taken not to get hooked to technology that becomes obsolete and a drag on development. The problem of ancient steel mills in some industrialized countries demonstrates this point.

6. Cost of Money

In determining how the cost/benefit equation works out, the real cost of money should be taken into account. Many developing countries have rather high real interest rates, and the high financing costs added to the higher depreciation costs resulting from below capacity utilization of expensive capital equipment could more than cancel out any cost savings that the technology was intended to achieve in the first place. Interest cost should be taken as a direct production cost, rather than as an overhead item, and this should take into account the opportunity cost of the plant's equity capital as well.

7. Labor Cost

Where lower labor cost is a primary factor, care should be taken not to choose a technology that will lock an enterprise into a low labor cost dependency, especially if the wage levels to deliver the low labor cost are clearly inadequate from a social point of view. Sweat shops are unavoidable in many countries with high unemployment rates but investing capital to equip sweat shops would hardly be the most desirable way for a developing country to invest its scarce capital.

8. Priorities in Acquiring Technology

Technology can only be acquired thru research and development, thru purchase or by theft. Each way of acquiring it involves costs or, at least, the risks of costs. Furthermore, it costs money to use technology. Since the resources of any country, especially of a developing country, are necessarily limited, a developing country should carefully consider priorities in allocating its resources for the acquisition and use of technology. Technology designed to more efficiently produce mass consumption goods are more likely to deliver favorable benefits to costs ratios, because of attainable economies of scale, and therefore should be given priority over technology designed to produce limited-market goods. Thus, technology that will contribute to more efficient production of basic food, clothing and shelter goods should be given priority over technology that will enable the country to produce, for example, helicopters, or even cars. And, of course, technologies that will create more real economic-value-added kind of jobs should be chosen over technologies which create jobs with little or no real economic-value-added — e.g. technology to produce building materials from readily available raw materials rather than technology to force uneconomic production of cars. Moreover, technologies that can offer a larger number of productive jobs should normally be favored over technologies that offer fewer jobs.

GOVERNMENT POLICIES TO INFLUENCE CHOICE OF TECHNOLOGY

The subject of choice of technology has been discussed under the assumption that the choice will be influenced by government policy. The reason, of course, is that in essentially private enterprise economies, private enterprise would normally simply choose technologies that promise the greatest and quickest financial rewards, and in measuring such rewards, social development objectives — such as creating productive jobs — are not likely to be taken into account.

If a government wants to influence the choice of technologies by its entrepreneurs, so that in its broader measure of benefits, the technologies will contribute to the attainment of the government's social and economic development goals, the government would have to formulate appropriate investment policies and rules. But while seeking to thus influence the choice of technologies by its entrepreneurs, the government should avoid excessive regulations, and the rule and regulations designed to implement its policy should be of general industry-wide application, and should not be enterprise-specific, whether the rules and regulations involve carrots or sticks.

Some measures that a government in a developing country could take to influence the choice of technologies in a manner designed to contribute to the country's achieving its development goals would be:

1st—Avoid over-valuing the local currency. An over-valued local currency produces a bias in favor of imported technology and its accompanying capital equipment.

2nd—Avoid the common practice of using high tariffs to keep out luxury or unessential goods. High tariffs simply encourage local production of such goods, often with just barely enough value added to imported components or intermediate products to avoid the high tariffs. Resources used to import — and use — such technologies contribute

little or nothing to development, and are not likely to create many jobs, because of the limited market for such goods. The more logical way to discourage the use of luxury goods is to impose high sales or purchase taxes.

3rd—If an enterprise is to bear cost penalties because of the choice of less cost-effective but more labor-intensive technologies, the government would have to provide subsidies — directly or thru tax concessions. The cost of such subsidies should be carefully measured against the cost of social welfare benefits the government may otherwise have to provide. While such measures may be necessary and defensible in certain cases, they should be used very sparingly. Favoring any sector will necessarily result in discriminating against non-favored sectors, causing truly economically competitive enterprises to become less so.

4th—Avoid extending concessional interest loans for the purpose of importing capital equipment. Such a policy, widely practiced, produces a bias in favor of importing capital equipment-based technology, as opposed to using local, more labor-intensive technology.

5th—Avoid the choice of technologies whose use can be economic only at production levels which would require the export of the greater — or even a very substantial — part of the production, unless the country has very clear comparative advantages in the international marketplace. Critical dependence on export markets can be dangerous, especially if export sales are dependent on two-tier pricing favoring export sales. Aside from the risks of market denial because of dumping charges, it hardly makes sense for the customers of a lower per capita income country to be, in effect, subsidizing customers in a higher per capita income country.

6th—To encourage unpackaging imported technology, so that locally available technology and capital equipment can be melded with imported capital equipment, the government would have to offer financing support for locally produced capital goods to match financing terms offered by overseas Export-Import Banks. Enterprises in developing countries often prefer to buy capital equipment from abroad because overseas Export-Import Banks offer longer term and cheaper financing — even if the basic cost of the capital equipment may be higher.

Government should encourage the development of local capital goods industries that can compete with foreign suppliers on equal terms. Such industries can provide a growing number of skill-intensive jobs as a country develops. They can also spearhead the development of technology locally. Such industries should not, however, be sheltered by high tariffs, as this would simply impose cost penalties on the industries using capital equipment.

7th—While it is understandable that governments would like to ensure that adequate-for-living wages are paid, government should be wary of letting their social development objectives—or political motivations—race ahead of their industries' economic capabilities. Premature forced raising of wages will produce a bias in favor of special equipment against labor. Forced wage level increases have to be carefully carried out. At the appropriate time and in suitable circumstances, it can be done—as Singapore has demonstrated.

8th—Give high priority to providing the infrastructures—utilities, transport and communication facilities, etc.—needed for the efficient use of modern technology. Here again, a lesson can be learned from Singapore. Establishing mini-industrial estates, especially

for industries with common infrastructure needs, could materially reduce the cost of providing infrastructures. Concentrating industries requiring similar or related ancillary industries support makes it more likely that the needed support industries will be set up. Japan has several such mini-industrial estates (e.g., a garment manufacturing estate near Osaka; a metal-working estate in Gifu, near Nagoya).

9th—Promote the development of working skills to increase the capacity to use and develop technology. Vocational training and engineering courses should be given higher priority by the developing countries—probably because the required investments in training facilities are greater in such education than in non-technical education. Working skill levels can also be greatly raised thru the promotion of in-service-training programs in cooperation with local as well as overseas firms, or even foreign government agencies. Japan's JETRO (Japan External Trade Organization), for example, offers such training arrangements in Japan.

CONCLUSION

It is understandable that many developing countries, in their anxiousness to provide employment opportunities for their people, choose technologies mainly because they are labor-intensive. But national development calls for more than providing work opportunities. Acquiring and using technology to create jobs that do not add—or add little—to the bottom line of a country's balance sheet is a waste of the country's resources.

For technology to optimally serve a country's development efforts, there is need for the country's planners and decision makers to clearly understand the role of technology in development. In addition, they have to clearly recognize the factors bearing on the choice of technologies.

And, finally, they must have the wisdom, the political will and the integrity to set up the institutional framework and the guidelines that will persuade those who use the technology to choose the technologies that will yield the best benefit over cost ratios for the country, even while yielding the user-enterprise a satisfactory profit.

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