

Technical Change and Economic Reforms: Cautionary Tales For Developing Countries

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I. Introduction

Technical change and economic reforms both promise much to developing countries. In a narrow sense, they promise an increased output of goods and services from the countries' scarce stocks of inputs; in a broader sense they hold out the hope of a more smoothly functioning economy, better attuned to meeting the nations' needs. The latter phenomena — economic reforms — have the additional appeal that they can be undertaken solely at the developing countries' initiative, and implemented solely with their own resources. Little is the surprise, then, that attention should be focused upon technical change and economic reforms.

But between the promise and the reality there is often incongruity. The change may not materialize, or, conceivably, they may materialize in undesired forms. It can even happen that changes lead not to improvements but to reduction in output, or greater discords.

It is my purpose in this paper to consider the sorts of adverse effects that technical change and economic reforms may generate, and the likelihood that these adverse effects will arise. The analysis will remain quite general, although a few examples may be cited, from other's and my own research, so as to illustrate the main points.

In outline, the paper will commence with definitions of the three chief phenomena — technical change, economic reforms, and the countries' needs. These definitions will be abstract, deliberately so as to make them applicable to all developing countries, regardless of size, location, form of government, or stage of development. The paper will proceed to discussions of the nature of technical change, and of the economic reforms that usually accompany it. The next section of the paper will attempt to identify the resistance that arises in anticipation of, or in response to, technical change, and to suggest how this opposition can alter the outcomes. Finally, there will be a conclusion which summarizes the main points.

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II. Definitions and Concepts

In order to keep the discussion within bounds we shall adopt interrelated but narrow definitions of our three chief variables. Beginning with a country's needs, we shall assume that these can be encompassed within a single relationship, the so-called social welfare function. We shall also assume that this function is being maximized prior to the introduction of a new technology and its associated reforms. Since the economy will surely not be perfectly competitive in either structure or operation, the optimum position will be a second-best in welfare terms. In simpler words, we shall assume that the economy is performing as well as possible, and being directed as skillfully as possible, given its participants' preferences. Before the technical change is considered, the economy is perfectly organized, in the sense above, and no reform can be undertaken which would improve upon its existing state.

But if the technical change is to be most beneficial, i.e., if, as a consequence of the change, social welfare is to be raised by the greatest possible amount, reforms will be needed, so as to assure that the economy is as perfectly organized in its new state as it was in its previous state.

Let us illustrate these points; imagine that some economic body — it could equally be a state enterprise or a private firm — intends to undertake a project that incorporates an advanced technology. We assume that before the project is undertaken the economy is operating optimally, given the country's objectives; we now wish to determine what should be the exact design of the economic reforms in order to obtain from the change the largest possible additional gains, additional that is to those presently being realized. If we, the entrepreneurs or the planners or the leaders of the country, institute the proper change and implement the proper reforms the economy will subsequently operate optimally, given the (perhaps identical, perhaps altered) objectives. The task, therefore, is to choose the best technical change and to implement the best accompanying set of reforms, best that is in terms of the economic outcomes that result.

In considering just those economic reforms associated with a particular technical change we are neglecting all possible reforms that might improve the performance of the economy before the technical change comes about. In other words, we are neglecting any reform of the *existing* economy. This is no to say that we do believe that developing countries achieve first-best allocations, only that we are conveniently assuming that they have achieved second-best allocations. That these second-best allocations are in any way fair, or reasonably efficient in terms of the countries' potential, or desirable to most of their citizens, is not claimed; all that is

claimed is that they are the best that the leader of the countries can achieve, given the constraints that they are operating under. We start our analysis from this point, and devote our attention to the (marginal) issues raised in contemplation of the *next* change

This notion of restricting one's attention to the next change — that of adopting a new technique and instituting, in conjunction, a set of economic reforms, so as to achieve the greatest possible increase in social welfare from a country's limited resources — is central to much recent work in public economics (see Guesnerie, 1980; Dreze and Stern, 1985, particularly the section entitled "Reform Viewpoint"; 15-19). Using Dreze and Stern's nomenclatura, the problem is to choose, within or on the resource boundary, a technology and a set of reforms so as to maximize dV , the marginal increase in social welfare, where the increase in social welfare is equal to:

$$dV = \left(\frac{\partial V}{\partial s} \right) \left(\frac{\partial \phi}{\partial z} \right) dz \quad (1)$$

