participants to adjust the scale of their operations.

Around the world, fisheries managed with IFQs or cooperatives experience sustainable profit rates that range from 20 to 60 percent. These overall economic benefits are indicative of both cost savings and revenue increases. They derive from ownership of the catch shares and the ability to transfer the shares from one fishing participant to another.

Benefits from ownership include the reduced incentive to race for fish, which results in longer fishing seasons and a slower pace of fishing. The slowed pace improves the ability of vessels to optimize on-board processing facilities, resulting in increases in the amount of product sold on the market per pound of fish caught. Essentially, the incentives shift from maximizing the quantity of fish caught to maximizing the value of the catch.

Additional benefits can be gained from the transferability of the catch shares. Typically, fisheries managed under an IFQ system see a reduced number of vessels as excess capacity is removed from the fishery, and participants utilize the additional flexibility to determine the optimal scale of their operations. Higher-cost (and thus less-efficient) vessels will find it more profitable to sell or trade their shares than to fish them, and so the total allowable catch will be caught at the lowest possible cost.

One of the most powerful forces of change created by catch-share programs is a constituency whose wealth is a function of the health of the marine environment. Wealth creation, in turn, can lead to improved stewardship, sustainability, and further innovation to increase value. ■

Taking a Closer Look at the Cost of Air and Water Pollution in China

Sandra A. Hoffmann

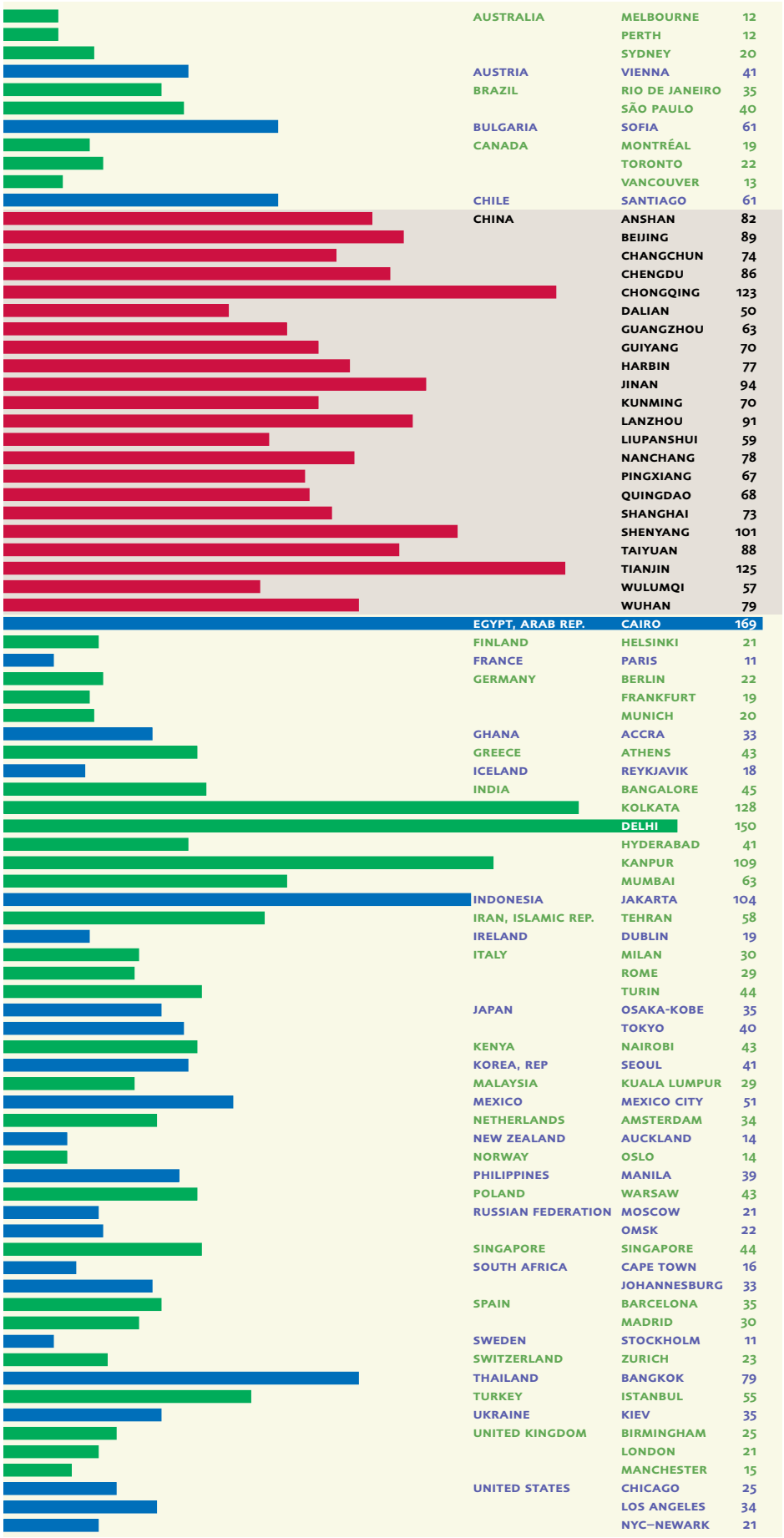
In recent months, the press has been filled with stories of the extraordinary efforts the Chinese government made to assure that environmental conditions met world approval during the 2008 Olympics. Earlier this summer, the city of Qingdao mobilized thousands of people to clean up an algal bloom that choked the coastline and threatened Olympic sailing competitions. In Beijing and neighboring cities, factories were closed to a surrounding distance of 300 kilometers. In Beijing itself, government vehicle traffic was cut by 70 percent and private vehicles were already put under an alternate driving-day restriction, two moves that were expected to reduce 40 percent of the 3.3 million vehicles on its streets. Such unparalleled actions paid off—at least temporarily: the air over Beijing cleared a few days before the Olympic opening day.

