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RESEARCH NOTE

The "Sixth Modernization"? China, Safety, and the Management of Risks

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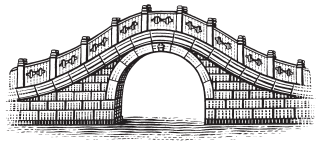

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EXECUTIVE SUMMARY

This article examines the reasons behind China's failure to develop mechanisms to manage environmental and technological risks resulting from rapid industrial development.

MAIN FINDINGS

- Recent revelations about the safety of Chinese products, deep-seated problems with industrial safety in China, and the increasingly serious degradation of China's environment point to the underdevelopment of institutions for managing environmental and technological risks.
- China's response to these problems through efforts to strengthen state regulatory agencies is a necessary, but not sufficient, step.
- The often-puzzling relationships between risk and modernization experienced by other countries suggest that, in addition to state regulatory action, China also needs decentralized mechanisms for identifying risks, for developing science-based health and safety standards, and for ensuring the accountability of public and private actors responsible for creating hazards.

POLICY IMPLICATIONS

This "sixth modernization"—the development of institutions and values that can manage environmental and technological risks—will require significant political change and will take time. The international community, which has acquired an increasingly serious stake in the ways risks are managed in China, can help move the process forward by redoubling efforts to promote the establishment of international best practices for safety, reliability, and environmental protection:

- Foreign governments can do their part by making cooperative risk management a more central objective of their China policies and by expanding programs with the Chinese government for the development of modern regulatory regimes of law, science, decisionmaking, and enforcement.
- Foreign companies can help by giving greater priority to the dissemination of the norms and values of modern safety culture among their Chinese partners.
- Governments and industry, along with NGOs, can help move the process forward by sponsoring programs to explore how market-based mechanisms and state action can work together in the Chinese context to produce effective risk management regimes.

Recent reports of widespread safety problems with Chinese manufactured goods, adulterated foods, and unsafe drugs, as well as China's unacceptably high rates of industrial accidents (especially in mining) and the alarming severity of China's environmental problems, all point to the failure of institutions for managing environmental and technological risks. These problems raise questions about the sources of such failures—culture, incomplete institutional reform, stage of economic development, failed democratization, and so on. They also bring increased international attention to the dark side of China's rapid economic growth and Beijing's quest for "modernization."

This article examines the reasons behind China's failure to develop mechanisms to manage environmental and technological risks resulting from rapid industrial development. China's response to these problems through efforts to strengthen state regulatory agencies is a necessary, but not sufficient, step. The often-puzzling relationships between risk and modernization experienced by other countries suggest that, in addition to state regulatory action, China also needs decentralized mechanisms for identifying risks, for developing science-based health and safety standards, and for ensuring the accountability of public and private actors responsible for creating hazards. This "sixth modernization"—the development of institutions and values that can manage environmental and technological risks—will require significant political change and will take time. The international community, which has acquired an increasingly serious stake in the ways risks are managed in China, can help move the process forward by redoubling efforts to promote the establishment of international best practices for safety, reliability, and environmental protection.

Chinese citizens, of course, have long been aware of the negative effects of the country's rapid growth and have had to live with the safety and environmental risks these effects engender. Seasoned foreign observers, likewise, have been cognizant of the problems for quite some time and are not entirely surprised by the outpouring of reports on these problems. Yet the recent cascade of horror stories has brought a new focus to the issues and prompted remedial action in Beijing and other capitals. These stories also point to more fundamental concerns over how risk and dangers are perceived and managed in one of the world's largest and fastest-growing economies.

Much of the discussion on these problems has focused on the need for improved government inspection and regulatory mechanisms, both in China and in the many countries receiving Chinese exports. Although such mechanisms certainly are needed, a sophisticated literature on risk and safety

in other countries, discussed further below, suggests that much more is involved. The seriousness of the problems for China's domestic population and for China's trading relationships in the global economy calls for a rethinking both of how questions of safety and risk are approached in contemporary Chinese society and of what might be done to make China safer and Chinese products both safer and more reliable.

