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Agricultural Intellectual Property Rights in Developing Countries: The Economics of Terminator Genes

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The Issue

The protection of agricultural intellectual property rights (IPRs) is controversial, especially in developing countries where IPR enforcement is lax. Proprietary seed technology that is developed by private-sector firms is protected by patents and enforced through technology-use agreements (TUAs) with farmers in developed countries. Developing countries lack the institutional and legal infrastructures, as well as the incentives, to enforce seed IPRs to the level of developed countries, however. Despite weak IPR protection, genetically-modified (GM) seeds have been widely adopted in many developing countries, often through black markets and brown-bag seeds.

There are two main consequences of developing countries' inability/unwillingness to protect seed-company IPRs. The first is that innovating firms and host countries of innovating firms have sought alternative methods to collect returns on the unlicensed use of their technology. Two of these methods are the World Trade Organisation's (WTO) Agreement on Trade Related Aspects of Intellectual Property (TRIPS) and the development of technological solutions that render second-generation seeds sterile.

The second consequence of weak IPR enforcement in developing countries is that private firms do not have incentives to undertake research to develop products that are targeted at developing-country markets. Returns to research are uncertain if innovating firms are not granted exclusive rights to market new products.

This policy brief outlines the status of GM crops in developing countries and provides an overview of IPR-protection methods. The brief presents estimated economic welfare results from a simulation of a range of IPR-protection mechanisms in the Argentine soybean industry. The issue of returns to research is also addressed by estimating how much more productive (measured as higher yield) a new seed product that is coupled with genetic-use restricting technology (GURT) trait would have to be for an adopting developing country to benefit from its introduction.

Conclusions and Policy Implications

A model was developed to generate estimates of the economic effects of a range of IPR-protection schemes in a developing country that had already experienced large-scale adoption of a GM crop that embodies proprietary intellectual property (the model was applied to the case of herbicide-tolerant soybeans in Argentina). The model's quantitative results led to the following conclusions.

1) Cost-reducing seed technology generates large economic benefits for the adopting-country's production sector.

2) Coercive trade sanctions from an innovating-firm's host country in retaliation for insufficient enforcement of IPRs will reduce exports from the adopting country. However the negative effects are likely to be smaller than the economic gains to the adopting agriculture sector, and the trade sanctions are unlikely to target, or directly affect, the adopting industry.

3) A negotiated levy between the IPR holder and the adopting country can generate gains

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for both the adopting industry and the innovating firm, depending on the size and disposition of the levy. A levy can also be implemented and enforced at lower costs than institutional enforcement of IPRs.

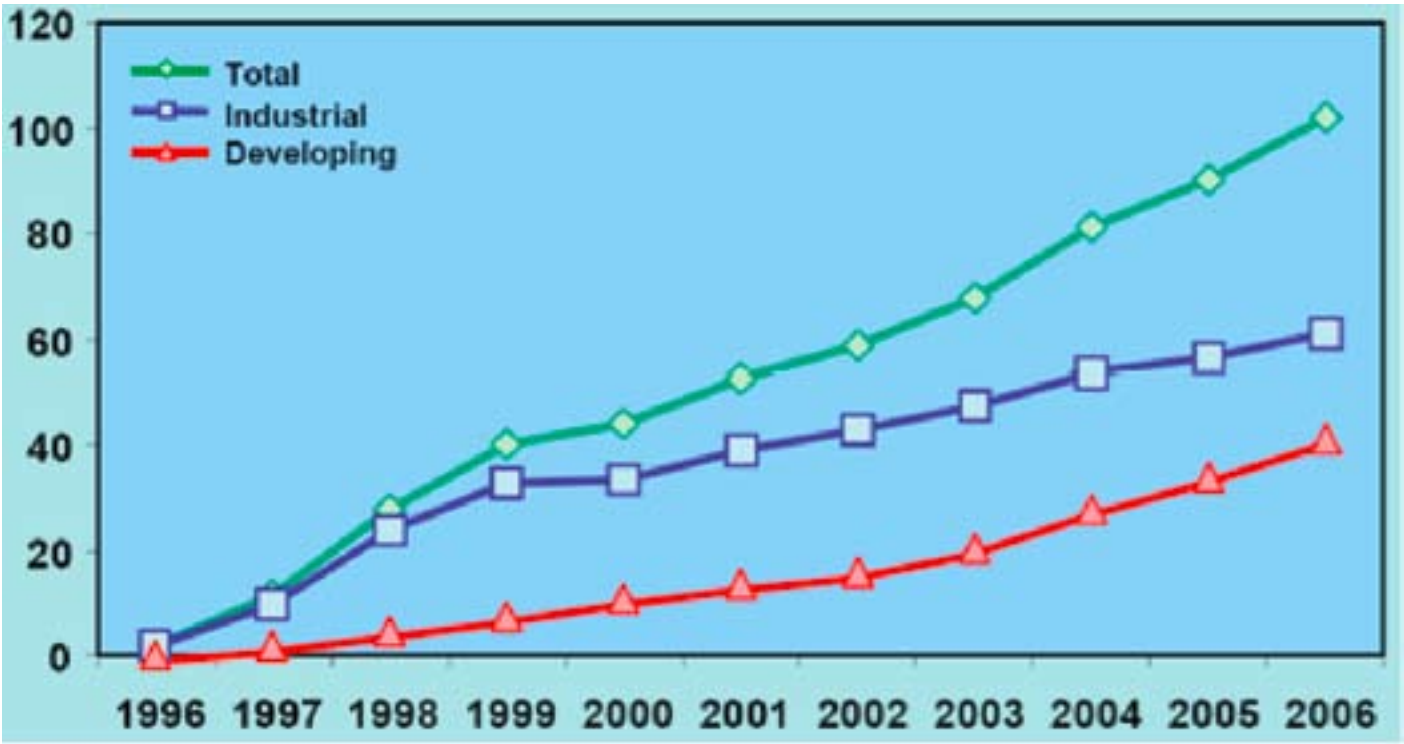
4) The coupling of GURTs with herbicide-tolerant (HT) traits in crops that have been adopted in developing countries would have significantly reduced economic welfare in the adopting sector. The price of seeds for protected crops would be higher and farmers would either continue using traditional (non-HT) varieties or purchase smaller quantities of seeds (or a combination of both). Higher seed costs could be offset by the development of higher-yielding seeds, but the increase required for Argentina's soybean sector to benefit from GURTs is unrealistically high.

