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Innovation and Crisis in Asia

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INNOVATION AND CRISIS IN ASIA

This working paper frames and summarizes the “MIT Project on Innovation and Crisis in Asia,” conducted from 1999 through 2001. The Project was, most centrally, an investigation of crisis and choice, an enduring relationship in world politics and, especially, in economic change. Modern social science is filled with “shock adjustment” metaphors invoked to characterize the ways in which change occurs.¹ Much like our understanding of evolutionary biology, notions of “punctuated equilibrium” or of “paradigm shifts” presume that significant institutional and normative adjustments follow sudden major challenges to a previously stable system. War is the most common “punctuation.” We speak confidently of a post-WWII world that operated under different rules (as set by the superpower confrontation) and with different institutions (e.g., those of Bretton Woods) than the prewar one. New ideas, such as Keynesianism or Communism, can have the same effect.²

Similarly, technological innovations—in transportation, communication, or other elements of infrastructure—can also provide dramatic “punctuation” of a stable order.³ Entrepreneurs had different expectations of markets before the Industrial Revolution than later, before the diffusion of railways or of telephones than afterwards, or prior to the introduction of just-in-time production than they do today. Similarly, microelectronics and then the Internet each transformed the business models deployed for generating wealth and profit. In each case, new technology led to the redistribution of economic and political power. New products, like new world orders, can transform what we believe to be the “normal” social, political, and economic conditions within which we make choices.

Stephen Krasner captures the way in which social science focuses on the effects of the adjustment, effects that canalize choice and set in place new institutions that channel and constrain action in a new “normal” political economy. The resulting institutions in turn are dislodged only by shocks of equal or greater magnitude: “New structures originate during periods of crisis. They may be imposed through conquest or be implanted by a particular fragment of the existing social structure. But once institutions are in place they can assume a life of their own, extracting societal resources, socializing individuals, and even altering the basic nature of civil society itself.”⁴

The contributors to the “MIT Innovation and Crisis Project” tested these ideas against the Asian financial crisis of 1997-98, the most significant challenge to the ways in which innovation and production had been organized in the most dynamic corner of the global economy at the turn of the last century. While the crisis was financial, at least initially, the choices and outcomes on which our authors focus are technological ones. Their papers seek to understand and explain whether and to what extent the Asian financial crisis shifted the institutions of science, technology, and innovation in Asia and across the globe.

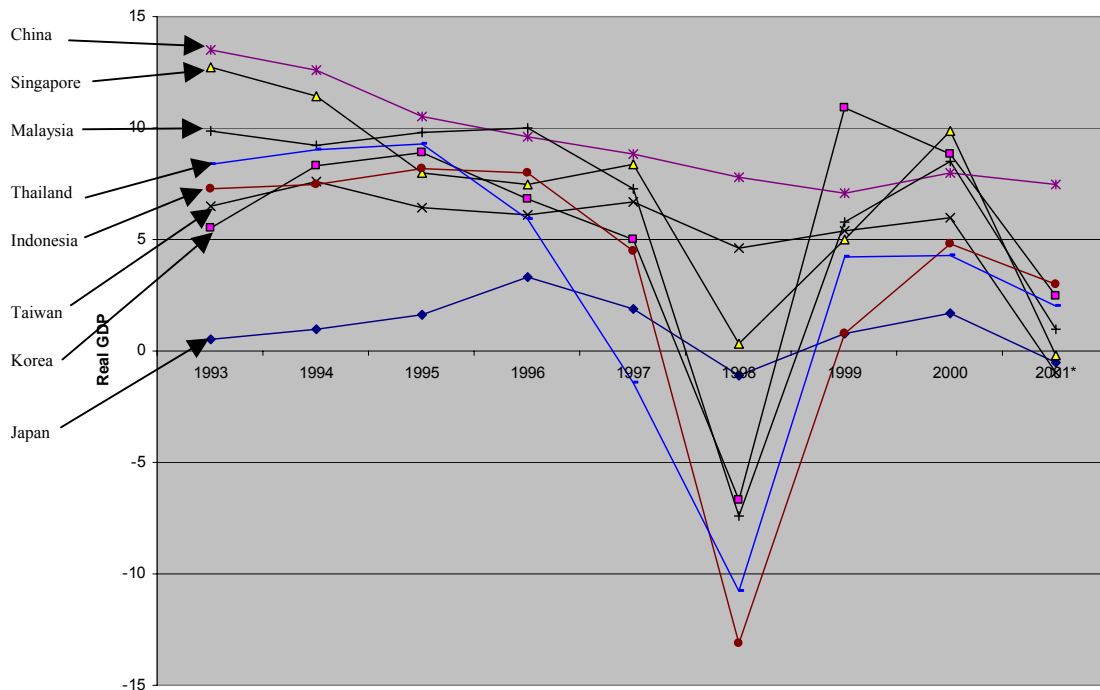
In mid-May 1997, a financial crisis expanded outward from Southeast Asia after a broad and deep attack by private investors on the *baht*, the Thai currency. The crisis spread

rapidly across the region. The five “crisis countries”—Thailand, Malaysia, Indonesia, the Philippines, and South Korea—all experienced similar symptoms, including massive capital outflows, collapse of the stock market, exhaustion of foreign reserves, and successive currency depreciations.

The central banks at first responded by intervening to defend currency values. They raised interest rates and, as one contemporary institutional account put it, “tightened capital and exchange controls, particularly on forward or derivative transactions and their financing. However, these responses failed to restore investor confidence, and further capital outflows, sharp depreciations of the exchange rate, and falls in the stock market took place.”⁵

The scale of this crisis was unprecedented.⁶ The five “crisis countries” sustained a net reversal of more than \$100 billion in private capital flows, approximately 11 percent of GDP, during the last half of 1997. Concurrently, the value of the currencies in these countries continued to fall sharply.⁷ The Asian nations listed in Figure 1 experienced declines in GDP from 1.1 to 13.1 percent in 1998. Within a year, the crisis had taken on global dimensions.