This article is divided into three main sections:

- pp. 132–39 examine the often-contradictory relationships between risk and modernity with reference to the experiences of other countries
- pp. 139–43 review China's relatively successful experience in modernizing its system for promoting aviation safety and assess the relevance of that experience for improved risk management more generally
- pp. 143–46 discuss what a repertoire of risk management mechanisms might look like, assess the likelihood that these will appear in the near future, and consider how the international community might facilitate their appearance

THE PUZZLING RELATIONSHIP BETWEEN RISK AND MODERNITY

China's remarkable growth story has ideological foundations in a century-long quest to make China a wealthy and powerful country. This quest intensified in the late 1970s with the reaffirmation by China's leadership of the concept of the "four modernizations"—of industry, agriculture, national defense, and science and technology. In the subsequent decades, Beijing has brought about extensive reforms in industry, agriculture, national defense, and science and technology, and China has become more capable in these four areas. As a result, the economy has grown at sustained high rates, hundreds of millions of people have been lifted out of poverty, and vast social changes have taken place. Modernization, of a sort, has occurred. But missing, in the view of some, is a "fifth modernization" of democratic political change.

At the same time, environmental degradation has worsened, corruption has become widespread, and the population has been put at risk by safety practices that impose long-term costs both on individuals and on the society as a whole. The ubiquity of these problems demonstrates ever more clearly that the economic growth and social change brought by progress with the four modernizations have raced ahead of what might be called the sixth modernization—the development of institutions and values that can manage risks in highly developed, socially and technologically complex

societies. China's growing dilemmas in managing technological and environmental risks, therefore, call attention to the relationship between risk and modernization and the question of whether the sixth modernization can be successful without the fifth.

Modernity and Safety

Implicitly, the wealth and power expected from "modernization" have long been seen in China—and elsewhere—as risk-reducing, safety-enhancing developments that can lead a country out of endemic poverty and vulnerability to floods, famines, and epidemics, and away from the threat of life-style-destroying foreign incursions. These expectations, derived as they were from observing the histories of the modern West and Japan, are not without reason. Industrialization and the substitution of inanimate energy for animate energy; widespread literacy and educational opportunities; the development of modern science; an institutionalized capacity for technological innovation; and the development of risk management institutions make many of the benefits of modernity possible. These are the very attributes that provide the means for extending life expectancies, providing for healthy diets, controlling natural hazards, and providing for security and defense. On the face of it, the late Aaron Wildavsky appears to have been correct in quipping that "richer is safer": and, given that modernity has been the route to mass enrichment, Wildavsky's observation might be revised to read, "modern is safer."[1]

With some justification, this proposition continues to be an article of faith among China's leaders and, it would appear, among China's mass public. Yet defenders of modernity's contributions to the reduction of hazards in China and elsewhere would nevertheless acknowledge that the process of modernization engenders new risks and considerable social costs in the form of environmental pollution, callous industrial practices, and accidents. From their perspective, these problems that now characterize contemporary China are, however, reminiscent of problems faced by the earlier, successful modernizers: Western Europe, North America, and Japan all faced severe environmental and safety problems at earlier stages of industrialization. These modernizers gradually overcame these problems once more basic human needs were satisfied, science and technology advanced, additional wealth was available for cleaner technologies, and changing political conditions came to sustain new regulatory regimes (e.g., the development of science-based

[1] Aaron Wildavsky, *Searching for Safety* (New Brunswick: Transaction Press, 1988).

standards, codification of laws and policies, and the establishment of regulatory agencies). In this perspective, China would appear to be at a somewhat vulnerable stage, but with successful economic development should be able to outgrow these problems, much as the earlier modernizers have done.

