Agricultural productivity and the impact of GM crops: What do we know?

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The need to raise rates of agricultural productivity growth has recently been emphasized by Alston and Pardey (2014). They argue that a slowdown in the decline in real food prices since the 1970s is consistent with declining rates of growth in agricultural productivity. Their calculations show that over the past two decades, global average yields grew at lower rates for three key staples: wheat, rice and corn.

These same authors also note that while public funding of agricultural research and development (R&D) has fallen in developed economies, changes in intellectual property rights regimes have provided greater incentives for private firms to invest in development of genetically modified (GM) varieties of a range of crops including corn, soybeans, cotton and canola. This raises a legitimate question: what is known about the impact of first-generation GM crops on agricultural productivity?

By 2010, 20 percent of global cropland was planted to the four main GM crops: the US and Brazil accounting for 85 percent of GM corn; the US, Brazil and Argentina accounting for 92 percent of GM soybeans; India, the US and China accounting for 90 percent of GM cotton; and Canada alone accounting for 85 percent of canola. The productivity impact of these GM crops is expected to occur in two dimensions: first, the *intensive margin*, whereby the pest/weed reduction benefits of the technology increase the productivity of other farm inputs on existing land, thus raising yield/acre; and, second, the *extensive margin*, where the technology allows previously marginal land to be brought into production.

Barrows, Sexton and Zilberman (2014), present substantive evidence for the positive yield impact of three GM crops: corn showing a 2-14 to 9-19 percent yield increase; cotton showing a 0-25 to 5-29 percent yield increase; and soybeans showing a 2-39 percent yield increase, where the upper-bound estimates assume the impact on the extensive margin is entirely due to GM technology, while the lower-bound estimates assume production would have occurred on the extensive margin anyways. In addition, GM corn and cotton adoption has mostly occurred on the intensive margin, while for soybeans it has mostly occurred on the extensive margin, especially in Brazil and Argentina.

This research suggests that privately funded R&D has had a positive impact on agricultural productivity, with associated effects on prices and land-use, at least for the first-generation of commercially available GM crops. However, comparison of the adoption rates for GM cotton and corn is very revealing: the former has been adopted globally, while adoption of the latter has not received regulatory approval in a majority of the world's corn producers in China, Europe and Africa, i.e., the productivity potential of GM corn has not been fully realized.

Concerns about the safety of GM crops, which arose in the late-1990s, have in all likelihood slowed down the approval and release of GM varieties of rice and wheat. For example, in the case of rice, China has not released an approved GM variety, due to concerns about the effect on international trade. Given recent food price spikes and their impact on food security, and the fact that the world will be relying more on emerging economies such as China and Brazil for both global food production and investment in agricultural R&D, revisiting the impact GM crops may have on agricultural productivity is an important issue for public debate.