
Preface

The historic rise of the People's Republic of China, driven by an economic transformation that has proceeded almost without pause over the last three decades, is hardly news in 2007. As a result of this rise, and because of its size, it is commonplace now to regard China as a newly arrived global power. Domestically, China's recent trajectory is believed to have lifted hundreds of millions of its citizens from poverty, a transformation of unprecedented scale and pace in the history of nations. While this growth in part reflects an underperforming economy when reforms began, and has brought with it a growing imbalance in the distribution of wealth, in aggregate human terms China's economic progress has been incontrovertibly positive.

It has not had many positive impacts, however, on the natural environment, both within China and across the globe. Fossil energy sources, especially coal, have fueled the economic transformation. As in all nations, burning fossil fuels causes environmental externalities, the term in economics for the costs of individual activities that are inflicted on society as a whole. Among such externalities are the damages of air pollution, foremost its impacts on human health. China has made laudable progress on some fronts of pollution control, for example, forcing the substitution of gas for coal in central cities to reduce large particulate loads in urban air (and limiting, at the same time, carbon dioxide emissions). Addressing many other forms of pollution and their damages, however, is proving more vexing.

Clearing the Air: The Health and Economic Damages of Air Pollution in China presents a new modeling framework for integrating the study of economic growth, energy utilization, and environmental quality in China. Our initial effort in this area, published in 1998, was confined to a projection of Chinese economic growth and carbon emissions, using an aggregate growth model without industry detail. I completed this project in collaboration with Dwight Perkins of the Department of Economics at Harvard and Mun Ho of the Kennedy School of Government. Ho and I then developed a multi-sector model of Chinese economic growth in collaboration

with Richard Garbaccio, now of the U.S. Environmental Protection Agency. This model gave special attention to the dual plan-and-market features of the Chinese economy in the 1990s. We developed a version of this model with perfect foresight dynamics in collaboration with Karen Fisher-Vanden, now of Dartmouth College. In constructing these progressively more elaborate models we obtained the invaluable assistance of Li Shantong and Zhai Fan of the Development Research Center of the State Council of China.¹

Our new economy-energy-environment model of China incorporates population projections including the changing demographic structure, projections of productivity growth, enhancements of labor quality, and changes in household spending and savings behavior. We have analyzed changes in Chinese energy use at the industry level, using data from the 1987 and 1992 input-output tables, and this information is incorporated into projections of energy use per unit of industry output in the model. The initial version of the model incorporated a sub-model of local health impacts of sulfur dioxide (SO₂) and total suspended particulate (TSP) emissions, using information generously provided by Gordon Hughes and Kseniya Lvovsky of the World Bank. This version was first used to examine the reduction in local health damages due to a policy to reduce carbon emissions. Our subsequent analysis focused on the effects of “green tax” policies, designed to reduce local air pollution damages, on economic growth, on reductions in mortality and morbidity, and on carbon emissions.

The model described in the book is the culmination of the improvements to this economic-energy-environment model. We have developed a new environmental sub-model that incorporates industry-specific contributions to the TSP and SO₂ concentrations. We have also incorporated the latest economic data for China, including the 1997 input-output table. We are pleased to acknowledge the contributions of Cao Jing, who provided outstanding research assistance to us in completing the new version of the model.

The core of the environmental submodel, initiated in collaboration with Jon Levy of the Harvard School of Public Health, is the assessment of “intake fractions”—a methodological approach to estimating human exposures to pollution in data-constrained contexts such as China’s. Intake fractions are derived by modeling pollutant dispersion and human exposures from a sample of real sources. This research was conducted partly in collaboration with Hao Jiming and his colleagues Wang Shuxiao, Liu Bingjiang, Lu Yongqi, and Li Ji from the Department of Environmental Sciences and Engineering of Tsinghua University, Beijing, mainly in residence at Harvard’s Division of Engineering and Applied Sciences. Another part of this re-

search was conducted by Zhou Ying, Jon Levy, James Hammitt, and John Evans of the Harvard School of Public Health. Zhou and Hammitt contributed additional research, on the economic value that Chinese citizens place on health, to the environmental submodel.

The ambitiously collaborative nature of the study exemplifies the objectives of the Harvard University Center for Environment (HUCE). This Center grew out of a faculty committee established in 1993 by then-President Neil Rudenstine. The committee's chief mandate was to foster collaboration in environmental research and education across disciplines, and across the ten schools of the university. Under the chairmanship of atmospheric scientist Michael McElroy, the committee evolved into an intellectual and physical center supporting a wide scope of initiatives, bringing students, researchers, and faculty together from across the university. Today the HUCE, under Daniel Schrag, continues to manifest Harvard's vision of how a comprehensive university can best cultivate research and education in a topical area as consummately interdisciplinary as humankind's relationship to the natural environment. Rather than create a self-contained department of environmental studies, the HUCE is designed to draw on the strengths of the entirety of Harvard University, and to evolve as its many initiatives and the interests of participants grow and change.

The China Project has been one of the largest and most sustained single research initiatives of the HUCE, now also supported by Harvard's Division of Engineering and Applied Sciences. Established by McElroy and a team including Xu Xiping of the Harvard School of Public Health, Chris Nielsen and Peter Rogers of the Division of Engineering and Applied Sciences, William Alford and the late Abram Chayes of Harvard Law School, Dwight Perkins and myself of the Department of Economics, Mun Ho of the Kennedy School of Government, and others, the China Project's focus has been the challenge of reconciling China's economic development with protection of the atmospheric environment, and in particular integrating the Chinese domestic priority of air pollution control with the global objective of limiting emissions of greenhouse gases. This topic requires a challenging confluence of knowledge and expertise in economics, law, policy, and natural, applied, and health sciences, among others. It is also a topic that draws together two longstanding academic communities at Harvard: those who study environment, and those who study China.