The "Risk Transition"

This interpretation of the experience of the modernized countries, seemingly the dominant discourse of modernity, can be referred to as the "first rich, then green and safe" (R>G&S) hypothesis. At first glance this interpretation is appealing on empirical grounds. In terms of environmental remediation, for example, this understanding builds on the proposition that the relationship between economic development and environmental degradation follows the inverted-U-shaped environmental Kuznets curve, in which pollution rises dramatically in early phases of industrialization but then declines as average per capita incomes increase beyond a certain threshold. Similarly, industrial safety can also be seen as following an inverted-U pattern—worsening in the early phases of industrialization only to gradually improve as societies become wealthier. Following the R>G&S hypothesis, then, contemporary China might be seen as being in a difficult phase of modernization—a point of "risk transition" in which, according to Kirk Smith, traditional risks linger on and new risks of industrial society have also appeared, but where old approaches to risk management no longer work and new approaches have yet to appear.[2] Nevertheless, with R>G&S assumptions China would be expected to emerge from the transition in a safer and greener condition.

It is not clear what accounts for successful passage through the risk transition, but the following is one of several possible explanations—all of which are of relevance to contemporary China. First, the economic development that comes with modernization means that there are simply more resources available in society to address social costs. With greater wealth, consumption schedules shift from basic human needs to a desire for greater security and more environmental amenities. Because the latter are typically public goods supplied by government, public opinion and increased political participation in support of safety and the environment put pressure on political elites and lead political elites to conclude that the political costs of ignoring environmental and safety problems could escalate. Government therefore begins to address the social cost by increasing expenditures on the

2 Kirk R. Smith, "The Risk Transition," *International Environmental Affairs* 2, no. 3 (1990).

environment and by establishing new regulatory regimes to prevent pollution and promote industrial and product safety, forcing the internalization of costs that had been externalized. This government task can be lightened, in some circumstances, when economic growth also makes possible the acquisition of cleaner and more efficient technologies and leads to industrial restructuring away from heavy manufacturing and processing industries toward more high technology, information-intensive industries and services.

In addition to this state-led approach to internalization through regulation, other mechanisms enter in as part of a process of overall institutional modernization—for example, an increasing importance of liability law, new forms of insurance, and the raising of technical standards by professional communities—such that the modernizing society acquires a repertoire of institutional mechanisms for managing risks.[3] As thoughtful defenders of the modern project have noted, a capacity for institutional innovation to manage risk through both public and private action can be seen as a defining characteristic of modernization. Although there clearly are signs that R>G&S processes of change are at work in China, at the same time, the development of a full repertoire of modern risk management mechanisms remains attenuated, and it may be premature to conclude that China represents another case supporting the R>G&S hypothesis.

As international environmental consciousness has evolved in recent years, the suitability of the R>G&S approach has been questioned by environmentalists. One line of argument is based on the belief that the world's resources and, more importantly, nature's "sinks" and other natural environmental services for absorbing and processing pollutants cannot sustain R>G&S patterns of development that would follow the environmental trajectories of the industrialized "modern" countries, especially in large, populous countries like China and India. Furthermore, as techniques of accounting for the environmental and safety costs of development have improved, analysts are better able to quantify the actual costs of R>G&S approaches to development, which often turn out to be much higher than assumed, as current calculations of "green GDP" are suggesting. Thus, it would make more sense for China to invest in safety and environmental protection earlier in the development trajectory to avoid or reduce costs than to incur these costs and then pay for the remediation. China's attempt to transcend R>G&S—in policy statements by central leaders, at least—in favor

[3] See Howard C. Kunreuther, "A Conceptual Framework for Managing Low-Probability Events," in *Social Theories of Risk*, ed. Sheldon Krimsky and Dominic Golding (Westport: Praeger Publishers, 1992), 301–20.

of sustainability and Hu Jintao's "scientific development concept" is a product of both of these considerations.

Is it Safe to be Modern?