The variable s is defined as the vector of "signals", the various external data available to all the individuals in the economy, if it is individuals whose welfare enters into the social welfare function, or to the collective, if it is its welfare that enters into the social welfare function (in practice, s consists of data such as prices, tax rates, rations of commodities, etc.). The variable z is the vector of net additional output of goods and services produced by allocating existing resources to the new technology; and the function ϕ is defined as the extent to which the country's productive institutions are altered by the implementation of those policies designed to exploit the physical potential of the new technology. The function ϕ thus represents the effects of the economic reforms. The two symbols d and ∂ represent total and partial derivatives respectively.

When the proper net increase in output (dz) is accompanied by the proper reforms $\partial \phi / \partial z$ and communicated by the properly revised signals $\partial V / \partial s$, the change in social welfare (dV) is maximized. In principle, the new technology and its associated reforms should be adopted only if the change in social welfare is positive; i.e.,

$$dV^* = \left(\frac{\partial V}{\partial s} \right) \left(\frac{\partial \phi}{\partial z} \right) dz > 0 \quad (2)$$

is the optimal decision rule.

Such a statement as that of equation (2) is by no means trivial. It signifies, in the context of public economics, that of many feasible projects only those that yield an increase in social welfare, under the new

conditions, should be undertaken. In our context, it signifies that only if the reform is possible ($\partial \phi / \partial z > 0$) and if the increased output ($dz > 0$) can be properly distributed given the informational structure of the economy, and if the new allocation is superior in welfare terms ($\partial v / \partial s > 0$) is the undertaking desirable; i.e., is equation (2) fulfilled.

The product of the partial derivatives, which are the terms in parentheses on the right-hand sides of equations (1) and (2), have a familiar interpretation: they are the shadow prices of the net inputs and outputs produced by adopting the new technology and implementing the reforms. Defining, as Dreze and Stern do, the vector of shadow prices as ν , we see that

$$\nu = \left(\frac{\partial v}{\partial s} \right) \left(\frac{\partial \phi}{\partial z} \right) \quad (3)$$

and, at the optimum,

$$dV^* = \nu^* dz \quad (4)$$

Note that the (new) shadow prices are, in principle, not necessarily the same as those that supported the previous optimum allocation; it is understandable that some alteration might occur, in order to assure that sufficient resources are transferred to the design, construction and operation of the plant incorporating the new technology. For a small project in a large, developed country the change in shadow prices might be negligible, but for the typical project in a developing country the change in shadow prices could be substantial.

At this stage in the analysis it becomes necessary to define the two terms in our title — technical change and economic reforms. The first gives us little difficulty: technical change can be defined as the change in the methods of production of goods and services which yields the net change in the vector of outputs (dz) from the economy's existing supply of inputs. It is, according to convention, the change in the state of the arts. If the net change in outputs, valued at the (new) shadow prices for inputs and outputs, yields an increase in welfare, the technical change is a technical advance. This is equivalent to saying that technical change leads to a shift in the production function and technical advance too an expansion of the production surface for at least one combination of inputs, that combination of inputs being the minimum-cost combination at the new set of shadow prices.

Turning to the definition of economic reforms, we see that the mathematical formulations of equations (1) and (2) permit of two different types of reforms, those associated with changes in "signals" ($\partial v / \partial s$, ∂

$v^*/\partial s$), and those with changes in net output ($\partial \phi / \partial z$). In common parlance the term reform is applied to both — to adjustments in prices, tax rates, rations, etc.; and to alterations in the organization of production and exchange, or, to use the Marxist term, to changes in the “relations of production”. Both types of reform can be thought of as institutional, although the first are generally applied to those institutions governing the choices of members of society whose outcomes enter into the social welfare function and the second to those institutions influencing the manner in which inputs are combined to yield outputs. Crudely, the first could be thought of as reforms directed towards altering the distribution of consumption, the second towards shifting the structure of production.