Figure 1. Percent Change in Real GDP of Selected Asian Countries



* Projected

Source: IMF *World Economic Outlook May 2001*, Statistical Appendix, Table 1.7, p. 32. IMF *World Economic Outlook*, Statistical Appendix, Tables 2 and 6, p. 166, p. 173.

The timing and depth of the crisis varied widely from country to country across the region. Thailand's economy contracted almost immediately following the onset of the financial crisis, even for the year 1997. Japan, Korea, Indonesia, Malaysia, and Thailand all lost ground the following year. Of the countries displayed in Figure 1, only China and Taiwan were relatively unaffected in terms of overall economic growth. Over the next two years, all of these countries, except Japan, experienced a significant rebound in part due to a powerful upsurge in the silicon cycle, driven by consumer demand for electronic equipment and corporate demand for telecommunications infrastructure.

The slowing of the U.S. and European economies that began in 2001, however, hampered the Asian recovery. Sales in the semiconductor industry—which is often considered a bellwether for the electronics-oriented economies of East Asia—were forecast to fall 26 percent to \$35 billion for the Japanese market, and 23 percent to \$39 billion for the Asia Pacific market in 2001. A generalized slump in the information technology industries, especially telecommunications, extended and broadened the nature of the Asian economic downturn. By mid-2001 Japan's trade surplus was half the level of its 1998 peak.⁸ The Asian “economic miracle” that had stimulated so much awe, admiration, and even dread, now invoked pity and apprehension in greater measure.

Of course, these concerns may well be premature or misplaced. It remains to be seen if the economies of East and Southeast Asia will heal and, if in doing so, they might once again provide alternative models for the organization of innovation and economic development. During the final decades of the last century, there was an intense debate about forms of capitalism in general and about the organization of national scientific and technological infrastructures in particular.⁹ National governments, with their governing ideologies and industrial policies, were seen by many as exerting a profound influence on the development of science and technology within their borders. Domestic scientific and technological capabilities, in turn, were seen as key to national economic success—and to national security—at the dawn of the new millennium.

This debate was only the latest version of one that has framed the choices of states and firms for centuries. Following Adam Smith in the late 18th Century, liberals have emphasized the self-regulating virtues of politics and markets. Governments would always distort the essentially benign workings of markets, and states should do no more than provide rules that safeguard private property. The government could properly protect private property and provide collective goods such as education or defense, but should otherwise stand clear of the more efficient marketplace. Where markets were most open and where trade was most unfettered by tariffs or by regulation, innovation would flourish and wealth would be generated.

Friedrich List was the most prominent among several influential “national economists” who expressed doubt about the self-regulating virtues of markets. List disagreed fundamentally with free trade liberals, whose views derived from Adam Smith and David Ricardo, over how to ensure the generation of national wealth. On his account, the productive power of manufactures was central to national security, and the provision of national security could not be left to competition among narrowly constituted private

interests. Some sectors needed protection before they could succeed. They could not be expected to produce the collective goods upon which national wealth and security depend unless they were nurtured to maturity. Free trade was fine, indeed desirable, but only after critical national industrial capabilities were assured. List argued that national advantage was not only bequeathed by history and by naturally occurring factor endowments; it could (indeed, it should) be created through temporary insulation from world markets if need be. List's view has resonated ever since in the industrial policies of late developing states.

Indeed, despite the dramatic increases in trade and cross-border investment associated with “globalization” in the 1980s and 1990s, some economies seemed to nurture more insular systems of innovation. They were more likely than others to apply science and technology policy to explicit national goals. The success of “developmental” programs, involving both direct and subtler state intervention, suggested that there were ways to deploy public policy to accelerate and deepen economic advancement for the benefit of a nation’s citizenry. On the other hand, more “liberal” economies seemed headed inexorably toward the same sorts of relatively more open scientific and technological institutions associated with the industrial states of Western Europe and North America.¹⁰ This was a high stakes debate. Getting capitalism and the institutions of investment and innovation “right” could mean millions of jobs, billions of dollars of profits, and realignment in the global balance of power.¹¹

But, as the participants in this project reveal, “getting it right” has meant different things to different actors. The industrial and industrializing economies of Asia that have received so much attention have never been monolithic. Nor do they seem likely to become so, theories of convergence to neo-liberal institutions and ideologies notwithstanding. China (since 1979) and several of the ASEAN states were relatively open to direct foreign investment and to dependence on the foreign technology that often accompanies such investment.¹² While not “liberal” in a neo-classical sense, they appeared willing to pay some of the costs in reduced autonomy that can result from foreign control over domestic assets.

Other states in the region, such as Japan and the Republic of Korea, made a different calculation. While they, too, were eager to acquire foreign technology, they chose to do so at a more distant arm’s length, eschewing the foreign influence that comes with direct foreign investment. Their rather more mercantile orientation invited intense pressures from foreign firms and governments for liberalization. Not opening their markets indiscriminately required that they bear a greater share of the costs of nurturing their more autonomous technology systems.

Whether relatively open or closed, each of the economies in East and Southeast Asia had grown enormously in the last quarter of the last century. And each faced a crisis that might force it to change.

Modeling Crisis and Choice

In general, there are four classes of factors that constrain and channel choice in the face of crisis: 1) the institutional configuration of states, 2) the ideological preferences of political actors, 3) the material capabilities of economic actors, and 4) the creativity of political and economic leaders. Here we introduce each set of factors in turn and match them briefly to the technology and manufacturing base of the national economies examined in this project.

