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On the proportionality of EU spatial *ex ante* coexistence regulations

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ABSTRACT

The EU is currently struggling to implement coherent coexistence regulations on genetically modified (GM) and non-GM crops in all member states. While it stresses that any approach needs to be "proportionate to the aim of achieving coexistence", very few studies have actually attempted to assess whether the proposed spatial *ex ante* coexistence regulations (SEACERs) satisfy this proportionality condition. In this article, we propose a spatial framework based on an existing landscape and introduce the concept of shadow factor as a measure for the opportunity costs induced by SEACERs. Our empirical findings led us to advance the proposition that flexible SEACERs based on pollen barriers are more likely to respect the proportionality condition than rigid SEACERs based on isolation distances. Particularly in early adoption stages, imposing rigid SEACERs may substantially slow down GM crop adoption. Our findings argue for incorporating a certain degree of flexibility into SEACERs by advising pollen barrier agreements between farmers rather than imposing rigid isolation distances on GM farmers. The empirical questions of proportionality and flexibility have been largely ignored in the literature on coexistence and provide timely information for EU policy makers.

Introduction

The European Union (EU) is currently struggling to implement coherent coexistence regulations on genetically modified (GM) and non-GM crops in all member states. According to the European Commission's (EC) guidelines, "Coexistence refers to the ability of farmers to make a practical choice between conventional, organic and GM crop production, in compliance with the legal obligations for labeling and/or purity standards. The adventitious presence of GMOs [genetically modified organisms] above the tolerance threshold set out in Community legislation triggers the need for a crop that was intended to be a non-GMO crop, to be labeled as containing GMOs. This could cause a loss of income, due to a lower market price of the crop or difficulties in selling it. [...] Coexistence is, therefore, concerned with the potential economic impact of the admixture of GM and non-GM crops [...]" (EC, 2003). Since the publication of these guidelines, some member states have developed, and others are still developing, a diversity of *ex ante* regulations and *ex post* liability rules on the coexistence of GM and non-GM crops (EC, 2006).

In this article, our attention is drawn to the first group of *ex ante* regulations, and more specifically to spatial *ex ante* coexistence regulations (SEACERs). Our concern is that some of the proposed SEACERs may impose a burden on GM crop production. The European Commission has clearly emphasized the *proportionality condition* of SEACERs in a Communication to the Council and the European Parliament: "[...] coexistence measures should not go beyond what is necessary in order to ensure that adventitious traces of GMOs stay below the labelling threshold [...] in order to avoid any unnecessary burden for the operators concerned. While some member states have taken this advice into account, others have decided to propose or adopt measures that aim to reduce adventitious presence of GMOs below this level. In some cases, proposed measures, such as isolation distances between GM and non-GM fields, appear to entail greater efforts for GM crop growers than necessary, which raises questions about the proportionality of certain measures. [...] While the Commission recognizes the legitimate right to regulate the cultivation of GM crops in order to achieve coexistence, it stresses that any approach needs to be proportionate to the aim of achieving coexistence" (EC, 2006, p. 6).

The scientific and regulatory community mainly focused its attention on the technical nature of the issue, more specifically on the feasibility of the proposed SEACERs. A first school of thought examines the feasibility of keeping the adventitious presence of GM material in non-GM products below established tolerance thresholds (Ceddia et al., 2007; Damgaard and Kjellsson, 2005; Devos et al., 2004, 2005; Eastham and Sweet, 2002; Hoyle and

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Cresswell, 2007; Hüsken and Dietz-Pfeilstetter, 2007; Messéan et al., 2006; Sanvido et al., 2008; Van De Wiel and Lotz, 2006).