But, of course, the real impact of pollution in China has less to do with the Olympics than with the sustained exposure that the Chinese population faces. China's remarkable economic growth over the past 25 years, spurred by massive industrialization, has had severe environmental consequences. Fine particulate levels (PM 10) in major Chinese cities are roughly twice World Health Organization guidelines and three to four times those typically seen in U.S. or European cities. In meeting rising energy demands, China has become the world's largest emitter of sulfur dioxide. Water supply and quality, which are strongly affected by both industrial pollution and biological waste, have been a focus of public concern in the past few years.

China has made strides toward implementation of more effective environmental quality management. Significant progress was made during the 1980s and 1990s, but those advances have slowed in the past decade. For example, energy efficiency—which increased markedly from 7.5 tons of coal per 10,000 yuan of GDP in the 1980s to roughly 2.5 tons in the late 1990s—has stagnated since then. Likewise, urban air quality improved in the 1980s and 1990s but has stalled in the past decade, due in no small part to the rise in car ownership, up 31 percent between 1990 and 2003.

Despite this gloomy recent performance, China is in a good position to move more aggressively to address these environmental quality problems. Rapid industrialization has provided the financial resources to take advantage not only of modern pollution control technologies but also decades of experience throughout the world with designing more effective pollution control policies. The challenge ahead is finding means of efficiently controlling pollution without unduly slowing the economic growth that lifted an estimated 400 million people above the extreme poverty line between 1980 and 2000.

Efficient pollution policy requires information. RFF Senior Fellow Alan Krupnick and I are working with a team of scientists and economists from the World Bank, Norway, and China to model the health and productivity



Left: Average annual PM10 concentrations observed in selected cities worldwide, 2004–05. Despite higher counts found in larger capitals, China's cities lead the world in overall levels of pollutants.

Source: World Bank Indicators, 2005

impacts of air and water pollution in China. The model is national in scope and regional in detail. It both provides a baseline picture of pollution impacts and builds China's capacity to assess the effectiveness of pollution control efforts. By combining Chinese ambient monitoring data with international and locally estimated dose-response functions, the model makes it possible for China to evaluate changes in the impacts of pollution on human health, agriculture, fisheries, and physical infrastructure over time. By valuing impacts in monetary terms, it also provides a means of comparing otherwise incommensurable alternatives.

As part of this project, we conducted some of the first surveys in China estimating people's willingness to pay for reductions in their risks of death associated with air pollution. This international collaboration marks a significant step toward developing a green accounting system and the essential information infrastructure for efficient pollution control in China. ■