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The Politicization of Technology Choices

An analysis of the factors involved in international technological advance and of the various strains and tensions created by the intervention of national political considerations.

Introduction[1]

We live in a world of national jurisdictions: states, boundaries, legal entities, and contending constraints on economic performance. These realities are manifested in constraints on the behavior of firms that become crucial factors in the determination of strategy and in the choice of technology. The purpose of this article is to draw attention to the politicization of technology choices—for all actors and at all levels: firms and industries at the national level, economies, states, international firms, and global firms.

Politicization

Politicization is a fact of life—the manifestation and the impacts may differ, but the fact remains. For the firm, success is defined in terms of profit; technology choices are defined almost exclusively in similar terms. In both instances success is almost always contingent on understanding, and maneuvering within, the constraints imposed by the state, its capabilities, political processes, legal frameworks, and modes of determining outcomes. Success

for a state—in choice of technology and on other issues—is governed by objectives other than profit. This observation must not be misunderstood: for the state (and for state enterprises) profit is crucial, but other conditions, and other priorities must prevail.

A nation—the nation-state—unlike the firm, seeks to meet a variety, even a hierarchy, of objectives: security, stability, cohesion, development, and profit (economic gain). This hierarchy of goals creates some of the strains between the firms operating across national boundaries and the nation-state in whose jurisdiction the firm seeks to enhance its profits. (Whether profits are viewed in global or local terms is not central to our concerns here).

These fundamental differences in the goals and characteristics of the two entities shape the politicization problem. To the extent that firms can understand, adjust, influence, or manipulate the constraints of politicization, their success, on their *own* terms, will be enhanced.

Firms and States

Firms are not in the business of business for philanthropic reasons. States are not in the business of state-building and state-maintenance for philanthropic reasons either. Firms and states are bound together by the fact that each has something the other wants. Hence the bargains, hence the strain, hence the inevitable and invariable politicization. And, when the firm is driven by the need to increase access to complementary assets to retain

its competitive edge, then the lateral expansion of its activities brings it in direct contact with those in control of the jurisdiction in which it seeks to operate. The firm's channel strategy—*how* the firm seeks access to complementary assets—will determine the *type* of political factors encountered: i.e.,contractual modes vs. integration modes (ownership).

Politics, as we all know, is defined as *who* gets *what, when, how*. And, short of the use of guns, the business of politics is conditioned by negotiation, bargaining, and, of course, trading in threats and uses of leverage. The firm, at all levels, also bargains, negotiates, trades in threats and resorts to using leverage. But the nature and content of the leverage differ, as do the intended consequences.

When the *firm* operates in an industry or sector important to the state, the parameters of politics are shaped by their respective power and capabilities. A notable case is that of Brazil and the computer industry. Brazil had one set of objectives, and the international computer giants had others. The contentions revolved around Brazil's objective to acquire computer development capabilities. The established global firms objected to and, in Brazil's view, obstructed the state's strategy. The politicization and the ensuing disputes were born of the conflicting goals and capabilities brought to bear on the disputes.

When the *state* believes that the firm's operations are important for its own development strategies—and the real political objectives of national leaderships—the parameters of politics become defined by the respective power and capabilities of the state and firm. The outcome is simply a function of who has more clout and more capacity to bargain and exert leverage—often in the literal sense.

Technology is both the subject (the goal) of such a bargain and an instrument in the exchange. It is an instrument in that if the technology chosen can not be disaggregated into its component parts, the entity making the choice (either the state or the firm) is more likely to be able to control the technology, a condition that has important, broad implications. Politicization, at a minimum a nuisance, can become a fundamental impediment to the activities of the firm. It may slow operations, detract from central activities, and ensnare management (perhaps at all levels) in the quagmire of local politics. If permits for business and permission to operate are at issue, then the firm becomes entangled in local bureaucratic procedures, the universal nightmare of firms operating overseas.