Institutions

The elements of institutional configuration of a political economy—its regulatory structure, the organization of private interests, their relationship to the state, and the location of local firms in the value-added supply chain—may each be critical in determining its capacity to resist external shocks. For the purposes of this paper, however, the “innovation system” is the institutional configuration of greatest significance. The concept of national innovation systems was introduced in the mid-1980s by scholars who were dissatisfied with the neo-classical treatment of innovation as an exogenous variable. It has drawn largely from the field of evolutionary economics, stressing the endogenous nature of innovation in its own development. An innovation system is “the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies.”¹³

A *national* innovation system comprises firms, universities, nonprofit entities, and public agencies that produce or support the production of science and technology within national borders. There seem to have been enduring differences in the national innovation systems of the leading industrial states in North America, Europe, and Asia—differences in the style and focus of supporting policies, in the ways in which research and development (R&D) is funded, where it is conducted, and in the technical orientation of industrial research.¹⁴ On this view, innovation systems that span sectors in the same country have more in common with each other than they do with the same industrial sector in other countries. It follows that one wonders if firms ever really leave their nationality at the shores of their home economy. Are they really amoral utility maximizers, shorn of their nationality when they cross borders? Or are Japanese firms still Japanese, and U.S. firms still American, and German firms still European when they invest and operate in Singapore, Taiwan, or Guangdong? Would Chinese and South Korean business executives hold different views on this subject?

The host economies are also important in the *national* innovation system model. The national economies, in which multinationals invest, shape innovation within their borders through public policies and political ideology. On this view, their policies and interventions are likely to be consistent and have similar effects across sectors. Whether these policies conflict with, or respond to, the preferences of indigenous firms, political battles over R&D tax incentives, over subsidies, over technology transfer requirements, over capital controls, or even over educational reforms, will determine much of the character of innovation within national borders.

The alternative institutional perspective is *sectoral*. A sectoral innovation system comprises similar relationships and institutions, but they interact within a functionally delimited domain, which may be nationally, regionally, or globally distributed. On this view, firms in the same business, even if in different countries, have more in common with one another (and organize their R&D in the same ways) than do firms in different sectors in the same country. Companies, and the states that hope to nurture them, have to respond to similar sets of technological imperatives. Here, there is more coherence within types of production or processes than within types of states. Aerospace industries in Russia, Japan, and Indonesia—like computer industries in Korea, Taiwan, and India—have more in common with one another than do aerospace firms and computer firms in any one of these states.

Clearly there is a division of labor in the same industrial sector across states, sometimes referred to as the “regional” R&D and production systems model. In a separate working paper, Rick Doner and Bryan Ritchie argue, for example, that Singapore, Malaysia, and Thailand occupy quite different rungs in a regional hierarchy of countries that produce hard disk drives.¹⁵ Walter Hatch suggests that the Japanese dominate sectoral production systems by integrating them vertically across the region from headquarters in Tokyo or Osaka.¹⁶ As these contributors and others will demonstrate, institutional arrangements vary considerably across the region, and by sector. Each is interested in delineating these differences and in determining for our readers how they vary systematically.

Whether an innovation system is bounded by a national economy or by an industrial sector, it can be understood to comprise (or be animated by) distinctive political norms. But politics has rarely been incorporated into models of innovation systems. Economists who focus on national characteristics to explain innovation argue that certain country-specific institutional variables, such as market structure or legal systems, shape innovative processes across sectors within national borders. Those who focus on sectors see a functional logic specific to particular business segments or supply chain characteristics. Although some political scientists have addressed the politics of innovation systems, the strategic, normative, and material bases for R&D are usually left unexplored.¹⁷ All agree that technological innovation is one of the most important engines of economic growth. All agree that investment in learning and innovation repays firms and nations. But few examine the extent to which the dynamics of innovation are politicized, i.e., determined by power relations among and within states, and between states and firms, both domestic and foreign. We turn, therefore, to ideology as an alternative to institutions.

Ideology

Different institutions and different capabilities may be informed by different ideas, and the strength and resilience of these ideas may be tested in times of crisis. The ideological preferences of actors in the world of innovation and production systems and their

fundamental assumptions about the value of indigenous research and development can be characterized ideal-typically as the difference between technonationalism and technoglobalism.¹⁸

States that embrace “technonational” norms are less willing to open their markets to direct foreign investment out of a concern that more mature foreign-based firms and technologies would snuff out nascent domestic ones. Technonationalists are convinced that their domestic economies need protection not only from predatory foreign investors, but also from the foreign technology and competition that they would introduce. They believe that a domestic economy can only be mature and the nation secure if it exerts substantial control over the generation of knowledge and the standards by which design and manufacture are undertaken. Importantly, this perspective informs choices independent of public policy. That is, co-national firms that operate under technonational assumptions may be more comfortable with one another and more willing to cooperate than are firms that are—as in the neo-classical paradigm—rational utility maximizers, always poised to change production locations or suppliers to achieve further advantage. Firms that adhere to a technonational ideology are more likely to maintain supply chain relationships with co-nationals without regard to geographic location, striving to keep the higher value-added activities in their domestic economies.

Technonationalists discern a difference between proprietary and generic technical information that has national, rather than corporate, borders. Under technonational assumptions, when co-national firms share information in the development of new technology, they are collaborating. Such collaboration, which may involve joint research and technology sharing, is viewed as a public good that would not otherwise be provided. And as a public good, it transcends antitrust or competition policy considerations. In a technonational setting, firms may also enter into intense competition, which may be muted by the state in infant industries or used as a device to winnow out the weaker players to promote a limited number of world-class contenders. Thus, the technonationalist perspective emphasizes autonomy over dependence on foreign technology, the diffusion of knowledge among national users, and the nurturance of domestic scientific and technological capabilities. A “developmental state” may be the spider in the national web of technology development, but the connections and mutual trust among co-nationals do not require state sanction.¹⁹