III. The Nature of Technical Change

In summarizing what little is known about the nature of technical change we shall be drawing our evidence from the sphere of micro-economics. Neglecting evidence from macro-economic studies follows from our narrow definition of technical change as the shift in a production function. Following the lead of Solow (Solow, 1957), macro-economists have generally lumped all changes other than those measuring increases in the quantity of inputs under the blanket term “technical change”. Micro-economists studying developing countries, like those cited by Westphal and his associates (Westphal, Rhee and Pursell, 1981) have tried to decompose the overall growth in the productivity of inputs into such separate sources as the expansion of industries employing more sophisticated techniques and the contraction of industries employing less; and into increase in the intensity of use of capital equipment and greater attainment of skills; as well as to shifts in production functions. In our terminology, all but the last of these sources are classified as economic reforms, not as technical change.

In generalizing about the nature of technical change in developing countries we shall make a convenient distinction between changes manifest in products and changes manifest in production processes, a distinction that arises more often in economists' analysis of change than it does in fact. With technical change, products — defined as items each designed to meet a set of specifications — tend to multiply and to become more precise in the functions to which they are put. General-purpose items tend to disappear, as specifications become tighter, reducing variability within a product type and usually increasing quality at the same time. The same set of product specifications come to be adopted by both producer and user, even by the whole industry. The bonds between producer and user

becomes close, and transactions between them conform to more exacting conditions. Ideas for still newer products, and the impetus for their manufacture, are generated increasingly by the potential users (Westphal, Rhee and Pursell, 1981). Users also raise their expectations of service, demanding that products be available immediately, which means that they must be supplied out of stock, rather than being entered on order books.

The effects of technical advances on individual production processes are equally profound. The scale of output increases, as does the volume at which minimum average cost is obtained. Economies of scale tend simultaneously to become blunter, so that smaller operations are at a lesser disadvantage, relative to those at larger scale. Possibilities for substituting one input for another are reduced; i.e., the elasticity of factor substitution falls (Pearl and Enos, 1975). Continuous processes replace intermittent ones; and production lines, defined as the integrated sequence of elemental operations, become longer. As product specificity and production scale increase, gestation periods for the design of processes and equipment, for the acquisition of inputs, for the construction of plant and for the start-up of operation all lengthen. Increasingly, ancillary processes — process design, equipment manufacture, plant construction, maintenance, product promotion — become the preserves of separate firms or industries which, through specialization of task and accumulation of knowledge, carry out these activities more efficiently. Capital equipment producers become agents for further technical change, along with those firms specializing in ancillary activities.

Accompanying these advances in individual processes are improvements in production planning and control. As operations are tied more closely together, their synchronization is perfected, not necessarily with a loss in flexibility. Synchronization extends from operations within a single firm to operations across firms, linking in one taut chain suppliers of components and other inputs, producers, and users. Production flow becomes increasingly important, legal or social autonomy less so.

The synchronization of existing processes, as well as their individual improvement, necessitates the sharing of information among all personnel involved — the operators, engineers studying performance, technicians in laboratories providing physical and chemical analyses, other engineers scheduling and carrying out maintenance of equipment, accountants assembling figures on costs and revenues, research and development workers attempting to create new products and processes, etc. Increasingly, there results a free interchange of data among employees in different parts and at different levels of our organization; from being a private

good, the property of an individual or a group bound by loyalty and patronage, information becomes a public good, available to all.

The chief consequence of technical change is the reduction in the average cost of producing the product to specification. Although the evidence for developing countries is not very abundant, it appears that when inputs are aggregated in very broad categories technical change can lead simultaneously to a saving in each category; compared to the older technique, the newer requires less capital and less labour (Bell, 1982: 30-45). But within these two broad categories, the manufacture of new products or the utilization of new processes can use proportionately more of certain less broadly defined inputs. Examples within the broad category of capital are the increased requirement for instrumentation and control within the broad category of labour the increased requirement for technical and managerial skills embodied in, among others, scientists, engineers, computer programmers, accountants and treasurers (Bhalla and James, 1986: 158).