There has been broad public opposition to the implementation of GURTs in commercial crops. This opposition has two bases. The first is a widely-held conviction among many farmers of the right to save seeds; this issue is not addressed in this research. The second is the concern that GURTS will render agricultural biotechnology beyond the reach of producers in developing countries who have benefited from such crops in the past. This research provides support to this concern by estimating the economic welfare losses that would have occurred had HT soybeans only been available in Argentina in tandem with GURT traits.

Background and Literature Review

GM crop adoption has grown quickly over the past ten years (see figure 1); global production is up to 252 million acres in 22 countries (James, 2006). The largest adopter is United States with 54.6 million hectares, followed by Argentina, Brasil, Canada, India and China. GM soybeans have been the principal biotech crop at 57% of global biotech area, followed by maize at 25%, cotton at 13% and canola at 5% (James, 2006). Eight of the ten countries with the largest GM acreage are developing countries; India, China, Argentina, Brasil and South Africa account for the bulk of developing country GM area. China has a large public research sector that is developing and testing a range of crops.

Figure 1. Global Area of GM Crops (millions of hectares)



Source: James (2006)

The IPRs of agricultural biological innovations are poorly protected in many developing countries. There are two primary factors that hinder the protection of plant IPRs in developing countries: 1) high transaction costs in monitoring and enforcing contracts and 2) low incentives for developing-country governments to protect foreign IPRs. As importers of biotechnology, the governments of developing countries have very low incentives to protect biotechnology IPRs.

There have been a number of responses to weak protection of IPRs in developing countries. The WTO's TRIPs agreement requires that all member countries enforce the IPRs of firms from other member countries through patents or sui generis protection systems. Member countries that do not provide this protection are subject to retaliatory trade sanctions from the host country of the innovating firm. The TRIPs agreement is an attempt generate incentives (the avoidance of trade sanctions) to protect foreign IPRs.

Another response has been the implementation of a levy on the use of GM seeds. This levy can be enforced through a combination of charging a premium for certified seeds and charging a royalty at the point of sale (usually an elevator) for harvests from uncertified seeds. This type of levy provides returns to innovating firms at lower institutional costs than legal protection of IPRs through contracts. The Brasilian National Association of Seed Producers accepted Monsanto's proposal on royalty payments for their RR soybean seeds in the first grow season after RR soybeans were authorized by the Brasilian government. Farmers have two options to pay the levy. They can either pay the GM levy, which was 0.88 Brasilian reals per kg (Reuters, 2005), when they purchase seeds from the seed company or they can pay a two per cent royalty at the point of sale.

There also exist technological solutions to weak IPR protection in agricultural biotechnology. Seeds that are bundled with variety GURT traits cannot be saved for second-generation production, so farmers much purchase seeds every year to benefit from commercial-quality germplasm. GURTs eliminate the monitoring and enforcement costs involved with protection of agricultural IPRs, and therefore address the first constraint to the protection of IPRs in developing countries.