Japan is the paradigmatic case of technonationalism.²⁰ For more than 150 years, Japanese firms and the Japanese governments embraced technology and the economy as matters of national security. State planners and technonationalists in the private sector fused industrial, technological, and security priorities. These were driven by military ambition in the first half of Japan’s industrialization, and by commercial needs in the second. Japanese planners carefully and consciously navigated between the Scylla of technological backwardness and the Charybdis of foreign dependence. As a result, each subsequent generation of Japanese products—whether aircraft, machine tools, eyeglasses, or chemicals—depended less than its predecessor on foreign technology. As one MITI official put it: “*ichigo yūnyū, nigo kokusanka*” (“the first time, we import, the second time, we do it ourselves”). This helps explain why as late as the early 1990s as much as

half of Japanese manufactured imports came from Japanese firms abroad, and why as much as 70 percent of the growth in Japanese imports between 1990 and 1997 came from “captive” (Japanese owned) firms.²¹ In Japanese practice, technology was often a quasi-public good developed and distributed through elaborate networks of producers and bureaucracies. As a consequence, Japan built an extensive network of “technology highways”—an infrastructure comprising at least as many lanes, but perhaps fewer roadblocks than in counterpart systems where antitrust and collusion were of greater concern.

In Japanese thinking, institutions such as research consortia and manufacturing alliances enable competitors to achieve common technical goals before they compete with each other in the market. Japanese firms therefore have cooperated in consortia at every level of the development cycle, including basic research, systems development, and even in device manufacturing. While the form and function of these consortia has varied—and while competition among the participating firms never disappears, and is often extremely vigorous—collaboration persists as a highly valued norm in Japan. Elsewhere it is denigrated as “collusive” or “anti-competitive.” Firms and the government vigilantly monitor the economy to mitigate the worst effects of market shifts and technological revolutions. They deploy a wide range of “TIPS” (technology and industrial policies) to *nurture* Japanese firms, including generous subsidies, tax breaks, loans, depreciation allowances, and R&D grants.²² Taken together, Japan provided a model of successful technonationalism, at least until the Japanese economic bubble burst in the early 1990s.

Technoglobalists, on the other hand, base their arguments on a more liberal and individualistic set of assumptions. They tend to reject collaboration as sub-optimal, and state regulators interpret collaboration as collusion. Such collaboration may distort economic growth rather than enhance it. From a technoglobal standpoint, while states should provide infrastructure to set the conditions for progress in basic science, it is by and large the individual firms that are responsible for technical advance and product innovation. States may intervene when public goods, such as R&D and technical education are insufficient, but they normally do so at the level of “basic” or “fundamental” scientific research, not at the level of “applied” product or process technology development. Since, on this account, firms make the greatest contributions when global barriers to the transfer and diffusion of technology are lowest, technoglobalists press policymakers to reduce the barriers to the diffusion of innovation worldwide.

Singapore and Hong Kong may be the classic technoglobalist states of Asia. Both economies embrace open, free trade principles that encourage unfettered capital mobility, accompanied by low tariffs, within a relatively *laissez faire* regulatory system. Historically, each has attracted significant direct foreign investment, and both have functioned as the regional headquarters for a number of the world’s leading multinational corporations. Perhaps as important, Singapore in particular, but also Hong Kong, has worked to create an environment conducive to high-technology manufacturing. These two “city states” have overtly courted foreign based companies as a means of acquiring and diffusing technology and technical learning as broadly as possible within their

respective populations. Singapore has been singularly successful, for example, in capturing the high-end of global disk drive production, although there are increasing signs that Singapore's technoglobal orientation may be more circumspect in the future.

Between these two ideal types, our empirical research indicates, lies an intermediate third option or range—what we call “technohybrids.” Some countries have embraced a limited form of technoglobalism in order to become vital players in multinational production networks. These hybrids self-consciously invite high-technology foreign direct investment as a means of technical learning in order to achieve explicit national goals and a higher standard of living for their citizens. In so doing they adopt strategic technology and industrial policies that both attract foreign-based multinationals and position domestic firms to capture some portion of added value in the production process. They invest substantial funds in national laboratories and infrastructure for technical education. In time, such states may spawn and privatize companies that reach state-of-the-art production in technically sophisticated industries.

Unlike technonational regimes that restrict or channel foreign technology investment, and unlike technoglobal ones that are largely indifferent to it, technohybrids may permit or even initially encourage a substantial degree of foreign control over domestic technological assets. As a developmental strategy, they may seek foreign assistance in the creation of a domestic technology infrastructure. Like technonational regimes, such states make determined efforts to attract and train scientists and engineers, often initially sending their best and brightest abroad, while upgrading indigenous universities to increase the supply of technical talent to local industry. In time their firms may acquire foreign subsidiaries to gain direct access to intellectual property and cutting-edge technologies. Unlike technonational systems, however, technohybrids open their markets to foreign direct investment in ways that generate mutual dependence between foreign-based multinationals and domestic producers.

Taiwan offers the paradigmatic example of the technohybrid regime—especially in the semiconductor industry, where local foundries mass-produce hundreds of different kinds of integrated circuits for foreign firms, using designs supplied by their customers. Increasingly, these customers are U.S. or European firms that do not have chip production facilities of their own. When demand is strong, foreign firms may have to wait on line, even as the Taiwanese foundries aggressively add capacity. When demand is weak, the foundries quietly supply local industries with excess production at reduced costs, or more recently, suffer the consequences of lower capacity utilization rates. China, too, has embraced elements of this approach. For more than two decades, portions of the economy as a whole, and the technology system in particular, have been decentralized and exposed to direct foreign associations. Centralized research and development and state-owned enterprises are gradually being displaced by links to foreign research laboratories and private entrepreneurs. The “not quite liberal” yet “not quite mercantile” technology systems of Taiwan and parts of China suggest alternatives to the dominant extant models.

Capabilities

Different ideas and different institutions do not map perfectly across different economic or political capabilities. Nor do they necessarily predict if states and firms will respond effectively in a crisis. By capabilities we refer to several structural features, including the size of the economy or in the case of China, for example, the projected size of its economy and markets. China's vast population and its dramatically expanding economy bestow capabilities that are unavailable to smaller states without regard to their institutional or ideological preferences. Unlike the ASEAN states, China can pursue a range of technology acquisition strategies and industrial policies, which are independent and may even appear contradictory or internally inconsistent.