IV. The Nature of Reform

If we were to draw upon Schumpeter's enumeration of four types of innovation — product, process, market and organization — we could claim that the first two, when diffused, lead roughly to what we have defined as technical change, the second two to what we have defined as reform. Difficult as it is to generalize about technical change, it is much more so to generalize about reform, even reform contingent upon technical change. Firstly, this is because the agencies undergoing reform may be located far from the industry in which technical change occurs; secondly, because the substance of reform cannot be measured with the precision of material objects; and thirdly because reforms are at least as much political and social phenomena as they are economic. Political are the shifts in power that accompany technical change, shifts from local autonomy to regional or national co-ordination, from owner to technically-trained managers, from private individuals to government officials and statesmen: social are the displacements of traditional forms of organization by an hierarchical form, of personal roles broadly defined according to birth and status by tasks precisely defined according to position within the productive system, of tribute based upon status by incomes based upon technical knowledge and performance and finally of mores cultural and spiritual by matters material. One's rank in society is determined less by what one is, more by what one does.

It should not be surprising that these political shifts and social displacements should cause resentment, resentment on the part of those who ex-

pect their status further to decline relative to that of the progenitors of technical change and the institutors of economic reform. Most individuals are quick to perceive threats to their position, to fear diminution of their influence, to anticipate reductions in their income and wealth; and the advent of new techniques, whose adoption would appear to have these undesirable consequences, are opposed.

For every action there is reaction; for every reform there is opposition. Just as surely as the change will be seen to benefit someone or other, so it will be seen to harm someone else. Those who adopt the new process, or produce the new product, will be expected to prosper; those whose product is supplanted, or those whose product is displaced, will be expected to suffer. The same antithetic expectations will arise regarding those who participate in the technical change, and those who are excluded, for whatever reason. Necessary as reform may be to enable a technical change to be exploited fully, that reform will be opposed.

One of the chief characteristics of developing countries, as compared to developed, is that the forces opposing technical change and economic reform are likely to be impregnable. The economies are frozen in patterns from which elements are not easily dislodge, because the bonds are not merely economic but political and social as well. market-related changes, such as in prices, are ot in themselves sufficient to reallocate resources from less preferred to more preferred activities, since markets are relied upon so little as a guide; resources move in response to administrative decree, or to family or group or regional or ethnic interest. In neo-classical terms, markets are not permitted to operate, or, when permitted, are exclusive to privileged agents.

If, on the one hand, opposition to reform is more formidable in developing countries, on the other hand the need for reform is greater. Economists have long and persuasively argued that distortions are greater in developing than developed countries preventing the efficient operation of some activities and prolonging the inefficient operation of others. Distortions are seldom removed through the operation of markets alone; they are usually created so as to subvert market forces, so as to remove the activity concerned from the sphere of the market. So, reforms are needed before the activity can be subjected to the disciplines imposed by demand and costs.

Yet the task of reform can be made even more difficult through anticipation. Since opposition to reform arises from *expectations* as to its consequences, as well as from the consequences themselves, opposition can be organized prior to the theme that reforms are introduced. The ordering of actions, the dialectic, can be reversed: instead of a sequence

reform/opposition/reform ..., one can encounter the sequence opposition/reform/opposition The first move may be seized by the opponents to reform.

If one or the other of the above sequences were repeated endlessly the final outcome might not vary appreciably. But for short sequences of interrelated actions in differing order the outcome of each sequence could be unique. In the language of games theory, to different sequences of nonsimultaneous plays in an extended game one would expect to observe different payoffs.

In game theory it can be shown that the player who moves first is generally at an advantage; they can probably hold in an environment chosen for reform. If the potential opponent to a technical change can strike first, his opposition is strengthened. Given the uncertainty that always exists in a developing country, uncertainty amongst other things in the direction and pace of reform, a sensible first move is to resist any alteration in an institution. Any novelty, any change, be it in process, product, area of authority, standard of behavior, structure of reward, whatever, is to be opposed *per se*. To oppose change out of hand is to seize the initiative, and seizure of the initiative is an effective mode of opposition, since the tactics available for a first strike are so numerous — an appeal to tradition, the raising of an alternate issue or promotion of an alternate programme, the formation of an alliance, an attack on the likely reformer, etc.

