Authors
Esther Duflo
Massachusetts Institute of Technology

Michael Kremer
The University of Chicago

Jonathan Robinson
University of California, Santa Cruz

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PSYCHOLOGY AND DEVELOPMENT: THEORY AND EXPERIMENTAL EVIDENCE[†]

How High Are Rates of Return to Fertilizer? Evidence from Field Experiments in Kenya

By Esther Duflo, Michael Kremer, and Jonathan Robinson*

The idea that peasant farmers are rational profit maximizers has been a staple of development economics since Theodore Schultz (1964). It has also been influential in shaping policy. For example, agricultural experts have stressed the importance of fertilizer use in raising agricultural yields, pointing to impressive results on experimental farms and to huge differences in agricultural productivity across countries with different levels of fertilizer use (Robert Evenson and Douglas Gollin 2003). Historically, many countries subsidized fertilizer in response. But economists have been skeptical of claims that farmers are leaving money on the table, noting that fertilizer may not have the same returns on real-world farms as on experimental farms, that returns to fertilizer may be low for many farmers, even if they are high on average (Tavneet Suri 2007), that fertilizer may require complementary inputs, or may be risky. Many countries have withdrawn or scaled back fertilizer subsidies, in part because of fiscal constraints, corruption, and inefficiency in the administration of fertilizer subsidies, but also because of a belief among economists that farmers would choose to use inputs that actually raised profits in real-world conditions. Yet critics have charged that the withdrawal of subsidies has led to massive declines in agricultural output, and in some recent cases fertilizer subsidies have been restored (Celia Dugger 2007).

Behavioral economists have identified major departures from economists' standard models among consumers in the developed world, and development economists are increasingly finding similar effects in the developing world (see e.g., Nava Ashraf, Dean Karlan, and Wesley Yin 2006). However, it is still unclear whether these departures have any major impact on production. Fertilizer offers an attractive context to explore this question. Because it can be purchased in small quantities and used on small plots of land, and because farmers in the area we study are familiar with fertilizer, which has long been used in the area, it is possible to vary fertilizer use experimentally on real-world farms and to measure the impact on the use of potentially complementary inputs and on output, thus determining whether it has at least the potential to be profitable in real-world conditions.

The Kenyan Ministry of Agriculture recommends the use of hybrid seed and fertilizer for maize, the staple crop in most of Eastern and Southern Africa. This recommendation is based on evidence from experimental farms that fertilizer and hybrid seeds increase yield from 40 percent to 100 percent (see, for instance, Kenyan Agricultural Research Institute 1993; Daniel Kaizanja 1998). However, only about 60 percent of Kenyan farmers used fertilizer and hybrid seed in 2004 (Suri 2007), and in

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Many policymakers advocate heavy subsidies to boost fertilizer use and raise agricultural productivity. In contrast, most economists assume that farmers already take advantage of potential profit opportunities, and argue that heavy subsidies are distortionary, environmentally unsound, regressive, and lead to politicization and inefficiency in fertilizer supply. In earlier work, we show that fertilizer is profitable for farmers in Western Kenya. Yet,

usage is low, pointing to possible inefficiencies. In this paper, we build a model with a small fixed cost of purchasing fertilizer in which some farmers are present-biased and partially naïve. Farmers therefore procrastinate, postponing purchasing fertilizer until proceeds from the harvest are spent. Consistent with the model, small time-limited reductions in the cost of purchasing fertilizer at the time of harvest induce substantial increases in fertilizer use, as much as considerably larger price cuts later in the season. Such small timelimited discounts could help present-biased farmers commit to fertilizer use without substantially distorting decisions of non-procrastinating farmers and incurring other costs of heavy subsidies.

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