In another example, the world's second largest economy, Japan has been able to maintain a higher standard of living and continue to restrict foreign direct investment into its manufacturing sector to levels far lower than other advanced industrial states. And it has done so even in the face of regional financial contagion that fell in the middle of a decade of Japanese economic stagnation. Such options are simply unavailable to the smaller economies in Asia, which must find means of inserting their capabilities into regional production networks that are usually controlled by foreign-based multinational corporations.

The foreign reserves available to central bankers also constitute a distinct capability and affect the range of available choices in the face of economic crisis. In 1998, when the full effect of the Asian financial contagion was felt, countries with over \$30 billion dollars in foreign exchange were—with the exception of Japan— all able to avoid recession. These included China, Taiwan, and Singapore with foreign reserves of \$142.8, \$84.0, and \$74.5 billion respectively in the spring of 1998. On the other side of the ledger, the economies of South Korea, Indonesia, Malaysia, and Thailand all contracted between 6.7 and 10.8 percent in 1998, and all had foreign reserves of between \$15.5 and \$30.3 billion. Countries with large foreign reserves were better able to defend their currencies from speculators and to stave off significant recession in the immediate aftermath of the 1997-98 financial crisis.²³

Finally, it is plausible to assume that in more differentiated economies, those that host a wider range of economic activities or that depend less on particular export markets or products, will be in a better position to weather crises that weaken or bring down more narrowly constituted ones. Small countries that have attracted major foreign direct investment may also be better positioned. The onset of the Asian economic crisis coincided with a decrease in demand for goods produced by the information technology industries, sometimes referred to as a downturn in the "silicon cycle." Economies like China's and Japan's that have significant levels of activity in a wide variety of industries tended to be better insulated than economies like South Korea's and Malaysia's, whose manufactures are more concentrated in electronics.

Leadership

Leadership is a final, additional factor that intervenes between crisis and change. Unlike institutions, ideologies, and capabilities reviewed above, leadership is a matter of agency. It is neither structural nor normative, and is accordingly more difficult to model. It is obvious that leaders matter.²⁴ How George W. Bush and Tony Blair responded to the terrorist attacks of September 2001 clearly will determine the destiny of a great many persons. Few will disagree that Martin Luther King transformed apartheid in America or that Mao and Gandhi inspired epochal change in China and India. Given how obvious this is, it is puzzling that so many intellectuals routinely subordinate the strategies and choices of individuals to forces that exist beyond their control. When asked directly, few will embrace the idea that there is no choice in history; similarly, no one will admit to holding the view that leaders do only what “great forces” dictate. Yet, in our collective retelling, choices are routinely limited by a mixed configuration of inherited resources, institutions, or ideas. The choices actors make are largely self-evident, if they are not always singular. Social science privileges constraint over choice.

To be sure, it is no less obvious that constraints matter. Not everything under the sun is possible. There is always a great deal beyond the control of even the most able strategist. Moreover, we can be certain that far more opportunities are lost than are seized in history. But if determined individuals can deliberately and systematically make their political space more capacious—if they can “stretch their constraints”—then analysts who privilege constraint risk missing how political actors mobilize creativity, prejudice, spite, passion, history, religion and philosophy to thwart adversaries and expectations. In the real world, some leaders do little more than bob like corks on a restless sea. But others, many others, do much more. Some revolutionaries invent futures using wholly new materials of their own design. Others tinker with materials at hand, first making a new past before constructing a future. And even those who do not construct elaborate strategies may select among equally plausible alternatives in the normal course of events. In short, constraints may be greater in the telling than in the acting, not least because the weight of great inertial forces in society and economy can be tipped into the balance for the leader’s scheme.

Leaders are political and economic actors with a greater range of potential assets at their disposal. They can “stretch” the constraints that geography, natural resources, old legacies, and international location provide. In the world of economy and technology, it can make an enormous difference that some individuals deploy these assets more adroitly and more purposefully than do others.

In the case of the Asian financial crisis of 1997-98, there was no more creative leader than Mahathir Mohammed of Malaysia. Although the initial manifestations of the crisis in Malaysia were similar to those elsewhere,²⁵ Malaysia met the crisis without succumbing to intervention by the International Monetary Fund. Instead, Prime Minister Mahathir took the reins, pointing to currency speculators as the true scoundrels in the unfolding drama. Wasting little time, Malaysia instituted capital controls in September 1998 to stem short-term portfolio flows and quell the off-shore *ringgit* market in Singapore. High-tech infrastructure projects were put on hold, reducing government

obligations by about \$10 billion; selective import duties were imposed; and a “buy Malaysia” campaign was set in motion.²⁶

A contemporary account in the *ASEAN Economic Bulletin* summarizes the flurry of unconventional activity nicely:

On December 5, the Deputy Prime Minister and Finance Minister, Anwar Ibrahim, unveiled a reform package. The key elements of the package included cutting government spending by 18 percent, postponing indefinitely all public sector investment projects which were still in the pipeline, stopping new overseas investments by Malaysian firms, freezing new share issues and company restructuring, and cutting salaries of government ministers by 10 percent. With these measures, the previous budget forecast of economic growth (7 percent) was lowered to 4-5 percent.²⁷

There was, however, a great deal of political turmoil when Mahathir, fearing Anwar’s enhanced influence at home and abroad, arrested his Finance Minister and consolidated his power. The central point of the Malaysian case is that no combination of institutions, ideologies, or capabilities is so strong as to force each state or economy into the same set of choices when faced by crisis.