Crucially, the China Project from the outset has embraced a second collaborative mandate: a full Harvard–China partnership in research with contributions from universities and institutes of the People's Republic of China. In early stages these collaborations were facilitated by designees of Song Jian, State Councilor and

Chairman of the then-State Science and Technology Commission. As the program evolved, the governmental associations also changed, and the Project has consulted over time with senior leaders that have included then-Vice Premier (and now Premier) Wen Jiabao, then-Minister Xie Zhenhua of the State Environmental Protection Agency (SEPA), and others. Qu Geping, the founding Administrator of SEPA and now often called the “father” of environmental protection in China, has long served as a key supporter and senior advisor to the HUCE China Project.

It is important to emphasize that the primary aim of the China Project is to advance independent inquiry, crossing disciplines and nations, and to contribute to basic knowledge judged by traditional standards of peer review and scholarly publication. Independent scholars define their own questions, rather than answer those posed by policy makers. The Project does not provide policy advice nor serve as an advocacy group. It has also sponsored research motivated by competing perspectives, reflecting the conviction that innovative ideas are generated and tested through critical thinking and intellectual challenges. Fostering fruitful debates is essential for mitigating biases due to a specific disciplinary orientation or a particular national perspective. University-to-university collaborations are uniquely suited to pursue this objective. Accordingly, the Project has built relationships over time with a number of schools and departments of Tsinghua University, Beihang University, Hong Kong Polytechnic University, Peking University, and others.

It would be misleading to dismiss the confluence of different scholarly points of view as Ivory Tower irrelevance. What we really know, collectively, about the prospects for reconciling China’s economic growth with local and global environmental protection, and the role of wealthier nations in this effort, is still very limited. Studies that merely apply conventional research methods without full understanding of the fundamental underlying assumptions that distinguish Chinese society and the Chinese economy from industrialized economies are unlikely to improve the practice of economic and environmental policy. Independent studies developed with careful attention to these fundamental assumptions and critically scrutinized empirical data have the potential for greater credibility and more original insights. This is the most important explanation of the intense interest in our results by senior leaders in China. Independent research is also the primary means by which the existing centers of scholarly excellence in China can build research capacities meeting international standards and by which non-Chinese scholars can better understand China’s unique development.

The first phase of the China Project set the stage for subsequent research by inviting interested scholars to write review studies or initiate preliminary research proj-

ects. The resulting papers were presented in a research workshop at Harvard, then revised and published in *Energizing China: Reconciling Environmental Protection and Economic Growth*, edited by Michael McElroy, Chris Nielsen, and Peter Lydon, distributed by Harvard University Press in 1998. A variety of externally funded, multi-year studies in a diversity of fields grew out of this initial effort. These have been reported in scholarly journals, law reviews, book chapters, and published reports, too numerous to list here but given on the HUCE website: www.fas.harvard.edu/~huce/china_project.htm/.

The economic and related work of this book comprise one of three major streams of research under the China Project with roots in the initial phase, each capitalizing on years of development of unique research models, new data resources, and time-tested collaborative relationships. The second is an atmospheric program led by McElroy, who with Wang Yuxuan has developed a high-resolution window over China within the GEOS-Chem global chemical tracer model to analyze poorly understood regional and seasonal dimensions of air quality in China, including complex secondary species such as ozone. The model now makes use of continuous observations of key atmospheric species collected at a measurement station deployed at a site north of Beijing since 2004, in a partnership of the Project with Hao Jiming and colleagues at Tsinghua University that includes William Munger of Harvard.

The third major research component of the China Project is interdisciplinary study of urban transportation, land use planning, air quality, human exposure, and health, now focused on the case city of Chengdu. This venture is partly inspired by and builds on the work of this book, refining some of its exposure and valuation methods, involving several of the same collaborators, and similarly structured as separable but linked modules led by different investigators. Key participants are He Kebin and Wang Shuxiao of Tsinghua University; Zhang Dianye of Southwest Jiaotong University; Shen Mingming of Peking University; and Chris Nielsen, James Hammitt, Guo Xiaoqi, Peter Rogers, and Sumeeta Srinivasan at Harvard.

Clearing the Air is the result of many years of development, data collection, and dedicated research by a large, international team of scholars. It was made possible by numerous funding institutions providing generous support either to individual modules or to the program as a whole. Each chapter contains its own funding acknowledgments, but we will summarize and thank them collectively here.

Three institutions provided major funding. The integrated project was initiated and several elements were funded by a grant from the V. Kann Rasmussen Foundation. Development of the economic model was funded chiefly by the Integrated

Assessment Program of the Office of Biological and Environmental Research, U.S. Department of Energy, under contract DE-FG02-95ER62133. The pollution dispersion and exposure assessment component was supported by a joint grant to the HUCE China Project and Tsinghua University Institute of Environmental Science and Technology from the China Sustainable Energy Program of the Energy Foundation.

Additional funding was provided for individual research components, workshops, or the participation of particular researchers. These include the Task Force on Environmental and Natural Resource Pricing of the China Council for International Cooperation on Environment and Development, the U.S. Environmental Protection Agency, The Henry Luce Foundation, The Bedminster Foundation and the Dunwalke Trust, the Harvard Asia Center, and the Harvard Kernan Brothers Fellowship. We are grateful to all of these institutions for making this program of research possible.

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Note

1. A note on the names of Chinese nationals in this book: In this preface they are rendered in correct Chinese name-order, with surnames first. They are reversed in the chapters, however, to prevent erroneous future citations of contributions to this book, a small but serious problem for Chinese in international scholarly literature.