Coexistence Rules and Regulations in the European Union

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The institutional environment for planting GM crops in Europe is heterogeneous. Poland wants to ban the planting of GM crops; Spanish farmers have been growing Bt-maize for several years; 120 communities in Belgium have declared themselves to be GMO-free; a local grain trader in Germany has announced that it will pay the same price for Bt and non-Bt maize. Luxemburg wants to fine farmers up to €750,000 for non-compliance with coexistence rules and in Poland a prison sentence of up to three years may be given; farmers in Upper Austria must apply for authorization for each field intended to be planted with GM crops and farmers in Denmark have to pay a levy of 100 DK per hectare of GM crops.

In 2003, the European Commission stated that "no form of agriculture, be it conventional, organic or agriculture using genetically modified organism (GMOs), should be excluded in the European Union" but simultaneously decided to follow the principle of subsidiary that "measures for coexistence should be developed and implemented by the Member States" (CEC 2003a, p. 1). Since then, some Member States have developed, and others are still developing, a diversity of coexistence measures that may have a profound impact on the adoption rate of GM crops.

Against this background, we ask the following question: How will the different coexistence policies among EU Member States affect the adoption of GM crops?

The trade-offs for different regulatory systems within the European Union are analyzed using the model by Beckmann, Soregaroli, and Wesseler (2006), which combines *ex ante* regulatory and *ex post* liability costs including irreversibility and uncertainty based on Kolstad, Ulen, and Johnson (1990).

We find the adoption dynamics of GM crops within the EU are likely to be very different across and within EU Member States. Heterogeneity of farms, farm practices, and landscape structure is one element causing variability. However, the political willingness for allowing GM cultivation and the legal framework for coexistence are rather mixed among the different countries. Moreover, while it is clear how to legally ban GM crops using *ex ante* regulations, it is not obvious which measure would best favor adoption since there are trade-offs. Each approach poses costs on the GM farmer either from the *ex ante* regulation or *ex post* liability side. We summarize the economic model underlying the analysis, and then provide an extensive review and classification (based on the economic model) of the different coexistence regulations in Europe.

Ex ante Regulation and *Ex post* Liability Under Irreversibility and Uncertainty

The derivation of the coexistence model begins by assuming a region with a number of farms *i*, where each farm is assumed to be managed by a risk-neutral and profit-maximizing decision maker (farmer). The possibility of planting GM crops such as Bt-corn exists. The case for crops approved by the European Food Safety Authority (EFSA) will be considered only, as they can be considered to be safe for the environment and human health according to the standards of the European Union. There are a number of *ex ante* regulations a potential GM farmer has to follow as well as facing possible *ex post* tort liability costs in case of

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the adventitious presence of GM crops in non-GM crops.[1] Following Beckmann, Soregaroli, and Wesseler (2006), the annual coexistence value of GM farming under *ex ante* regulatory and *ex post* liability rules, $\widehat{vc^{\ell}_{G_i}}$, can be defined as the difference between the gross margin, v_{G_i} with G for GM crops, and the costs related to *ex ante* regulations, r_i, and expected *ex post* tort liability, tl_i. The tort liability costs are uncertain and depend on the probability for admixture, μ_i, through for example, cross pollination, the monetary value of damage costs in case of admixture, d_i, and the probability that, if admixture happens, the party responsible will have to pay the damage, j_i, which again is a function of the court's view and the chance of being held liable in case of admixture, indicated by *law*. The variables r_i, μ_i, and d_i depend on farms size s, and regulatory policy, *reg*. The decision maker can be expected to adopt GM crops, if the value of GM farming, which is $\widehat{vc^{\ell}_{G_i}} = v_{G_i} - r_i(s, reg) - \mu_i(s, reg)d_i(s, reg)j_i(law)$ with ℓ indicating liability of the GM farmer and $\hat{}$ the situation without temporal uncertainty, irreversibility, and flexibility, will be larger than the coexistence value of non-GM farming, $vc_{N_i} = v_{N_i}$:

$$(1) \qquad \Delta\widehat{vc^{\ell}_{G_i}} \equiv \widehat{vc^{\ell}_{G_i}} - vc_{N_i} > 0$$

or if the current incremental benefits are larger than the future expected tort liability costs, $v_{G_i} - v_{N_i} - r_i > \mu_i(s, reg)d_i(s, reg)j_i(law)$.

Equation (1) does not include possible irreversible benefits and costs of adopting GM farming. Examples for irreversible regulatory costs are transaction costs because of negotiations with neighboring farmers or additional training costs for planting and handling of GM crops. Also temporal uncertainty about future gross margins, *ex ante* regulations and *ex post* liabilities, and flexibility about the timing of adoption are not considered. By including irreversibilities, uncertainty, and flexibility the coexistence value for a GM farmer can be stated as maximizing the real option value of adopting GM crops.

The temporal uncertainty about future gross margins, *ex ante* regulatory, and possible *ex post* liability costs can be modeled as a combined geometric Brownian motion and Poisson process. The geometric Brownian motion captures uncertainty with respect to the gross margins and the *ex ante* regulatory costs while the Poisson process captures tort liability as the risk of a slump in farm profits, if the farmer is to be held liable (see Beckmann, Soregaroli, and Wesseler, 2006, and the appendices in Soregaroli and Wesseler, 2005, for more details). Modeling as such will result in the following threshold level $[v_{G_i} - v_{N_i} - r_i]^*$ that current GM farm profits, including *ex ante* regulatory costs, have to meet for immediate adoption. The following equation (2) expresses the threshold level with γ_i indicating the chance of being held liable (the mean arrival rate of the Poisson process), η the risk-free rate of return, and α_i the drift rate of the geometric Brownian process. IR^{ℓ}_i indicates the net-irreversible costs at farm level. The assumption is $IR^{\ell}_i > 0, \forall i$. $\beta_{1_i}/(\beta_{1_i} - 1)$, with $\beta_{1_i} > 1$ capturing the effect of uncertainty and irreversibility:

$$(2) \qquad (v_{G_i} - v_{N_i} - r_i) > ([v_{G_i} - v_{N_i} - r_i]^*) = \left(\frac{\beta_{1_i}}{\beta_{1_i} - 1}\right)(\eta - \alpha_i + \gamma_i)\, IR^{\ell}_i.$$