In addition to being the first to move, the potential opponent has the advantage of being able to select his point of attack. Broadly, attention could be focused on the economic environment within which the technical change would occur, or on the institutional environment within which the reform would be promulgated, or both. It is very difficult to say much about these broad alternatives, but it appears that opposition can be directed effectively towards both adoption and reform, towards both adopters and reformers. Most effective of all appears to be opposition that is oblique in direction. If it is technical change that is to be opposed, attention is less often focused on the originator of a new process, or on the capital goods producer that builds the equipment that incorporates the new process, but more often on the firm that attempts to adopt the new process for its operations; attention is less often focused on the producer of a new product but more often on the users of that product. The reason for aiming not at the primary but at the secondary target is that originators and producers are committed to the novelty, and will resist opposition keenly, whereas potential adopters and users are already making do with an existing alternative, and will resist opposition less so.

If it is a reform that is to be opposed, attention is less often focused on the reform itself but more often on previous reforms and their failings; less often on the ability of a reformer to design and implement the reform itself but more often on his other attributes. The opponents' maxim is always to choose the arena and the rules of the game to be played.

It might be useful to illustrate these ideas with an example. Imagine the case, common to developing countries, of the proposed adoption of a sophisticated manufacturing process whose output would replace a product currently being imported. Imagine also that operating this process would require the employment of engineers, that engineers are in scarce supply, and that the country wishes to be self-reliant, creating its own engineering talent. One of the reforms that its government would be likely to try to institute would be to increase the numbers of young engineers available for employment in domestic industry.

This reform might seem to outsiders as innocuous, easily instituted, say, by increasing the flow of public resources into the education of engineers and alerting young graduates to the opportunity of employment in the firm operating the new process. But even at this early stage of the proceedings, before specific plant are designed and implementing agencies appointed, opposition will arise. At least three groups of opponents can be identified, the first comprised of educators, the second of importers and the third of the young engineers themselves. Educators would expect resources for other branches of education to be reduced, to the detriment of the training of doctors, lawyers, historians, artists, etc.; even the existing engineering faculties, to be expanded, might fear a lowering of standards of admission or an increase in the pressure under which they operate. Importers would foresee a loss of their markets, incomes and influence upon completion and operation of the new process. Young engineers, acquiring an internationally transferable skill, would fear restrictions on the right to choose their job, or even to emigrate. Independently or in combination these groups could be expected to try to halt any movement towards reform. If at first unsuccessful, they could be counted upon to try to modify any proposed reform in such a way as to protect their interests: the educators by trying to secure uniform increases in the resources devoted to all faculties in all universities; the importers to obtain exclusive licenses to bring into the country other, equally profitable goods; and the young engineers (and their families) to avoid any restraints on one's ability to choose where and at what and for whom to work. As the design, promulgation and implementation of the reform proceed, additional opponents, in government and outside, could appear; opposition could also arise among school-teachers, obliged to increase the hours in the syllabus

devoted to mathematics and science, among parents of children gifted in subjects other engineering, among civil servants administering diminishing arts programmes, just to mention a few.

The illustration of increasing the flow of engineers into an activity incorporating a technical change has made explicit the three chief characteristics of opposition, with whose summary we will close this section of the paper. The first characteristic is that any proposed change, be it technical or economic, will almost certainly give rise to position, since any change will threaten one or more vested interests. Unanimity in the face of change is hardly ever encountered. The second characteristic is that opposition to change can arise even before a specific change is proposed, and is likely to increase, rather than diminish, as change proceeds. The third is that those who oppose change can wield almost all the instruments that are available to reformers: opponents too can argue and exhort, publically and privately; can solicit funds to mount a campaign; can unite to mass their reserves and synchronize their actions; can appeal to custom, to interest, to existing law and administrative decision; and can enlist the bodies of state — legislative, judicial, administrative — in their cause. Opponents of technical change and economic reform even have two tactics not generally available to reformers — procrastination and revolt. Those instituting change usually wish to speed it up; it is opponents who benefit from delay; those instituting marginal changes usually prefer an otherwise stable environment; it is opponents who may benefit from disturbance.