The positive relationship between modernity and safety underlying R>G&S is, of course, no longer accepted so readily in the "modern" world of the West, where intellectuals have been moved to problematize and offer radical critiques of modernity, and where ordinary citizens have seemingly grown uneasy over the risks of contemporary life under conditions of "high modernity."[4] Citizens of modern societies are no longer sure that their governments and their economic, scientific, and cultural institutions adequately inform them of the risks of modern technologies. Furthermore, these citizens question whether these institutions can be relied upon to protect them against such risks. Fears of out-of-control technologies and the loss of trust in the institutions of environmental and technological governance have often come to replace the optimism once associated with the modern project. Central to these concerns is the management of complexity.

Sociologist William R. Freudenburg has nicely argued that with the division of labor in industrial society people necessarily come to count on the designs, production, and operation of the innumerable, interdependently linked technological systems that surround them.[5] Yet here again is a reminder of the basic paradox in the risk-modernity relationship. The modern division of labor can be credited with the elimination of many traditional risks that typically led to early death; life expectancy improves with the division of labor. An increasing division of labor, however, brings with it the high social and technological interdependencies that are vulnerable to failures, and vulnerable interdependencies provide a rational basis for risk concerns, especially when such concerns increase the likelihood of "recreancy" among the individuals and institutions entrusted to manage risk. Freudenburg views recreancy as "the failure of institutional actors to carry out their responsibilities with the degree of vigor necessary to merit the societal trust they enjoy."[6] Recreancy is thus a failure of individuals or institutions to live up to expectations of "trust,

4 See, for instance, Ulrich Beck, *Risk Society: Towards a New Modernity* (London: Sage Publications, 1993); and Anthony Giddens, *Modernity and Self-Identity* (Stanford: Stanford University Press, 1991).

5 William R. Freudenburg, "Risk and Recreancy: Weber, the Division of Labor, and the Rationality of Risk Perceptions," *Social Forces* 71, no. 4 (1993): 909–32.

6 Freudenburg, "Risk and Recreancy," 909.

agency, responsibility, or fiduciary…obligations."[7] Although used to refer both to situations where technical competence is not maintained and to those where fiduciary trust is violated, the concept of recreancy can be extended to failures that are an inevitable consequence of expanded interdependency.

This linking of recreancy to complexity, at first glance, seems somewhat misplaced in discussions of contemporary China, where the widespread failure to meet expectations of "trust, agency, responsibility, or fiduciary …obligations" is typically attributed to corruption and a moral vacuum in society rather than to the division of labor. In addition, evidence of recreancy in premodern China—for instance in the management of schemes to control flooding, traditionally one of China's principal risks—suggests that the relationship between risk and recreancy is not simply a matter of modernization.[8] What makes the Freudenburg thesis intriguing, however, is that the complexities of traditional water management, like the complexities engendered by the modern division of labor, often put those with fiduciary responsibilities in positions where the complexity of the tasks before them exceeds the institutional resources available to them. Conditions are thus created where corrupt practices and other moral failings can become well established, as public and private sector risk managers face problems beyond their control. Thus, institutional design intended to match resources with possibilities for harm must become an important task for modern societies. Whether this task can be accomplished in the face of modern complexity is a question that has led to lively debates in many countries, especially regarding the reliability of organizational arrangements for risk management. The terms of these debates are especially germane to the analysis of risk and safety issues in contemporary China.

Reliable Organizations?

For some, notably the defenders of the theory of the high reliability organization (HRO), modern technologies are indeed very demanding. Nevertheless, safety strategies can be devised that will reduce risks to acceptable levels; in John von Neumann's words, "reliable systems" can be made "from unreliable parts."[9] As parsed by political scientist Scott Sagan

7 Freudenburg, "Risk and Recreancy," 909.

8 Randall Dodgen, "Hydraulic Evolution and Dynastic Decline: The Yellow River Conservancy, 1796–1855," *Late Imperial China* 12, no. 2 (December 1991).