It is clear by now that the distinction between ownership and control in international business is especially important; ownership (by foreign governments) can be secured through a variety of formulas, but control is more elusive: it involves exercise of leverage, of effective decision-making, and of the capability to *make* choices. Parenthetically, then, from the perspective of the state the issue of unbundling imported technology packages be-

comes intertwined with efforts at exerting control.

Modes of Politicization

The ways in which politics intrudes on the business of the firm and the way the state introduces its objectives into decisions about technology choices shape the politicization problem. A comparative perspective on these issues illustrates the modes of politicization, and attendant motivations and consequences.

Industrializing States

Among the industrializing states, we turn to four countries: all quite different, and all important to international politics, to the Western alliance, to the global markets, and to regional security and stability. These four cases show ways in which choices become politicized, in the sense that choices that ought to be driven by economic or technical criteria are shaped by *political* ones.

First is the case of Brazil, a country with a large market, a substantially developed infrastructure, and a country in which the state plays a major role in guiding technology choices. The state has tended to write the rules (seemingly on a "take it or leave it" basis for some sectors). The state is a player of consequence in almost all sectors of economic activity, and the Brazilian market is too large to be ignored by external actors and too sophisticated politically to be penetrated without encountering a measure of state control. For Brazil, choices in technology have been more politicized relative to those of other large economies in the region, and politicization has been manifested across more sectors as well. In the computer industry the country has chosen the strategy of strong protection through legislation to restrict foreign access to the Brazilian market, especially in personal computers and mini-computers.

Second is the case of Kuwait, an oil producer of some importance and an entrepreneurial state of some repute. Kuwait's return on financial investments overseas exceeds the revenue from oil sales. The State of Kuwait is becoming known as Kuwait, Inc. The country's strategies for growth are based on assessments of the vulnerabilities of its polity. For Kuwait the risks and vulnerabilities are stark: close to 60 percent of its population are non-nationals and close to 80 percent of its labor force are foreign citizens Therefore, choices of technology are driven by the desire to reduce reliance on foreign labor. This oil-rich country is characterized by severe labor shortages, rendering conventional prescriptions for technological choices in developing countries irrelevant. The driving concern for Kuwaiti decision-making is to make technological choices that would reduce (possibly minimize) the constraints of labor shortages.

Third is the case of Korea, reputed to be the new legend, the new miracle, the new giant of Asia. Korea's

technological strategies are politicized in ways different from the Brazilian or Kuwaiti modes. Technology choices are driven by state policy and the government's intent to enhance the productivity of labor and to establish a strong productive presence in the region and elsewhere. The motivations for politicization of technological choices in Korea are also different. Within the confines of its endowment, Korea has been immensely successful in mounting a technological strategy that has enhanced its own advantages or, more accurately, has transformed the historical characteristics of economic underdevelopment into substantial growth and a presence internationally. A central component of the strategy was the active support of the government through the establishment of conditions favorable for foreign investment, combined with intensive support to selected industries, specifying and pursuing priorities for technological change.[2]

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Fourth is the case of Egypt. Egypt may appear to be a near-typical developing country. However, it has a large domestic market, a wide range of national firms, and the largest locally owned construction firm operating in the Middle East. Furthermore, Egyptian educators, administrators, scientists, engineers and other skilled individuals have traditionally staffed and administered the bureaucracies and economies of other Arab countries. As the state with the largest population, the most educated people, in terms of numbers, and the largest number of universities and research centers, Egyptian manpower has provided the backbone for the country's development strategies over the past four decades. This fact itself has generated politicization, as firms seek to improve their performance in an environment riddled with administrative controls of all kinds. Technological choices, then, are often made to bypass the regulations of the state, especially those pertaining to employment conditions.