China emerged from the crisis relatively unscathed, there is little evidence to suggest that its relative immunity from the Asian financial crisis was the result of any particular policy choice or leader. China benefited more from the backwardness of its own financial institutions than from the deft manipulation of policy by sagacious leaders. Four major state-owned banks dominated the Chinese financial system circa 1997. The main liabilities in the system were to Chinese depositors, and the main assets were loans to state-owned firms. Thus, while the Chinese banking system was insolvent, the enormous debt burden was denominated entirely in the *yuan*.

That said, however, leadership did matter critically after the Asian financial crisis, as Chinese policymakers came to understand the challenges and nature of economic reform, using the crisis as a spur to action.²⁸ Prior to 1997, very few Chinese leaders were willing to acknowledge that a large portfolio of non-performing loans actually constituted a problem. Although it was well known that state banks were dumping household deposits into negative-return investments, there was no discussion of how destructive that could be to long-term growth. That changed after 1997. Confronted with China’s financial problems, Chinese leaders undertook initiatives in bank commercialization and in the elimination of state-owned enterprises. Most radically, they changed course on their strategy for accession into the World Trade Organization.

For 13 years prior to 1999, the Chinese argued for accession to GATT/WTO on concessionary terms, terms that would essentially have permitted China to freeze in place a deeply distorted domestic market, including in the financial sector. Now, however, the Chinese leadership reversed itself and acceded to virtually all demands of the United States and other developed nations to transform the state bank/state monopoly situation

of pre-crisis days. Implementing these changes has not been smooth or easy, but the leaders' decision for institutional and ideological change since 1997 was breathtaking. Private entrepreneurs were welcomed into the Communist Party. The Chinese constitution was amended to recognize the role of private firms. The insolvency of the banking system was openly acknowledged, and steps were taken to shut down state-owned firms, despite a concomitant rise in unemployment.

Previewing Our Findings

As the diverse cases of Malaysia and China suggest, the 1997-98 Asian financial crisis had many manifestations and evoked a great many national responses. It was not one crisis, but many. Japan's was the earliest and the longest sustained. It began in 1990 with the bursting of its financial and real estate bubbles. Over the course of the next decade, the economy grew by less than half the rate it did during the previous decade. Dramatically slower growth was joined by a collapse in asset values. Over the course of the 1990s the Nikkei average fell from close to 40,000 points to just over 13,000 and land prices fell by more than 50 percent from their bubble-era high. Japan struggled through a series of political crises (seven different combinations of party coalitions produced eight prime ministers in the decade after the bubble burst) and economic transformations (the *keiretsu* recombined amid plans for "Big Bang" deregulation and record unemployment).²⁹ More than a decade after it all began, public debt and unemployment were both at record levels with no end in sight.

Indonesia sustained perhaps the greatest economic and political disruption. The Indonesian currency, the *rupiah*, lost nearly one third of its value within three months following the onset of the crisis. The International Monetary Fund, the World Bank, and the Asian Development bank intervened to provide \$18 billion collectively in financing commitments aimed at restoring investor confidence and bringing about an orderly economic adjustment.³⁰ But such assistance did not come without a political price tag. As one contemporary observer put it: "IMF supervision of Indonesian monetary and fiscal policy, and of general compliance with the IMF agreement is very, very strict... So short is the leash that national sovereignty can be said to have been impaired... The spectre of the national economy becoming an extension of markets of foreign multinational companies haunts sections of the domestic political community."³¹ Within a year, with the country enmeshed in a cycle of hyperinflation and currency depreciation, severe civil unrest led to the resignation of President Suharto of Indonesia. Fires burned in the capital, and marshal law was imposed to restore order.

The crisis brought the Indonesian innovation system to its knees. For nearly one-quarter century, the government of Indonesia had, for example, supported the aircraft industry as an area of strategic investment in high technology. The government established a scholarship program to send its best students abroad for technical training. It created national laboratories to assist in the effort, and in the middle 1970s, Indonesia entered into licensed production agreements with DASA of Germany (then MBB) and CASA of Spain to produce both helicopters and fixed wing aircraft.

Over the next two decades, Indonesia made remarkable progress in the research, design, and production of aircraft—consolidating nearly all activity in a single state-owned enterprise, the Indonesian Aerospace Company (IAe), then the Indonesian Aircraft Industry. But as a dramatic consequence of the Asian financial crisis, which for Indonesia was a full-blown economic and political disaster, all funding for aerospace technology development was terminated, and the country’s innovation system stagnated for the balance of the decade and beyond.³²

In the Republic of Korea, the won and foreign exchange reserves both also fell precipitously. But even though monetary policy was tightened briefly, it was relaxed due to fears that higher interest rates would adversely affect the highly leveraged Korean *Chaebol*. By the end of 1997, the won had slid by over 20 percent against the dollar and foreign reserves had fallen to \$6 billion from \$22.5 billion. The positive impact of interventions by the IMF and other international financial institutions appeared to be temporary and superficial at best. Leading candidates for the 1997 presidential election did not support the IMF program fully, and investor confidence was once again undermined.³³

The Bank of Thailand abandoned efforts to prop up the *baht* within just two months, and much of the economy came under IMF supervision. As elsewhere, however, market confidence eroded further, due in part to delays in “reforming” the financial sector. By May 1998, fiscal policy shifted to a more “accommodating” stance. Measures were adopted to shore up the banks and facilitate corporate restructuring.³⁴

As Doner and Richie describe in a separate paper in this series, the technology and industrial base of Thailand has remained bifurcated, with most high-technology products imported for assembly.³⁵ Local industry is still highly protected, working at the low-tech end, and is largely oriented toward the domestic economy. Because of the country’s weak engineering base, indigenous firms have been unable to absorb many technologies from abroad, and the country has been unable to develop a large pool of technical talent.

Of the seven countries analyzed in this project, China’s growth trajectory appears to have been least affected by the Asian crises. Chinese GDP has maintained healthy growth of 8.8, 7.8, 7.1, and 8.0 percent for the years 1997 through 2000 respectively. In another paper in this series, Barry Naughton and Adam Segal argue that while the crisis did cause some dislocation within China, it was not as great an economic factor as successive waves of domestic economic and political reform.³⁶ Chinese leaders act on the assumption that China will once again attain great power status. This perception influences their choices of economic and technology acquisition policies in ways that set China apart from other Asian states.