9 Cited in Scott Sagan, *The Limits of Safety: Organizations, Accidents, and Nuclear Weapons* (Princeton: Princeton University Press, 1993), 19.

and others, the debate over reliability turns largely on four issues: (1) high levels of commitment to safety by political elites and organizational leaders, (2) the backing of that commitment with adequate resources to permit the development of organizational redundancy, (3) the building of a "culture of safety" within organizations, in which safety and reliability are dominant values, and (4) the institutionalization of organizational learning, in which errors are reported and discussed in an atmosphere more educational than punitive and where great stress is placed on the importance of maintaining a climate of openness and candor in the organization for reporting, investigating, and analyzing mistakes when they do occur.

On the other side of the debate are those who argue that complexity will defeat even the best safety strategies, that the untoward is to be expected, or, as Charles Perrow would put it, that accidents are "normal."[10] Following the work of James March and Johan Olsen, this side sees organizations as "organized anarchies," or "garbage cans," in which goals are often inconsistent or incoherent, where there is a great deal of ignorance in parts of the organization regarding what other parts are doing, and where conscientious and dedicated participation in the life of the organization is likely to be the exception rather than the rule.

Thus, though normal-accident theorists would grant that the setting of clear safety and reliability goals, as well as the allocation of resources to safety, can make a positive difference, these theorists are nevertheless skeptical that this high-level commitment can endure. The goals of leaders and of organizations are multiple—encompassing both safety and production—and, more often than not, these goals are in conflict. In addition, it may not be reasonable to assume that the safety-first objectives of political elites will accord with those of organizational leaders or that elite values will accord with those of the rank and file. The genuine commitment of political and organizational elites to safety is doubtful, especially when these individuals are not personally at risk.

Similarly, redundancy carries risks as well as benefits for the normal-accident theorist. Redundant systems can contribute to interactive complexity, thus making human understanding of untoward events more difficult and more opaque; when a failure occurs it may go unnoticed and unrepaired because the redundant system functioned as intended and thus inhibited learning. Learning is also impeded by the inevitable distortions in the information on incidents flowing through the organization and because

[10] Charles Perrow, *Normal Accidents: Living with High-Risk Technologies* (New York: Basic Books, 1984).

complex motives govern the uses of information. The causes of accidents and mistakes are often difficult to pin down, and, when the causes are ambiguous, biases, preconceptions, and personal interpretations will be introduced and will distort the lesson to be learned. When accidents occur, pressures develop to assign blame and responsibility, and these pressures may be considerably more powerful than those pertaining to organizational learning.[11] In addition, the organization often embraces the norm of secrecy both in its internal operations and, more important, in its external relations. In short, for the normal-accident theorist, real organizations are characterized by biases, false reporting, secrecy, and blame routines that make the safety-through-learning program of the HRO theorist implausible.

According to the arguments of the HRO theorists, it is possible to keep the risks of complex industrial and technological systems within tolerable levels and in the process enjoy the considerable benefits that the technology affords. For the normal-accident theorist, on the other hand, properties inherent in many technologies and industrial systems make serious accidents inevitable, and there is no good reason to trust the risk-reducing and safety-promoting repertoires recommended by the HRO theorists. This article is not the place to try to resolve the debate between HRO theorists and normal-accident theorists. The existence of the debate, however, points both to the deep ambivalence within modern societies over environmental and technological risks and to the challenges of building institutions for effective governance of complex technological systems. The problems of governance are also central as China struggles with the "sixth modernization."

A SAFER CHINA?

A Lesson from Aviation?

While most observers would conclude that the realities of contemporary China accord more with normal-accident assumptions and that the conditions needed for safety and reliability (as specified by the HRO theorists) are all in short supply, evidence in support of HRO claims is not entirely absent. In the late 1980s and throughout the 1990s, China began to experience a rapid growth in civil aviation. With that expansion came a rash of accidents that made China's airline safety record one of the world's worst. The expansion of

[11] A phenomenon certainly not unknown in premodern China or in contemporary China, which saw fit to execute Zheng Xiaoyu, commissioner of the state food and drug administration, in the wake of recent scandals.

service and the increase in accidents occurred at a time when the number of foreign traders and investors traveling in China was also increasing rapidly. Thus, it was virtually impossible for China to mask the country's dismal safety record from an international community whose markets, capital, management, and technology were considered essential for China's development. Since the mid-1990s, in keeping with many of the prescriptions of the HRO theorists, China's airline safety record has improved notably.[12] It might be reasonable to ask, therefore, if able to dramatically improve its airline safety record, whether China could not improve its industrial safety and environmental protection record as well.