These four cases show differing state capabilities and differing effectiveness, and they represent different types of conditions confronting international and global firms as the local level of knowledge and skills increase over time. In many ways these four cases are textbook cases of politicization. For Brazil and Korea the technological challenge is to understand the difference between know-how vs. know-why. Know-how concerns the technology per se; know-why involves its implications and consequences. For Kuwait and Egypt technological challenges have not yet been defined in these terms. They do not as yet appreciate the difference between know-how vs. know-why, but inevitably they will.

In all four cases, technology choices are highly politicized—public actors play important roles—and the state sets the rules of the game. Firms are always affected by state policy and by the political agenda shaping that policy. To the firm, the political elements are exogenous, but they are important nonetheless. Learning to operate, and retain maneuverability, within the parameters of state policy and politics often determines the firm's success in the local environment. To be effective, state policy must wisely line up the right incentives for the firm; but wisdom is seldom in excess supply.

Many of the issues surrounding the international debates about access to technology—and choices of technology—involve national environments, not international agreements. For example, over 90 percent of the patents granted by developing countries are foreign-owned; about the same percentage are never employed in the country granting them.[3] This means that the firm has drawn upon the local environment for important commercial knowledge, perhaps has been even instrumental in generating that knowledge, but the long-term gain from the patents does not accrue to the national jurisdiction issuing it in the first place.

Industrial States

In the industrial world the politicization of technological choices is as sharp and stark as in industrializing states and clearly on the rise. Changes in the international system, in cooperation among states, and in the global power structure will make choices of technology essentially choices about strategies for national power. Three important developments influence this politicization: the consolidation of a European market after 1992, America's concern with protecting its competitiveness, and Japan's continuing bid for global economic dominance. (In 1986 about half of Japan's investments overseas were in the United States.)[4] These developments will sharpen the power/technology connections both at the level of national strategy and also at the level of discrete technologies in select industries—for example, in supercomputers. For the United States there is the added problem of managing a historical peculiarity: as the world's largest debtor, the United States also enjoys the largest net inflow of investment income. Historical parallels with Great Britain hold for the first condition, of course, but not for the second. These seemingly contradictory trends reflect countervailing forces and contending sources of politicization for choices of technology and for regulation of international trade in technology.

The internal/external linkages are inevitable. On the domestic front, because technological success depends clearly and obviously on other choices—in education, infrastructure, R&D, and so forth—trends and forms of po-

liticization will permeate all facets of social action bearing on technical choice. On the international front, because technology and information are constantly crossing borders, this trend renders single-nation industries a condition of the past and, paradoxically, reinforces the politicization of technological choices for nations.[5]

The clearest manifestation of politicization is around issues of technology "gap."[6] Since future economic viability depends on the ability to introduce a broad range of technologies in all sectors, critical size becomes important. It is the size factor that makes post-1992 Europe a credible challenger, the U.S. a global player, and Japan a noteworthy competitor. A technology gap—if it develops, and however it might be manifested—will have direct impacts on social and military affairs in all three regions and an effect on subsequent technology strategy. Restrictive practices made exclusively on national security grounds that limit exports of advanced technology are a clear manifestation of politicization in a crucial domain. There is a paradox, of course, and something of a political problem, when export restrictions are placed on a final product whose components are manufactured elsewhere.

Technological innovation is an essential condition for assuring long-term competitiveness.[7] Innovations respond to a variety of measures whose introduction depends on political actions, such as macroeconomic policy, industrial policy, patent policy, tax policy, and so forth.[8] In technologies where development is contingent on large-scale government involvement, especially those bearing on national security, the choice *process* itself can become highly politicized. The *form* of government intervention itself is the product of politicization. The U.S., for example, is especially uneasy about the role of government in all facets of entrepreneurial and investment activity, as a general ethic of restriction rather than expansion prevails.

There is also the fact that countries are often oblivious to the effects of their own policies on the interests of their allies. Such instances give rise to inadvertent politicization. Industrial countries will certainly be confronted with the challenge of managing the role of the state in ways that do not enhance the politicization of processes already infused with "high politics." In all other cases cited here, choices of technology are consciously driven by political factors and the objective of reducing risk and vulnerability.

