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The economics of adventitious presence thresholds in the EU seed market

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ABSTRACT

Since settling on its mandatory labeling rules for genetically modified (GM) foods in the late 1990s, the European Commission has considered a number of times setting tolerance levels (thresholds) for the accidental presence of GM material in conventional seeds. In every case, it has opted to defer the decision. In the absence of such thresholds, current European labeling laws require that seeds be labeled as GM if they contain any detectable trace of GMOs approved for cultivation in the EU. Conventional seeds with detectable traces of GMOs that have not been authorized for cultivation cannot be sold in the European market altogether. As the acreage of GM crops has continued to grow at a fast pace around the world, industry calls to the EU Commission for setting ''practical'' adventitious presence (AP) thresholds for conventional seeds in the EU have multiplied. In this paper, we examine the economics of alternative AP thresholds for conventional seeds in Europe from the perspective of those who must comply with the regulation – EU seed firms. Specifically, we first examine the operational changes that might be necessary for seed firms to comply with alternative AP thresholds for conventional seeds. Then, we analyze the associated market uncertainties, compliance costs and their implications on firm and industry competitiveness.

Introduction

Since settling on its mandatory labeling rules for genetically modified (GM) foods in the late 1990s, the European Commission has considered a number of times setting tolerance levels (thresholds) for the accidental presence of GM material in conventional seeds.[1] In every case, it has opted to defer the decision.

In the absence of such thresholds, current European labeling laws require that seeds be labeled as GM if they contain *any* detectable trace of GMOs approved for cultivation in the EU.[2] Conventional seeds with detectable traces of GMOs that have not been authorized for cultivation cannot be sold in the European market altogether.

A number of recent studies have indicated that preventing the adventitious presence of GM traces in conventional planting seeds is both difficult and expensive (Bock et al., 2002; European Commission, 2001; Kalaitzandonakes and Magnier, 2004; Messéan et al., 2006). And in line with such considerations, trace amounts of GM material have consistently turned up in conventional seed lots when those have been randomly tested (e.g. Central Science Laboratory, 2007; Mellon and Rissler, 2004; United States GAO, 2008). Despite these inherent market risks, the EU Commission has, so far, avoided bringing forward a proposal for specific AP thresholds in conventional planting seeds.[3]

As the acreage of GM crops has continued to grow at a fast pace around the world (James, 2012), calls for setting AP thresholds for conventional seeds in the EU have multiplied. Indeed, in recent years the European seed industry has actively lobbied the EU Commission for setting ''practical'' AP thresholds for seeds and has argued that in their absence the industry's competitiveness is in question (European Seed Association, 2007; 2010).

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[1] Most mandatory GM labeling laws make explicit allowances for the presence of GM traces in non-GM foods since perfect segregation of GM and non-GM material in the agrifood supply chain is not easy to achieve in practice. Such allowances are set up as tolerances or purity thresholds which define the amount of GM material that triggers labeling of a food product as ''GM''. Since the GM content allowed is generally meant to be ''accidental and unavoidable'', these purity thresholds are often referred to as ''adventitious presence'', or AP thresholds.

[2] For a general discussion on the economics of AP thresholds of food products and their welfare implications (see Giannakas et al., 2011).

[3] It should be noted that the EU is not alone in its lack of explicit AP policy for conventional seeds. In fact, only a handful of countries have set AP thresholds for conventional seeds. These include Argentina, Austria, Hungary, Italy, and Romania. Of these countries, only Argentina has any GM crop cultivation and hence, for the other countries, AP restrictions pertain only to maize seed imports.

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On the face of it, these arguments seem odd. While the existing AP restrictions in conventional seeds might bring about market risks and impose compliance costs, it is unclear why they should burden disproportionately the European seed industry. If anything, the European seed industry would seem to be best positioned to benefit from the current AP restrictions as there is little GMO production in Europe to interfere with its seed production systems. Furthermore, lack of explicit AP standards would seem to protect the EU seed industry from import competition. So are AP thresholds for conventional seeds needed in the EU market? Is the competitiveness of the EU seed industry being affected by the current AP restrictions and the lack of explicit AP thresholds for seeds? If explicit AP thresholds for conventional seeds were to be set, what are "practical" ones?

In this paper, we seek to provide answers to these questions by examining the economics of alternative AP thresholds for conventional seeds in Europe. Specifically, we first examine the operational changes that might be necessary for European seed firms to comply with alternative AP thresholds in conventional seeds. Then, we analyze the associated market uncertainties, compliance costs and their implications on the industry's competitiveness. To limit the scope of our study, we restrict our analysis to one type of seed: maize seed. Maize seed has the largest commercial value among all planting seeds and over the last 15 years it has provided a platform for the introduction of numerous GM traits around the world. Hence, the maize seed market is important in its own right and an excellent case study that can be generalized to other seed markets.