China's problems with airline safety can be traced to a number of factors. To begin with, the industry expanded very rapidly, and with the expansion came a variety of new owners and operators, many of whom had virtually no aviation-management experience. The rapid expansion created a surging demand for flight crews, which led to the employment of a number of poorly trained pilots. Similarly, the demand for professional maintenance personnel also exceeded supply, as did the number of maintenance facilities and available managerial infrastructure. The age and quality of aircraft were uneven, although China's heavy spending on modern aircraft led to a rapid technical upgrading of the fleet. (The improvement of capital stock by itself brought about an improvement in safety.) China's air-traffic control system was anachronistic, and the national regulatory structure for civilian aviation safety was still based on a low-volume, state-planned aviation model that had become obsolete.

The challenge of improving China's aviation safety record was thus a systemic one. Among other things, the task involved installing new leaders, reforming the national regulatory system based on international aviation safety standards, improving air traffic control, building modern maintenance systems, and implementing major improvements in pilot training. China invested substantial resources in this systemic transformation and was assisted in a variety of ways by foreign government bodies, especially the U.S. Federal Aviation Administration, and by foreign corporations. Boeing, in particular, invested heavily in Chinese airline safety in the belief that robust growth of demand for Boeing aircraft would depend upon the resolution of China's safety problems. Underlying the experience was the development of a system of responsibility and accountability that would ensure that norms of safety and

12 Andy Pasztor, "How China Turned Around a Dismal Air-Safety Record," *Wall Street Journal*, October 10, 2007, 1.

reliability were not subject to haphazard observation, but instead were built into the operation of the system. Although there was resistance from airlines (the "producers") to the new regulatory environment, the reform process was aided by international pressures; Chinese airlines wanted to expand their international markets but could do so only by conforming to new regulations based on international standards.[13]

Although different types of risks have different architectures, the transformation of China's airline safety record nevertheless warrants attention in light of current reports regarding China's industrial and product safety problems and deteriorating environmental conditions. The airline safety case seems to support one of the main tenets of the HRO argument, namely, that reliable systems can be built from unreliable parts. China's dismal safety record in the late 1980s and early 1990s was intolerable to China's political elites; the record threatened not only China's international reputation and prospects for the open-door policy but also possible economic gains. China's performance on safety issues thus attracted and maintained high-level political and managerial attention. This attention, in turn, led to increased investments and reforms in the system, which permitted the introduction of redundancy; the building of a culture of safety and reliability within the industry; and the development of practices that emphasized organizational learning.

Elite Attention: The Scarcest Resource

The surge of recent reports on China's safety and environmental dilemmas is likewise now damaging China's international reputation and threatens to impose economic costs in ways that are somewhat reminiscent of the airline safety case. And, as in the airline safety case, these reports are sure to attract—and, indeed, have already attracted—attention from elites, leading to attempts to establish accountability. Although he was not executed, the director of the General Administration of Civil Aviation of China (CAAC) was nevertheless held responsible for the safety record and was removed from his position.

The similarities may end there. Although the amelioration of the airline safety problem involved considerable social complexity and required action on many fronts, the complexity of that problem pales in comparison with the issues of industrial safety and environmental protection. Such complexity inevitably will exhaust the supply of elite attention in ways that the demand for such attention in the airline safety case never could. For this reason, it may be

[13] Elizabeth Keck, "Setting Aviation Standards in China," *China Business Review*, March–April 2000.

a mistake to believe that the reform of government regulatory agencies—the focus of recent action by Chinese leaders—can, by itself, be both a necessary and a sufficient condition for attacking the problems.