Institutional Basis for Technological Advances

At the institutional level a proverbial technology triangle defines the core of technical advance.[9] The triangle, based on the experience of industrial societies, is composed of: (1) government policies that support technical advance; (2) universities oriented toward industrial research, research on productivity, and development; and (3) corporations structured to receive, utilize, and generate advances in technology.

Although relevant to their progress, the triangle does not yet exist in most developing countries, but there is a gradual appreciation of its importance in enhancing technological capabilities. Brazil, Korea, Egypt, Kuwait and others are beginning to try to reproduce the triangle as a form of institutional development for mobilizing human resources. The important issue here is that policies to establish the triangle inherently politicize the process itself.

Politicization as Goal Setting and Decision Making

. Politicization manifests itself in several ways: there is considerable debate about *how* choices should be made, and what the criteria or *goals* that generate the choice of technology should be. By the last count there were at least nine different economic goals that can, in theory, drive technological choices.[10] To this we add the fact that often economic goals mask political objectives. Understanding this fact is important, and this consideration translates into understanding *who* sets the goals, *who* decides the *criteria* for the choices in technology.

Decision-making is always a political process. In an interdependent world, firms and states are concerned about the locus of decision-making: *where* are decisions made; *who* controls the decision-making context; how much discretion or *autonomy* is there in decision-making. The question of *where* evokes jurisdictions; the question of *who* evokes procedure; and the question of *autonomy* evokes capabilities—capacity to decide and to maximize gain based on the decision made.

In the international market for technology, transfers take place among: private firms of different national origins; within firms; between private firms and state-owned or controlled firms; and sometimes, but more seldom, between states. Politicization emerges in the form of regulation by states (legal instruments) of the markets for know-how (technology). For example, by forcing local participation, screening of foreign activities, or varieties of restrictive clauses, and the like, the state interjects its objectives in the technology-choice process.

Since many industries that countries view as strategically desirable are dominated by international and increasingly global firms (MNCs), it follows that conflict between MNCs pursuing global economic strategies and countries pursuing national domestic political strategies is difficult to avoid. This is especially the case in a competitive and rapidly changing international environment. The issue of divestiture brings this conflict into focus, invoking decisions about the reduction of scale and scope of operations across borders (for the firm) and across sectors (for the state).

Internationalization of Firms and Politicization Problems

Technology is constantly evolving, and the cliche that static means obsolete is particularly apt. The recent emphasis on attempting to acquire assets is an indication of responses to changing technological and market conditions. In industrial and developing countries new phases evolve in the development of both international business strategies and national security strategies. The intersection between the two draws attention to the crucial role of policy toward technology.

When a host government limits access to complementary assets, in essence interfering with the operation of the firm or obstructing business, then politicization takes place. If the firm is successful in understanding changes in both international production and the ownership of assets, it will have a basis for anticipating future trends in, and forms of, politicization.

It is difficult to differentiate between industries or technologies devoted to private needs and those devoted to public needs. But there *are* differences among technologies and industries. When two factors converge—(1) government as source of funds *and* rule setter; and (2) salience of technology to national goals—the politicization of choices is inevitable. For example, compare U.S. interest groups in aviation, semiconductors, the automobile industry, housing and so on. The role of procurement, regulation, antitrust legislation, patents, and related policies is designed, in part, to keep politicization of the process of technology choices under control and to introduce accountability and due process at each stage.

The idiosyncracies of domestic regulation and legislation do not address the increased complexity of the international corporate landscape. Multinational firms in the past were predominantly American. Today they come from most of the industrial states as well as from a few developing countries. In 1965-1969 the United States accounted for 65 percent of all direct investment overseas; by 1980-1981 its share was 28 percent.[11] These trends reduce the flexibility and maneuverability of U.S. firms and impose increasing competitive pressures and the prospects of public constraints on corporate activity.