To meet our objectives, in Section 'Firm operations and competitiveness in maize seed production' we review the normal operations of maize seed firms and the key determinants of their competitiveness. In Section 'Introduction of biotechnology and management of AP', we discuss the various operational adjustments that can be used by maize seed firms to manage alternative AP thresholds. In Sections 'Firm expectations for AP management and compliance costs' and 'Expected compliance costs and their structure' we analyze the compliance costs associated with such operational changes and their underlying structure. Since there are few countries where AP thresholds for seeds exist, actual experience in managing seed production and trade under alternative AP thresholds is limited. For this reason, for our assessment we use two separate *ex ante* methodologies: (a) statistical analysis of firm expectations and (b) simulation of representative maize seed production systems in the EU. As we explain later in the paper, these methodologies are complementary in their reasoning, analytical approach, and findings. In Section 'Operational changes and compliance costs in AP management: a simulation approach', we synthesize the results and draw inferences about the relationship of AP regulation in conventional seeds and the competitiveness of the EU maize seed industry. Finally, in Section 'AP restrictions and the competitiveness of the EU seed industry' we offer some concluding comments.

Firm operations and competitiveness in maize seed production

To understand how compliance with alternative AP thresholds could change the operations of maize seed firms in Europe, one must first understand their standard operations. Biological constraints dictate that maize seed firms adopt long planning horizons as product development and commercialization are characterized by lengthy gestation lags (Fernandez-Cornejo, 2004). Maize hybrids are produced by crossing two unrelated inbred (parent) lines. Identical hybrids perform differently under different growing environments (e.g. soil fertility, climate, photoperiods, or elevation). Hence, the key objective of seed maize firms is to select combinations of inbred lines that yield hybrids well-adapted to the growing environments of target markets.

To this end, inbred lines must first be developed during breeding operations. Over successive generations, rigorous selection for maturity, height, plant color, vigor, pollen shed, seed yield, disease resistance, and other characteristics is carried out (Copeland and McDonald, 1995). It typically takes 3–5 years to produce a desirable inbred. Hybrids are next developed through a similarly prolonged process of successive experimentation and selection. In any given year, thousands of combinations of inbred lines are produced and evaluated in hundreds of locations around the world in order to ensure adequate adaptation to various growing environments. It typically takes a battery of tests and another 3–5 years to develop a single marketable hybrid.

Commercial production of the few hybrids that are selected to be sold to farmers in any given year requires large amounts of their parent lines to be crossed in seed production fields. Hence, following breeding, the selected parent lines must be scaled up to substantial volumes. The scaling up of inbred lines for new hybrids typically takes two growing seasons. The subsequent commercial production of the hybrid seeds is done through contracts with selected farmers who, in most cases, are clustered around seed processing plants. Production planning for hybrid seeds starts in the beginning of each year and is based upon sales projections for the following year—12–18 months ahead of receiving orders from farmers.

Through this lengthy process, firms seek to develop hybrids with desirable traits that match closely market needs—a key determinant of product quality in the maize seed industry. Another key determinant of product quality is seed purity. Seed purity is safeguarded from breeding to hybrid production through advanced quality control systems (Desai et al., 1997). Due to the large amounts of commercial hybrid seeds produced in open environments, control of purity is most challenging during this last stage of maize seed production.

To maximize yields and geographic adaptation, parent lines and hybrid seeds are grown in the most fertile maize-producing lands, typically, in the midst of maize grain production areas. High purity levels are secured by avoiding mechanical admixtures as well as natural outcrossing through substantial isolation distances between seed production fields and fields producing maize for grain. Every year, maize seed firms expend significant efforts to secure fields with desired isolation distances. Contract farmers cooperate with neighboring farmers and firm field managers to meet isolation requirements and establish planting schedules that minimize the probability of adventitious pollen intrusion in their fields.

Strict quality control systems must ensure that seed purity is maintained through seed processing and conditioning as well. As the ears of hybrid maize seed begin to dry down in the field, seed processing plants prepare for harvest. Different fields planted with the same hybrid are harvested and delivered to the plant together so that they can be processed as a single seed lot. Early harvest is preferable as hybrid seeds maintain their quality best when dried slowly and in a controlled environment in the plant. Early harvest also helps to avoid risks of frost injuries (Desai et al., 1997). For these reasons, after harvest begins seed processing plants operate 24 h a day and 7 days a week to facilitate timely harvest, delivery, and processing of hybrid seeds. Processing of harvested hybrids involves dehusking, sorting, drying, shelling, conditioning, sizing, treating and packaging. From the time hybrids are delivered and through each processing step, each seed lot is separately tracked inside the plant—usually through computerized systems.

Key competitiveness drivers

As seed firms seek to optimize the performance and market competitiveness of their hybrids at various growing environments,