V. The Perversion of Reform

That opposition to technical change and economic reform should arise is obvious, and that opposition should be intense when vested interests are threatened is equally so. Were it not for the fact that interests were vested, reform would not be needed; in activities not yielding economic rent there is no resistance to change. But what is not obvious is that the changes that finally occur may differ substantially from those desired, or anticipated. Opposition alters the pace and direction of change and, in all likelihood, the terminus. If, as we considered in our definitions of improvement and economic reform in Section II, the reform were optimal as originally designed, any deviation from the original would achieve less than possible, would be a perversion of the original programme. By definition, the outcome would be less beneficial, less beneficial to the economy, than would have been the outcome from an unopposed reform. To be sure, the opponents to the original reform might fare better than they would

have had the reform been unblemished, but the rest of the economy would not fare as well as it might have. In the worst case, both proponents and opponents could be worse off.

What need to be asked are what sorts of perversions can arise? Under what circumstances? And with what consequences? How will opposition to technical change and economic reform affect the desired outcomes? Any attempt to answer such searching questions is bound to be presumptuous and can only be excused by the importance of the answers to developing countries, so sensitive to technical change and so propelled to economic reform. It will be best, most honest, to describe these answers as imaginings or speculations; even the word hypothesis lends them an excessive dignity.

Two imaginings have already been expressed; the first is that there always is opposition. The second imagining is that the opposition that does arise will pervert, rather than just blunt, the reform. It is not that the objective of the reform is achieved more slowly, or to a lesser degree, but that the objective is, to a lesser or greater extent, compromised. There eventuates something different from what the reformer intended.

Consideration of the circumstances under which perversions are likely to occur, in the course of designing and implementing reforms whose purpose is to facilitate technical change, gives rise to more thoughts. The continuity of any manufacturing process, of any product's distribution and consumptions, is subject to interruption, or even rapture, through opposition. Inputs can be denied; administrative prohibitions and legal injunctions can be obtained; sabotage can be committed. The more advanced the process, the more novel the product, the more sensitive it is to upset; a developing country choosing to adopt techniques currently employed in the developed countries is the most vulnerable of all.

Even if there is no materials resistance to the adoption of modern techniques delays may be imposed, delays which are the more costly the more capital-intensive is the technology. Costs per unit interval of time mount as completion nears, and with costs the pressures to compromise with opponents. What may commence as sharply carved decrees expounding reforms can subsequently, under the eroding forces of time and expence, become ill-defined.

Erosion of shape and purpose is more common in developing countries because technical change and economic reform are more recent phenomena. The innovators are novices, dealing with such matters for possibly the first time: they have no great fund of experience in adopting new techniques, in imposing reforms; they must carry out their duties in an environment less accustomed to change and probably more resistant to it.

Vulnerability, inexperience with reform and limited resources inhibit those who wish to improve allocation within the economy, so as better to realize its potential to fulfill society's objectives. All these three factors can be titled in favour of opponents to change. Often they have more resources at their disposal; sustained by the economic rents derived from their positions in the traditional economy, opponents to change must be expected to be rich, united, well-organized, highly-placed and experienced in defending their interests. To fail to admit the strength of opposition to change is to surrender the initiative in achieving it.

A final condition that may hinder the achievement of beneficial technical change and economic reform is the fragmentation of leadership so often encountered in developing countries. All too frequently one or more of a country's leaders is at odds with the rest over what is the desirable set of objectives, or is willing to sacrifice the nation's objectives to his own welfare. Opponents to change can then strike an alliance with this powerful man, whose own interest has been awakened. Under such circumstances it would not be surprising to find that the adoption of the technology, the promulgation of the reform, proceeded in a different manner than the optimal; it would not be surprising to find a perversion of change.

Techniques themselves cannot be perverted, since they are collections of operations obedient to physical and chemical laws, but the choice among techniques can be. Given that the initial preference is for the optimal technique, optimal in terms of its contribution to social welfare, opposition may lead to a less-than-optimum choice. Departure from the optimum configuration may occur along dimensions of scale, location, factor proportions and product definition; and is the more likely to occur the greater the opponents; intrusion into the act of choice.

Just as the choice of technique can be perverted, so can the course of reform. If opposition arises early, the reform can be attacked before its design has been completed or its implementation arranged; the energies of the reformers will be diverted from planning to defense of their programme. The reformers may even conclude that perfection of the design cannot be attained, for the revision of the programme, in the face of opposition, would give the opponents both cause and encouragement. In this way, designs for change can become fossilized among layers of discord.