Technological Choices and Strategic National Objectives

The intimate connection between national objectives and technological strategies was recognized nearly 20 years ago.[12] However, analysis of this connection has generally remained outside the view of either business analysts or scholars of national strategy. With increased competitiveness from Japan and Western Europe, the role of the state, national objectives and strategic concerns have become salient in assessments of firm-state

relations.

The allocation of resources for R&D, in the United States and elsewhere, are shaped by national priorities. Even when priorities are not entirely explicit, these R&D allocations are shaped by a broad sense of priorities.[13] For example, in the United States 90 percent of U.S. federal R&D funds going to industry are for defense, space and energy, three areas central to national priorities. In developing countries R&D funds are directed to broader "economic development" goals. Because government is by far the largest supporter of basic research, politicization of allocation is inevitable. Targeting of R&D efforts, when it occurs, is driven by conceptions of priorities in either general or specific terms—and that is an intensely political process.

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Politicization of technology choices within states is not independent of what is happening elsewhere. Competitiveness—the ability of a country to balance its trade while achieving an acceptable rate of improvement in its standard of living—becomes politicized as tradeoffs must be made. Goals define technological choices; and when technologies in question are central to national security, then political goals shape the characteristics of the technology programs. As an illustration, the striking difference between Eureka and SDI initiatives can be traced to their objectives: SDI is designed, in theory, to organize a well-focused system of military defense: Eureka, by contrast, has the objective of giving a general boost to industries in their civilian-oriented activities.[14]

Politicization of technological choices in relation to national priorities is manifested in yet other ways.[15] There are linkages between technology choices and high-tech innovation, e.g., supercomputers. The nation that leads the world in supercomputer technology (hardware, software, algorithms) has the possibility of leading the world in application of supercomputers: important in defense and energy, and in simulation of very large systems, manufacturing, and so forth.[16] In other words, this advantage means leadership in all crucial indicators of national power—leadership on a world-wide scale. If another country should assume leadership in this area, U.S. defense and technology may become significantly dependent on access to computers of foreign manufacturers. It is ironic that in many ways the present predicament of the United States regarding supercomputers is remarkably analogous to that of Brazil

in the latter's stance on its computer development policy: national autonomy is the central directive. The risks of losing ground involve broader risks, such as: technology lag, denial of access, loss of technological spinoffs, educational implications, impacts on basic research, and the like.

Since advanced technology and technological choices shape a nation's power in the international arena, conceptions of power, in turn, influence priorities and choices. Internationally, the debates about technology choices have become conflicts about:[17] (1) the *goals* driving choices of technology (growth vs. security), (2) the *strategy* of choice (self-reliance vs. greater integration in the global system), and (3) the *regulation* of cross-border firms and corporate activities internationally (unilateral, bilateral, or multilateral).

In the last analysis, consensus and debates over the technological gap, however defined, translate into constraints on the ability to participate, on an equal basis, in the design and implementation of "international bargains."[18] Dictating the terms of the bargain, between nations or firms, is ultimately a matter of power and leverage. A gap in technology is a constraint on power and a limitation in the ability to exercise leverage.

It is therefore important to recognize and stress the intimate connection between technological choices and capabilities, on the one hand, and national power and capability on the other. These linkages are generic: they get at the core of the politicization of technological choices. While the causation of technological change is left out of neo-classical models of growth, it is clear that politicization itself is an important element of that causation.

Conclusion

The politicization issue is an especially difficult one because nations now see their futures related to—even contingent upon—advanced technologies, and firms are seldom able to insulate their activities from the reach of the state. For the state, protectionist responses are often pursued by those who view themselves threatened or challenged. Protectionism worldwide would certainly be detrimental; but it is difficult to encourage policies for tech-

nological access or technology transfers designed to enhance the "global good" without confronting the reality, and force, of the pursuit of distinctly national objectives. While the size factor is crucial to the behavior and success of the firm, it is not a necessary or even sufficient condition for insulation from the encroachment of politicization.