Unlike the airline safety case, where state regulatory responsibility was concentrated, China faces two obstacles to regulatory reform in the areas of product and industrial safety and environmental protection. The first problem is the enormous diversity of industrial organizations in need of regulation. The second is the absence of alternative risk management mechanisms other than regulation. Chinese industry varies by type and technology, by market orientation, and by ownership and management. Enterprises range from modern plants employing the latest technology to primitive processing operations; some are owned by the central state, others are owned by local governments, and still others are collectively and privately owned and managed. As recent problems in the food and mining industries indicate, these sectors are characterized both by relatively large and modern firms as well as by thousands of small and more primitive operations, which nevertheless provide employment and generate revenues for local governments. Responsibility for regulation is often fragmented with the result that no one agency in the central government has control over the industries being regulated. Effective coordination among central government agencies, and between the central government and local governments, has long been recognized as a key problem of governance in a rapidly changing China.[14]

Despite the daunting problems of creating effective governmental regulatory bodies, there remain stubborn beliefs in China that the routes to effective risk management lie primarily within the state. Public opinion, to the extent understood by outsiders, had until recently consistently reflected this orientation. In addition, public policy in China has long been characterized by a tradition of state attestation as to the quality and reliability of products, even when the capability for reliable attestation may have been beyond the state. Moving beyond a tradition of state attestation to the building of a modern, science-based regulatory regime that is also sensitive to market forces is clearly a necessary step for the establishment of a modern risk management system, and China's efforts in this direction are to be applauded. Yet while increasing regulatory capability may be necessary for building a modern risk management system, this measure is certainly not sufficient; China's size and

[14] Waikeung Tam and Dali Yang, "Food Safety and the Development of Regulatory Institutions in China," *Asian Perspective* 29, no. 4 (2005): 5–36; and Tim Wright, "The Political Economy of Coal Mine Disasters in China: 'Your Rice Bowl or Your Life,'" *China Quarterly* 176 (Summer 2004): 27–44.

increasing social and technological complexity will always combine to defeat regulatory capability.

TOWARD A REPERTOIRE OF RISK MANAGEMENT MECHANISMS

To successfully modernize, China needs multiple mechanisms of risk management and governance that address the incentives and disincentives operating on individual economic decisionmakers, mechanisms that tap into market dynamics, professional standard-setting, and principles of social ethics. It is in this context that the idea of a full repertoire of risk management approaches, drawn from comparative experience, becomes important. The ability to introduce such diverse approaches will become an important measure of the quality of the society China is likely to have in the 21st century. In all cases, a modern risk management system will involve new thinking about the nature of public responsibility and accountability in ways that will pose major challenges to both state and society. The following considers some of these challenges.

The first is to provide for reliable societal "searchlights." Although periodic domestic and foreign media reports can call attention to safety and environmental abuses, China needs institutions that, on a regular and sustained basis, can shed light on the problems of recreancy in economic and regulatory affairs and make these problems transparent. The incentives for such institutions must be structured to reward those who are successful in providing this "searchlight" function, and not to sanction them, as is now often the case. In most modern societies, a free and independent press helps perform this function, as do activist civil organizations that have autonomy and the resources to identify, analyze, and publicize safety and environmental abuses. Chinese leaders, though beginning to appreciate the importance of transparency in China's risk management strategies, nevertheless hold tightly to the principles of state information control and limits on civil organizations as default values.

A second challenge is the specification of safety and environmental standards based on the specialized knowledge of technical experts. Standards can be—and are—contested in regulatory policy, and sound risk management is not based solely on expert standard-setting; yet modern regulatory policy inescapably involves the application of science to risk management decisions. There is much work to be done within China's developing regulatory agencies

to build strong scientific competence.[15] But, perhaps more important, there is also a need for greater autonomy in professional organizations rendering science-based technical judgments about standards. Until domestic competence can be established, China will have to rely on international standards and reconcile the technical justification for doing so with the emotional pull associated with the belief that a strong, rising China should be creating its own standards.

