

or variations of communist economics. He takes as given a rather stark dichotomy of “communist” versus “capitalist” economics. This precludes a more nuanced discussion of how economic factors up and down the command hierarchies might have influenced the ideological and political developments that form the core of the book (especially in chapters 30 and 40).² Although broadly accurate, this sharp differentiation between systems of political economy means that the parallel emergence of large public sectors in much of postwar, noncommunist Europe is only mentioned in passing.

Readers interested in understanding what the economics of state ownership and central planning were like in practice—at least for the central Soviet variant—would be well-advised to complement *Comrades!* with the recent research of Paul R. Gregory (2004) and Gregory and Mark Harrison (2005). The archive-based studies of these and other economic historians have revised long-standing generalities about Soviet central planning and state ownership. By uncovering the problematic microeconomic foundations of the command economy, Gregory, Harrison, and their colleagues have brought to the forefront the inefficiencies that arose from principal–agent conflicts, information asymmetries, and political control over planning decisions. A richly textured story of the collapse of the Soviet Union and communist political power around the world emerges from considering the tales told by Service in light of the economic forces outlined by these economic historians. With the persistence of formally communist (China, Cuba) and authoritarian, *nouveau*-Soviet (Russia and other former Soviet republics) regimes around the world, *Comrades!* should be of interest to economists studying the political and historical roots of economic change in the *nominally* postcommunist world.

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² Service’s description of the Soviet industrialization drive of the 1930s overplays the scale of technological imports, even going so far as to state that “Stalin’s eagerness to trade was a godsend to American industry” (p. 174). Undoubtedly, the Soviet economy of the 1930s did benefit by exploiting the technological gap with the West, but the impact on an American economy in the grips of the Depression was miniscule.

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Q Agricultural and Natural Resource Economics · Environmental and Ecological Economics

Global Warming and Agriculture: Impact Estimates by Country. By William R. Cline. Washington, D.C.: Center for Global Development, Washington, D.C.: Peterson Institute for International Economics, 2007. Pp. xv, 186. \$21.95, paper. ISBN 978–0–88132–403–7. *JEL* 2007–1562

For years, economists have seen the challenge of global warming as a problem of intergenerational discounting. Oh, and also a case of international free-ridership. Not to mention a matter of uncertainty and risk perception, plus non-market valuation, and enough interaction effects to crash a supercomputer. These complexities help us to understand, if not forgive, the slow response of policymakers in the United States and elsewhere.

William R. Cline’s new book on global warming sidesteps all that nuance and does the arithmetic on a crushingly simple aspect of the problem: climate change will hit the world’s poorest people especially hard, where it hurts the most. People with no choice but to be farmers will see their agriculture become even less productive and the malnourished will find food to be even scarcer.

Agriculture is the canary-in-the-mine of global warming’s economic impact. The sector is almost completely exposed to the elements, especially

in low-income countries. Production responds quickly to changes in temperature, rainfall, and cloud cover and, although farmers and ranchers have a potentially powerful arsenal of biochemical and mechanical tools with which to fight back, their productivity depends on climate and the existing toolkit is most limited where productivity has been lowest.

The simplest conceivable model of global warming reduces to a rise in average temperatures: a projected increase on the order of four degrees centigrade may make France (now averaging around 11°C) more like Portugal (at about 15°C), but it also makes Portugal more like South Africa, which in turn warms to be like Zambia and so forth. The hottest countries, such as Mali and Burkina Faso (now above 28°C), will become like no nation we know.

Cline's approach exploits cross-sectional information on past agricultural productivity at each level of temperature, and compares the results to biophysical simulation models of crop growth. It turns out there is not much difference: the best crop growth models have been well enough calibrated to observed conditions, over a wide enough range of conditions, that their simulation results match cross-sectional observations fairly closely. Of course, warming will change more than just the average temperature. There are changes in seasonality, rainfall, and cloud cover, all of which have a direct effect on crops and livestock but also influence the growth of competing species. There is only one major dimension of climate change over which no observed systems have ever adapted: the impact of atmospheric carbon itself. Atmospheric CO₂ fertilization could help accelerate photosynthesis in many crops but its real-life impact will be limited by other constraints on plant growth. Cline handles this by presenting his results both with and without a CO₂ fertilization effect.