The Asian economic crisis offered an extraordinary opportunity to understand the relationship between technology and finance on the one hand, and between government policy and the global marketplace on the other. It raises the possibility that our models of technoglobalism and technonationalism are inaccurate, and provides a chance to

investigate and modify each. After all, if the Japanese were such technonationalists, why did they allow so many jobs to migrate off shore in the 1990s? Why do they now export more technology to the United States than they import?³⁷ And why did they move so vigorously to deregulate their financial system? We wonder if the financial crisis of 1997-98 generated new imperatives driven by political and economic instability. Did it clarify the ways in which Asian governments and companies think and behave regarding critical technology assets? It may be that if the Asian crises deepen, a liberal logic of “technoglobalism”—as predicted by many economists and analysts in the Washington foreign economic policy community—will prove irresistible. We wondered whether Japanese and Korean technological assets, for example, are more readily available for foreign acquisition than in the past.

On the other hand, in the face of widespread financial disintegration and new political uncertainties, technonational structures and norms may have been reinforced, reshaped, or in some cases, introduced. The costs of openness and the loss of control may drive some states to harden a mercantilist logic of retaining and building core national technical competencies. This may persist until the crisis in confidence ends and the next round of international competition comes into focus. This project was designed to sort out what we know about the behavior of Asian states and firms when financial and economic crises force reconsideration of national technoeconomic strategies.

Whether the Asian financial and economic crises of the late 1990s should be seen as agents of profound change or forces that bolstered extant state propensities, the response of Asian innovation systems to the crisis did affect macroeconomic and industrial policies. It has also affected the ways in which business is transacted throughout the region. The United States and European companies have gained greater access to some formerly resistant Asian economies, through direct investment, possibly even through technology acquisitions. This observation is elaborated by several of the contributors to this project, particularly with reference to apparent change in the Republic of Korea.

As Linsu Kim argues in another of the project’s working papers, the crisis created hardship for many Koreans in the short term, but it also introduced an opportunity for Korea to make fundamental changes in its technonationalist orientation.³⁸ Changes in industry and at the highest levels of government, he writes, will force Korea to accommodate to globalization, but he adds, it will be carried out in the Korean national interest. In a separate working paper, John Ravenhill agrees that the crisis in Korea catalyzed fundamental policy change.³⁹ He argues that while the crisis paved the way for greater foreign investment in the automobile sector, it was more than a financial crisis because it was systemic in nature. For Ravenhill, the origins of the crisis that struck the Korean automobile industry are a direct consequence of a technonationalist developmental strategy gone wrong. In his view, Korean automakers took on excessive debt, diversified beyond their core competencies, and sought market share in lieu of profits.

Two other contributors to this the MIT Project on Innovation and Crisis in Asia, D.H. Whittaker and Walter Hatch, address the extent to which Japanese technonationalism

may have unraveled in the long decade of the Japanese crisis, that began with the early 1990s with the “bursting of the bubble,” deepened with the onset of the more generalized Asian financial crisis in 1997-98, and continued into the next millennium. Whittaker emphasizes the changes in Japan: a restructuring of the financial sector, greater foreign participation in Japanese financial markets, and a weakening if not the demise of the corporate cross shareholding system.⁴⁰ Whittaker argues that the ongoing Japanese crisis differs from the broader Asian one. In his view, Japanese banks contributed to the more general financial crisis by making too many imprudent loans to firms in the affected countries.

Hatch offers an alternative view that Japan’s technonational regime is alive, if unhealthy, but only because it has been regionalized into Asia.⁴¹ Japanese corporations have consciously availed technological assets to different Asian countries, depending on their level of technological development. Even though it has been squeezed by advocates of global trade and investment, and there are pressures toward convergence, Japan’s technonational regime has remained remarkably resilient—and has done so to the likely detriment of Japan. The Japanese system of “relationalism,” he argues, has been extended in much of the rest of East Asia, prolonging the day of reckoning for Japanese companies. To a great extent, Japan’s technonational regime continues to be guided by “norms and institutions of cooperation.” The Asian financial crisis of 1997-98 provided a means for Japan to extend its production and financial networks more deeply into Asia, supporting Japanese transplants throughout the region. This is a technoeconomic system that is very unlike the neo-liberal regimes of Great Britain or the United States.

Asian states that have heretofore paid the costs of indigenous technology development may have become more open to foreign direct investment and licensing in areas beyond non-financial services. Those that had been willing to license technology only in the short term for political reasons may find new advantages in the sale of knowledge. Others may be forced to maintain their technological dependence for economic and political reasons. In some sectors national and regional investment in science and technology will be curtailed severely. In others, it may be expanded.

The changes that we can observe today, which many observers thought unlikely a few years back, could alter fundamentally the industrial policies of Asian governments, and the technology strategies of Asian, U.S., and European multinationals. The various Asian nations and firms struggling with deflated equity markets, volatile exchange rates, foreign debt, high unemployment, and political uncertainty responded to the financial crisis in different ways. Accordingly, questions regarding the nature, extent, and durability of the various innovation systems throughout Asia are empirical. They require careful mapping.

Organization of the MIT Project on Innovation and Crisis in Asia

The contributors to the project refined and examined the relationship of crisis and innovation in Asia in workshops and conferences held at MIT in 1999 and 2000. As we

learned on those occasions, discussions of innovation in Asia tended to move from one perspective to another, depending on the particular mix of countries and industries in question: focusing first on the politics of national innovation systems of particular countries; at other times, on specific industries such as automobiles in Korea or semiconductors in Taiwan; and finally on technology hierarchies in cross-national production systems such as hard disk drives in Singapore, Malaysia, and Thailand. These varying perspectives are reflected in the working papers of the project. Working papers 01.07 and 01.02 speak to the issues of continuity and change in Japanese innovation.⁴² Although the authors present very different understandings of the economic and political crises in Japan, they are in agreement that the jury is still out regarding fundamental change in the technonationalist culture of that country.