Third, new mechanisms of accountability must be introduced. Although much attention in recent press reports has been given to the need for the development of government regulatory mechanisms by which societal action is held accountable by the state, it is important to recall that accountability can also be achieved through other mechanisms. The rule of law, of course, becomes an especially important tool in decentralized risk management, especially when tort law becomes well established and can impose meaningful sanctions on abusers of safety and environmental norms. When credible and enforced, worker compensation laws, likewise, play an important role in risk management. Worker compensation issues, in turn, point to the important role that insurance plays in risk management, and, although China's insurance industry has grown rapidly in recent years, its role in actively promoting safety remains underdeveloped. Capital markets can similarly become an important tool for introducing accountability into risk management once producers begin making the association between responsible practices and access to finance.

China's technological and environmental risks are intimately tied to recreancy on the part of both state and societal actors, and solutions to those problems will require the introduction of mechanisms for making recreant behavior more transparent and for holding to account those engaged in such activity. Considering the issues of transparency, standards, and accountability, it is clear that current Chinese society, under the unchallenged control of the Communist Party, will have trouble introducing mechanisms of this sort. Without such mechanisms, however, China's quest for modernization will be elusive: A large, rapidly growing, technologically sophisticated economy and an increasingly competent R&D system alone do not make for a modern society.

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15 The recent announcement that the Ministry of Public Health and the State Environmental Protection Administration have launched a joint action plan to study the health effects of environmental pollution is a step in the right direction. See Taige Li, "China Moves to Tackle Pollution Effects on Health," *SciDev.Net*, November 26, 2007 ~ http://www.scidev.net/News/index.cfm?fuseaction=readNews&itemid=4088&language=1.

The Sixth Modernization without the Fifth?

The mechanisms discussed above require a society made up of social units with the autonomy and motivation to find decentralized mechanisms to govern the complex systems that economic and technological development generate. In most modern countries, the development and institutionalization of these mechanisms occur within a democratic constitutional framework that makes possible decentralized risk management innovations while providing mechanisms for holding the state itself accountable. At the same time, modern democracies have certainly not solved all of their own problems of risk management, and it is by no means clear that an unspecified democratization in China can be expected to improve the problems of industrial safety and severe environmental degradation. China can, perhaps, find an alternative approach to the "sixth modernization," but it seems certain that doing so will nevertheless require rather extensive political change as well as changes in social attitudes. The sixth modernization, therefore, can be expected to be a protracted affair.

If China cannot make rapid progress on the "sixth modernization," industrial-safety and environmental-risk problems will afflict Chinese society for some time. These problems, however, do not stop at China's borders; the negative spillover from China's industrialization has become global, as regularly reported by international media. The international community, therefore, also faces a long-term challenge of managing safety and environmental risks originating in China. How the international community responds may affect the pace of the sixth modernization in China.

Foreign companies, of course, are among those affected. In some cases, foreign companies faced with unsafe or defective products may simply exercise their exit option and discontinue relationships with Chinese partners. In other cases, foreign companies—as they have already begun to do—can strengthen their own private-sector inspection regimes to ensure the quality, safety, and reliability of products coming from China. Corporations that remain engaged in China can expand their influence based on their self-interest (and again, some have done this). In this way, these corporations can become important agents for disseminating the norms and values of modern safety culture and for diffusing knowledge and techniques concerning the decentralized mechanisms of risk management.

As in the case of aviation safety, national governments will also wish to increase their regulatory assessment of Chinese-made products and the movement of these products across national borders. On the other hand, national governments and the European Union could also expand cooperative

programs with the Chinese government for the development of modern regulatory regimes of law, science, decisionmaking, and enforcement, as some governments have begun to do. Billions of people inside and outside of China have become stakeholders in China's "sixth modernization." It is in the interest of these stakeholders that these efforts be redoubled and made a central theme of national and regional China policies. ◈