We have suggested that the choice of technique can be perverted; the consequences of this perversion are familiar: inappropriate technology, overly capital-intensive; wrong location; excessive or insufficient scale; etc. One vivid description of possible outcomes is Leland Johnson's (Johnson, 1967); many others have been reported, although few authors are so

candid and comprehensive. Political scientists and journalists investigating the consequences of the choice of technique in developing countries tend to avoid economic analysis, economists to shun cause.

There can be other discouraging outcomes in the sphere of production, as a consequence jointly of deficiencies in technical choice and economic reform. If reform is perverted necessary inputs may not become available in sufficient quantity or of high enough quality. Outputs may be denied the markets for which the products were conceived. The act of compromising with opponents may also burden the productive apparatus with unwarranted or insufficiently adaptable inputs. All these factors raise costs and reduce the profitability of operation, in addition to denying the economy the volume of goods and services it has been scheduled to receive.

Discouragement can extend beyond the sphere of production to the process of reform itself. As a consequence of one or more perversions those who try to secure technical change, to undertake reform, can be disgraced. So too can methods be discredited: the failure of a desirable project challenges the activity of project evaluation; a deficiency in the output of a desirable product depreciates the value of national economic planning. The perversion of one reform prejudices future reforms, for prospective reformers lose heart and prospective opponents gain assurance. Finally, the organizations that are created in the course of technological choice and economic reform, deflected in purpose, diminished in stature, and deprived of support, are seldom disbanded. They remain derelict on the bureaucratic scene, reminders of an unsuccessful past.

VI. Conclusion

The presumption in many developing countries, and in all international agencies, is that the range of choice, where technology is concerned, is relatively narrow. It is generally believed that the advanced techniques which the developing countries covet use economic resources in almost completely fixed proportions; that it is almost impossible to substitute those resources which developing countries have in abundance (generally unskilled labour) for those which are scarce (generally technically-skilled labour, technically-skilled management, and foreign exchange) (Eckaus, 1955; White, 1978; Fransman and King, 1984).

It is also presumed by the same bodies that the range of choice over economic reforms is relatively wide, of not infinite. It is generally believed that the feasible set of reforms which developing countries need to exploit, so as to achieve the potential of advanced techniques, is complete; i.e., that it is possible to design and implement any conceivable reform.

Whatever the new technology demands in terms of altered quantities of inputs, prices, types of institutions, etc., these can be provided.

In this paper we have argued that such asymmetry over the domains of control — restricted domain in the case of technology, limitless domain in the case of reform — is surely wrong. In most, perhaps in all, developing countries the policy mix is as sparse as the technology mix. The task facing those who try to maximize the benefits from technical change and economic reform is not to take the technical changes as given and design an optimal set of economic reforms; the task is to take the potentials for both technical change and economic reform together and to find the best "package" among the limited possibilities that are available. In the language of control theory, both technical change and economic reforms are controls, and both control sets are severely constrained, the former by the rigidity of advanced technologies, the latter by the lack authority and/or unanimity within the governments of the developing countries. Some separate choices there are, in the specifications of a process or a product, in the composition of a reform; but fewer joint choices exist the intersection of choice sets is much more limited. Many feasible techniques have to be rejected because economic reforms cannot be instituted which would enable them to be operated efficiently; many feasible reforms have to be abandoned because they are not compatible with the appropriate technology.

Opposition to change is ubiquitous. What, in the absence of opposition, may seem like a feasible "package" of technical change and economic reform, may not be so in its presence. The reformer's choice, in this eventuality, is between an alternate package, less desirable in its outcome but capable of being implemented, and the original package, likely to be perverted in its course. Presumably, the decision regarding which of the two alternative to implement should be made in terms of which outcome promises the greater increase in total welfare; but in an uncertain world where earlier outcomes affect later such a rule would be vacuous. Perhaps all that can be said is that in anticipating technical change and planning economic reform the rulers of developing countries should, ahead of time, make explicit allowance for potential opposition, and choose programmes which attain a nice balance of improvement and practicality. But this is just a more complicated way of saying that economic choice should conform to "realpolitik".

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