Plant varieties cannot be patented in Argentina, but are protected under national seed law which requires that all seeds be certified before sale. However, enforcement of the law is so lax that an estimated 50 to 85% (US GAO, 2000) of soybeans are grown from either saved or black-market seeds. Given that there is no patent protection for RR technology in Argentina, Nidera, the largest seed company in Argentina, acquired free access to available HT varieties and now sells its HT seeds to farmers without requiring them to sign contracts that constrain reselling or saving seeds for the following year.

Weak IPR protection, the wide-spread use of farm-saved seeds and large black markets for seeds significantly affect innovators' returns on their investment of biotechnology in Argentina. Weak enforcement has reduced incentives for biotechnology firms to invest in R&D of new varieties that are suitable to the local production conditions. Some firms have argued that stronger protection of IPRs through GURTs would generate sufficient revenues to increase their R&D expenditure, thereby creating higher-yielding seed varieties.

Modelling and Results

A partial-equilibrium trade model was built and calibrated to observed price, production and trade data in Argentina. That model was used to generate welfare estimates for a range of IPR protection scenarios. The first scenario considered the case in which an innovating firm is able to protect their HT technology to the level of a patent. The innovator would be a monopolist in this technology and would be able to charge a higher price for the improved technology, providing that the new technology afforded sufficient cost savings to the adopting producer[1]. If the current HT soybean technology had only been available to Argen-

[1]The sufficiency of the cost savings is determined by the level of innovation. A drastic innovation reduces production costs by a large enough amount that innovating firms are not threatened by competition from existing technology. Firms that produce and market nondrastic innovations must consider competition from existing technology in their pricing decisions.

tine producers at the monopoly price, then the model estimates that economic welfare in Argentina's soybean industry would be approximately US$ 445 million below the level with unprotected soybean IPRs.

The second scenario considers trade retaliation from the host country of the innovating firm. The TRIPS agreement allows trade retaliation in the amount of revenue lost to the innovating firm; the host country to the innovating firm applies import duties equal to US$ 445 million (the monopolist's hypothetical revenue from above) on Argentine products. This penalty is unlikely to affect Argentina's soybean industry as trade retaliation measures could be applied to a number of other Argentine exports.

The third scenario analyses a levy (that has precedent in Brasil) on GM technology. This scenario results in an estimated welfare decrease for the Argentine soybean sector of approximately US$400 million from the current black-market baseline.

The model is also used to analyse the effects of GURTs in HT soybeans. The model simulates a scenario in which the current HT technology is only available with a bundled GURT trait. Argentine farmers would then have the option of adopting the new seeds and repurchasing every year, or continuing to use traditional varieties. For farmers to adopt the GURT seeds and generate economic benefits for Argentina's soybean sector, seeds would have to be almost 90% more productive (measured as higher yield) than current varieties. The genetic and physiological characteristics of soybeans make such an increase unlikely, even if the incentives for R&D are present for innovating firms. If farmers reverted to traditional non-HT seeds, then economic welfare in Argentina's soybean sector would be approximately 20% below current levels because of less productive (measured by higher chemical input costs) seeds.

Concluding Remarks

Protection of agricultural IPRs will remain an important policy issue. The share of agricultural R&D that is undertaken by private firms is increasing, and the products that emerge from this research will contain intellectual property that will be protected in adopting developed countries. As these products are adopted in developing countries, innovating firms will seek alternative mechanisms to acquire returns on the use of the intellectual property.

The WTO TRIPs agreement has been in effect since the implementation of the Uruguay Round Agreement on Agriculture in 1995, but has so far worked only as a coercive threat against member countries - there have not been any agricultural biotechnology TRIPs cases. However the threat of trade retaliation is credible, and may have played a role in the implementation of the Brasilian levy.

The role of GURTs in protecting agricultural IPRs will remain controversial. This technological solution to the protection of IPRs grants the innovating firm exclusive license over the technology, and eliminates contracting requirements that can function in developed countries. However the introduction of GURT traits into biotech crops would reduce access to new technologies, especially in developing countries. The positive economic effects of technology spillovers in developing countries would decrease, unless the higher level of appropriability of returns to research to innovating firms leads to vastly more productive seeds. The increase that would be required for soybeans for Argentina to have benefited from GURT technology is approximately a 90% increase in yields - an unrealistic objective given the genetic and physiological characteristics of soybeans.

This research provides empirical support to the concern of many groups (for example the Consultative Group on International Agricultural Research) that GURT technology will negatively affect agricultural producers in developing countries.

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