Issues of advanced technology have already emerged within the context of international organizations, especially the GATT framework. However, it is unreasonable to expect such institutional agreements worldwide to eliminate or even substantially reduce the invariable influence of politics.[19] Technological *choices* bear on eventual technological *capability;* and for a nation, technological capability determines the ability to participate in international bargains. The most powerful influence the terms of the bargain, the nature of the conflicts and the terms of cooperation.

All this points to the *globalization* of politicization, an emergent reality, not a cliche. However imperfect they may be, codes of conduct and regulation of technology crossing borders are designed to protect the weaker from abuse by the stronger. Generally worthy in most instances, codes of conduct also render politicization explicit, as they draw attention to conflicts between international codes and the constitutional norms of states. The U.S. case is especially illustrative, as legal constraints prevent government from confiscating private property, from committing private financial resources to public purposes, and from committing private firms to public endeavors—conditions that might obtain under international codes.

As we look to the future, we see one area in which choices of technology have not yet become politicized, but will assuredly become so: choices of technology for the management of global problems and for the protection of global assets (ecological conditions) and the global commons (the atmosphere, the oceans, etc.). With increased international sensitivity to environmental problems, pressures for responses to global problems will draw attention to the dual role of technology as a source of and a soultion to such problems. These pressures will necessarily render technological choices even more intensely political, and will contribute to the globalization of politicization.

Notes

1. An earlier version of this paper was presented at the Massachusetts Institute of Technology Industrial Liaison Program Symposium on "The Technology Development Process: An International Comparative Perspective," April 25-26, 1989.
2. Jairam Ramesh and Charles Weiss (eds.), *Mobilizing Technology for World Development* (New York: Praeger Special Studies, 1979), pp. 139, 169.
3. Ramesh and Weiss, op. cit., p. 58.
4. For a review, see *The Economist*, May 28, 1988, p. 70.
5. Frank Press *et al, A High Technology Gap: Europe, America, and Japan* (New York: Council on Foreign Relations, 1987).
6. Press, *et al.*, op. cit.
7. For a broad comparative analysis of U.S. competitiveness, see George N. Hatsopoulos, Paul R. Krugman, Lawrence H. Summers, "U.S. Competitiveness: Beyond the Trade Deficit," *Science*, Vol. 241, July 15, 1988, pp. 299-316.
8. Press *et al.*, op. cit., p. 14.

9. Ramesh and Weiss, op. cit., p. 123.

10. For a summary of economic criteria, see National Academy of Sciences, *Appropriate Technologies for Developing Countries* (National Academy of Sciences, 1977), Chapters 1, 3, 4.

11. For a brief comparison of trends, see *The Economist*, November 17, 1984, p. 107.

12. See, for example, Robert Gilpin, "Technological Strategies and National Purpose," *Science*, Vol. 169, July 31, 1970, pp. 441-448.

13. For a comparative analysis of scale, scope, content, and impacts, see Leonard Lederman, "Science and Technology Policies and Priorities: A Comparative Analysis," *Science*, Vol. 237, September 4, 1987, pp. 236-238.

14. Press *et al.*, op. cit., p. 60.

15. For revealing case studies of the differences among states, see Toshio Shishido, "Japanese Industrial Development and Policies for Science and Technology," *Science*, Vol. 219, January 21, 1983, pp. 259-264; Manfred Popp, "German Energy Technology Prospects," *Science*, Vol. 218, December 20, 1982, pp. 1280-1885; "Technology the French Way," *The Economist*, November 17, 1984, pp. 94-95.

16. Press *et al.*, op. cit., is especially instructive in appreciation of this concern.

17. See Ramesh and Weiss, op. cit.

18. Press *et al.*, op. cit., p. 70.

19. See Ramesh and Weiss, op. cit.