Taken together, working papers 01.01, 01.04, and 01.05 present different aspects of changes in the Korean state and economy, some of which began long before the Asian financial crisis and some that were generated by it.⁴³ Of the seven Asian countries treated in this project—China, Japan, Malaysia, Singapore, South Korea, Taiwan, and Thailand—South Korea stands out as the country that has experienced the most dramatic institutional change, both in terms of economic structure and government administration. Much of that change can be attributed to the economic and political crises that swept the region in 1997 and beyond, but as one chapter argues, the structural conditions underlying that change were put in place as fundamental building blocks in the early years of Korean industrialization. All agree that Korea has outgrown the technonational orientation that initially enabled it to achieve world class technology and innovation in a number of global industries.

Working paper 01.05 also focuses on Taiwan.⁴⁴ William Keller and Louis Pauly note that of all the countries buffeted by the Asian crises, Taiwan was the least affected at least until mid 2001 when that country slipped into recession. Indeed, there appear to have been no severe political or economic perturbations, from the onset of the financial crisis through the earthquake of September 1999 that literally bumped the island's major industries off line. In this and other ways, Taiwan presents a bit of a conundrum. Government and industry continue to impart a complementary blend of globalist and nationalist innovation strategies for nation building, even though in recent years, industry appears to be playing a more dominant role in this common project to build an electronics industry powerhouse. China would also appear to fit into the “technohybrid” category. But as the authors of another project working paper, Naughton and Segal explain, due to its sheer size and history as a great power, China has the option to deploy a variety of strategies to build its economic and technological infrastructure, and several innovation experiments may co-exist side by side.⁴⁵

In the final project working paper, Doner and Ritchie analyze the high-technology disk drive industry that spans Southeast Asia—specifically Singapore, Malaysia, and Thailand.⁴⁶ Here, the authors argue that a downturn in the industry, already in progress, was exacerbated by the financial contagion, beginning in the spring of 1997. All three nations participated differently in a hierarchical regional production system with Singapore at the top; and all three responded to the crisis differently, as suggested above.

But perhaps most interesting, the authors conclude that Singapore, which had previously been seen as a quintessential technoglobal state, the “regional headquarters” for many multinational corporations, responded to the crisis by introducing technonationalist steps to create new indigenous small and medium size companies.

As we “interview” the industry and country working papers produced by this project, we are struck by the extent to which Asian technology after the millennium is characterized both by change, as in the cases of South Korea and Singapore, and by overall continuity (with change at the margins), as typified by the cases of Japan and Taiwan. At the beginning of this paper we suggested several ways to characterize innovation and Asian states. In the context of an increasingly global Asia, however, we think that small states will continue to mix in degrees of technonationalism with the catechism of globalization, eventually creating as many hybrid combinations as there are industrializing and industrialized states.

This project, then, marks not so much the continuation of an old debate, as we first suggested, but more an Asia coming to terms with an increasingly global economy of the 21st Century. We envisage an Asian economic landscape in which small states will have to revise continuously their technology and industrial policies, creating political space and niche markets in which their companies can maneuver for advantage. Far from the demise of the state, such policies will be necessary to offset the scale and scope of foreign-based multinationals now in the process of consolidating dominant positions in global markets.

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⁶ Stephan Haggard, *The Political Economy of the Asian Financial Crisis*. Washington, DC: IIE, 2000, p. 1.

⁷ OECD, *Asia and the Global Crisis: The Industrial Dimension*, 1999, p. 9.

⁸ SIA Press Release, “Semiconductor Industry Association Forecasts Semiconductor Recovery for 2002-2004,” November 8, 2001.

⁹ Although the success of Japan in the 1980s stimulated considerable debate about the varieties of capitalism (see, for example, Chalmers Johnson’s landmark study of Japan as a “developmental state”: *MITI and the Japanese Miracle*. Stanford: Stanford University Press, 1982, research on the varieties of capitalism has long been a staple of comparative political economy. See Gershenkron, *Economic Backwardness in Historical Perspective*; and Andrew Shonfield, *Modern Capitalism: The Changing Balance of Public and Private Power*. New York: Oxford University Press, 1965. Michel Albert, *Capitalism Vs. Capitalism*. New York: Four Walls Eight Windows, 1993, is of more recent vintage. And most recently, Peter A. Hall and David W. Soskice, eds., *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage*. New York: Oxford University Press, 2001.

¹⁰ See the essays in Suzanne Berger and Ronald Dore, eds., *National Diversity and Global Capitalism*. Ithaca, NY: Cornell University Press, 1996. Accounts of the “developmental state” are Johnson, *MITI and the Japanese Miracle*; Meredith Woo-Cummings, ed., *The Developmental State*. Ithaca: Cornell University Press, 1999.

¹¹ See Sandholtz et al, eds., *The Highest Stakes*. New York: Oxford University Press, 1992, for a snapshot of these concerns during the pre-crisis years when the United States seemed in secular decline.

¹² ASEAN is the acronym for Association of South East Asian Nations. The member states are Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Miramar, Philippines, Singapore, Thailand, and Viet Nam.

¹³ Freeman, *Technology Policy and Economic Performance*.

¹⁴ Paul N. Doremus, William W. Keller, Louis W. Pauly, and Simon Reich, *The Myth of the Global Corporation*. Pinceton N.J.: Princeton University Press, 1998, p. 60.

¹⁵ Rick Doner and Bryan Ritchie, “Economic Crisis and Technological Trajectories: Hard Disk Drive Production in Southeast Asia.” Cambridge, MA: MIT Japan Program Working Paper 01.06 (June 2001).

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