A second school of thought assesses the feasibility of implementing alternative SEACERs in a spatial environment. Perry (2002) uses a stylized square agricultural landscape to assess the feasibility of GM crop allocation under varying levels of SAECERs. They conclude that stringent SAECERs combined with an increase in adoption of organic cultivation restricts the cultivation of GM crops within the landscape, in some cases even hampering the coexistence of both production systems. Dolezel et al. (2005) confirm these findings by estimating the area lost for non-GM crop cultivation due to SAECERs in three Austrian regions. Moreover, this case study concludes that in landscapes with a high planting density of maize and small fields, spatial feasibility is negatively correlated to increases in the stringency of SAECERs and GM crop adoption. Sanvido et al. (2008) examine the feasibility of SAECERs under spatial constraints at two levels. At the aggregate level, national statistics are used to assess whether the available arable land in Swiss communes is large enough to enable isolating an assumed area allocated to GM maize. This approach is complemented by a Geographic Information System (GIS) analysis at the field level. The authors demonstrate that both the planting density as well as the distances between maize fields can strongly differ within the communes and hamper coexistence, despite the feasibility to comply with SAECERs at the aggregate level. Devos et al. (2007), using a combination of GIS data and Monte Carlo simulations, investigate how these spatial arrangements influence the feasibility of implementing SAECERs. Their results show that clustering may be an effective strategy to facilitate the coexistence of production systems. Therefore, Devos et al. (2008b) propose the theoretical solution of pooling arable land to increase the feasibility of SAECERs in the landscape. However, besides agronomical problems such as the promotion of monoculture, clustering also creates significant transaction costs. Furtan et al. (2007) assess the economic and institutional feasibility of such coordination through the case of private organic clubs in Canada. Although institutional settings differ between Canada and the EU, the results offer some insight in the dynamics of economic and institutional feasibility of SEACERs. If the size of the cluster decreases or SAECERs become more stringent, the costs of the private clubs increase. Messéan et al. (2006) use a GIS analysis to assess the influence of alternative SAECERs on farm level costs but do not provide any information on their economic feasibility and the impact of spatial patterns. Munro (2008) investigates spatial feasibility of SEACERs within an economic environment. Within the spatial restriction of a stylized rectangular agricultural landscape, he stresses the importance of appropriate policy options as efficient outcomes will not be achieved in an unregulated market. The feasibility of SAECERs depends mainly on the size of the barrier which must be maintained in order to avoid cross-fertilization. However, as the model is built on a simplified spatial economy, it does not take into account the geographical influence of landscape, land fragmentation, and field configuration on the spatial impact of GM crops. Ceddia et al. (2009) attempt to overcome the constraint of a stylized agricultural landscape through the incorporation of a general aggregation index, developed by He et al. (2000), in their model. Using this model, they assess the biological efficiency of different policy variables including SAECERs. However some of the proposed policies would not be feasible from an economic point of view as they would generate excessive costs for farmers. Moreover, the aggregation index does not account for the actual shape of agricultural plots.

This literature review shows that the interaction between SEACERs and the spatial configuration of the landscape is still poorly understood. Demont et al. (2008b) analyze this interaction and illustrate that spatial feasibility of SEACERs can be significantly reduced in densely planted areas if they trigger a domino-effect of non-GM crop planting decisions. However, it could be useful if this interaction could be summarized in a single measure. Moreover, the question whether the SEACERs currently proposed by the EC satisfy the proportionality condition has received limited attention in the literature (Demont et al., 2008b; Demont and Devos, 2008). Therefore, in this paper we develop a measure for assessing the spatial impact of SEACERs on the coexistence of a theoretical GM crop with its non-GM counterpart based on a real geographical dataset and analyze whether the proportionality condition is satisfied. The article is organized as follows. After this introduction, in "Spatial modeling framework" we introduce our new concept and describe our spatial modeling framework. In "Data" we describe our spatial dataset and in "Results" we report the results generated by the framework under a set of alternative scenarios. "Discussion" critically discusses the results and "Conclusions" finally concludes.

Spatial modeling framework

Shadow factor

SEACERs generally incorporate spatial isolation measures such as minimal distance requirements between GM and non-GM crops. They typically follow the *newcomer principle* in that they intend to protect conventional non-GM crops from the externalities caused by *newcomers*, i.e. new GM varieties of the same crop species (EC, 2003). Visually, we could interpret SEACERs as creating protective *halos* around non-GM crops in a landscape. Where a halo overlaps with a field where a GM crop is intended to be planted, a *shadow* is created on the field. Complying with SEACERs implies that shadows are exempt from GM crop planting of a particular crop species. Shadows induce opportunity costs as they constrain farmers' planting options. According to the newcomer principle, any costs for implementing coexistence measures are to be financially borne by GM crop farmers. Costs are not limited to opportunity costs; they also include operational and transaction costs. However, for the sake of parsimony our spatial analysis does only take into account opportunity costs as the latter are directly related to the spatial configuration of a landscape. Farmers intending to plant GM crops will weigh the costs of implementing coexistence measures against the benefits of planting GM crops (the so-called *GM rents*, see below). In other words, they will check whether the costs can be amortized over the remaining area they intend to plant with GM crops.

To summarize this trade-off, we define the *shadow factor* as the ratio of the total area of the shadow induced by SEACERs to the remaining total area planted with the GM crop assuming perfect compliance with SEACERs. The shadow factor is a measure for the opportunity costs borne by GM crop farmers per planted hectare of the GM crop as a result of complying with SEACERs. The nominator of the shadow factor measures the total area that needs to be converted to the second-best alternative crop, which can be a non-GM variety of the same crop species or another crop. The denominator relates the opportunity costs to the object to be regulated through SEACERs, i.e. the GM crop planting intentions. A shadow factor of one, for example, implies that the shadow induced by SEACERs covers half of the GM area, such that the opportunity costs borne by GM farmers on one unit of shadow need to be amortized over one unit of GM crops. The shadow factor can be used to assess the impact of alternative SEACERs in different landscapes under given market conditions as it summarizes the interaction between SEACERs and the spatial configuration of the landscape. In order to gain insight in the concept of shadow factor, in the remainder of the paper we simulate a set of alternative