The central contribution of the book is to add up and compare global cross-sectional and crop-simulation results at a politically relevant level of aggregation. Cline begins his book with a detailed review of the existing literature on agricultural impacts of climate change and then offers a short chapter reviewing more speculative literature on three dimensions of adaptation: the impact of atmospheric CO₂ fertilization, the extent to which irrigation can respond to climate stress, and the extent to which increased trade can offset productivity changes. That long intro-

duction sets the stage for Cline's country-by-country estimates.

Cline's calculations begin by averaging results from six major global climate models to obtain temperature and rainfall estimates for the world's land surface, divided into cells of 2° latitude by 3° longitude. There are about 2,800 such cells, which he aggregates into 116 regions: 68 countries, plus 38 subzones within large countries, and the remainder aggregated into 10 residual regions. Cline's simulations shock each of these 116 regions by the projected climate changes out to 2070–2100. Cline may have chosen this time horizon in part for political reasons, to be long enough for substantial warming to occur, while still falling within the lifespan of children who are alive today.

The link from climate change to agricultural productivity in each geographic cell is derived first from cross-sectional comparisons of observed farms over space, in the "Ricardian" approach pioneered by Robert Mendelsohn, William D. Nordhaus, and Daigee Shaw (1994). Statistical estimates for the sensitivity of land productivity to climate variables are taken from the U.S. data of Mendelsohn and M. E. Schlesinger (1999), substituting local estimates from similar regressions where studies were available. These response functions are then compared to crop growth model results mainly from Cynthia Rosenzweig and Ana Iglesias (2006).

Critics of Cline's approach may accuse him of doing think-tank research, using simulation models to make a point rather than test a hypothesis. Certainly he simplifies radically and, where academic researchers might stop in the face of ambiguity or uncertainty, he just chooses a midpoint parameter value and moves on. But the heart of Cline's work in this book is simple arithmetic, averaging others' results for 2°×3° cells into national estimates for politically meaningful regions. In so doing, Cline is admirably transparent and future researchers with new results on key parameters can readily update his sums.

The bottom line is quite simple: Cline projects a worldwide decline of between 3 and 16 percent in agricultural productivity, depending on the degree of carbon fertilization. And the impact is hugely inequitable: many industrialized countries gain while the developing world suffers large losses, which vary widely within regions. India is among the worst-hit, as is North Africa

and Mexico, all of which have baseline decline in productivity of more than 25 percent.

Cline then compares the magnitude of this shock to a guesstimate of changing supply–demand balance by region, finding that climate-driven declines would not be offset by continuation of past trends in productivity growth, relative to the demand increases that would follow from extrapolating trends in income and population growth. So something must give: either we make the investments needed to ramp up agricultural productivity growth faster than it has grown in the recent past or the poor will suffer lower income growth and worse malnutrition.

In ecological terms, the impact of global warming has been seen first at the extremes of the natural world, in the melting of polar ice and the death of tropical coral reefs. Economic impacts are also experienced first at the extremes of climate sensitivity, perhaps in alpine ski areas and—as Cline emphasizes—in tropical agriculture. If global warming has a silver lining, it could be in awakening the world to the burden that is already imposed on poor regions by their climates and their desperate need for new technologies adapted to their unusual needs. Previous work, such as William A. Masters and Margaret S. McMillan (2001), has found strong links between historical temperatures, population density, and economy-wide growth, as markets and trade have only partially overcome the burden of a tropical climate on health and agriculture. Cline’s new book applies

this kind of cross-sectional analysis within agriculture and uses it to show how projected global warming adds insult to injury by further lowering tropical countries’ agricultural productivity.

Cline’s findings could conceivably influence climate policy, although the equity concerns highlighted by his results have played only a limited role in the past. It seems more likely that Cline’s results could be used to help mobilize and target other remedies, such as public investment in new farm technologies to help farmers overcome their geographic constraints. As Cline shows, global warming is raising the climate hurdle, challenging us to devote even greater effort to this goal—or else watch the world’s poorest farmers suffer even more than they already do.

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