Equation (2) says that farmer i would adopt GM crops, if the current incremental value of GM farming, $(v_{G_i} - v_{N_i} - r_i)$ is greater than the threshold value $[v_{G_i} - v_{N_i} - r_i]^*$. Passing this threshold value depends, among others, on the regulatory and liability costs.

The regulatory costs have a direct impact on the current benefits of the technology as well as an indirect impact on *ex post* liability costs. An increase in reversible regulatory costs r_i reduces the current benefits, $(v_{G_i} - v_{N_i} - r_i)$, and passing the hurdle will be more difficult. But at the same time *ex ante* regulations may reduce *ex post* liability costs (the chance of being held liable, γ_i) making immediate adoption more likely if the effect $\partial[\beta_{1_i}/(\beta_{1_i} - 1)]/\partial\gamma_i < 0$ overcompensates the effect $\partial(\eta - {}_i + \gamma_i)/\partial\gamma_i > 0$. Similarly, an increase in irreversible costs due to *ex ante* regulation increases the right-hand side of (2).

The liability costs have, firstly, a direct impact on the irreversible transaction costs and hence on IR^{ℓ}_i and, secondly, due to tort liability, on γ_i. An increase in the chance of being held liable, again, reduces the ratio $\beta_{1_i}/(\beta_{1_i} - 1)$ and increases $(\eta - {}_i + \gamma_i)$.

Generally, the direction of changes in reversible *ex ante* regulatory and *ex post* liability costs on the current incremental value of GM farming and the hurdle for GM farming is the same. Whether one effect or the other will be stronger, and the effect on adoption is

[1] Adventitious presence can be defined and measured in different ways. The results depend on the method used (Messean et al. 2006).

positive or negative, is an empirical question and depends on the farm-specific benefits of the technology and the specific *ex ante* regulations and *ex post* liability rules. What remains to be noticed is that treating irreversible regulatory costs as reversible costs underestimates the true costs of regulation and biases the interpretation of results towards immediate adoption.

In the following we will look at the different coexistence regulations in the European Union and by using (2) classify measures adopted by countries, highlighting their importance. We classify the different regulations with regards to the costs they impose on GM farmers and their impact on the adoption of GM crops. In particular, we differentiate between costs imposed by *ex ante* regulations and *ex post* liability rules, their relationship, and whether or not they can be considered as being either reversible or irreversible. The actual development of EU markets for GM and conventional non-GM crops does not show relevant price spreads between the two types of commodities. For the qualitative comparison of rules and regulations we assume the same price for GM as well as conventional non-GM crops and a higher price for organic non-GM crops.

Coexistence Regulations in Europe[2]

The regulations on coexistence in the EU are based on the general guidelines for coexistence developed by the European Commission (CEC 2003a). The guidelines together with the regulation on tracing and labeling of GMOs (CEC 2003b) address concerns of some Member States about the introduction of GM food and feed in the EU (Bijman and Tait 2000). Some Member States, such as Austria, Denmark, Germany, Luxemburg, and Portugal, have already started adopting regulations governing the planting and handling of GM crops, while other Member States are still in the process of developing their regulations. The *ex ante* regulations and *ex post* liability rules are summarized in Table 1. Readers should note that most rules and regulations are intended to be implemented and hence may not be finally approved by national governments and/or the European Commission and are, therefore, subject to change.

[2] The analysis is based on a document published by the CEC (2006) and several other documents. A list of the documents is available upon request from the authors.

Ex ante *Regulations*

Regulations are considered *ex ante* if GM farmers have to follow them, if they want to plant GM crops. The regulations, in some cases, are very specific and differ widely between Member States, from almost no additional *ex ante* regulations, as in the Czech Republic, to very detailed regulations, as in Austria.

The most drastic *ex ante* regulation is banning the planting of GM crops. Several Member States ban the planting of GM crops in specific areas, mainly nature reserves. Actually, a ban requires the approval of the EU. In general, EU-approved GM crops are considered safe for the environment and hence should not be a threat to nature reserves. For specific traits, approval by the EU may include a restricted use for growing. The coexistence rules and regulations in Portugal allow regions to be defined where the cultivation of certain types of GM crops can be banned to ensure the possibility of planting in other regions (CEC 2006). In Poland just recently, the upper house of the parliament initiated a ban on trading and planting GM seeds. The legal validity of such bans is questionable, as they are not in line with the Directive 98/34/EC (CEC 2006).[3]

Instead, several Member States require farmers to get official approval before they are allowed to plant GM crops. In Austria, farmers need an approval for each single field and crop from the local authorities, while Hungary, Ireland, and the Slovak Republic consider a similar procedure.

Almost all Member States include registration and information responsibilities for GM farmers. These include registration of areas in data bases, with some of them being publicly available, the duty to inform neighbors and landowners and record keeping. Wallonia, Belgium, considers approval for planting GM crops based on the agreement of neighbors. In the case of Hungary and the Slovak Republic the approval demands a declaration of consent by neighbors and landowners.

In general, some of the approval procedures and the registration and information duties transfer the decision-making rights from the farmer to public authorities and can impose

[3] The Italian law poses a total ban of GM crops in the territory until the regional local governments adopt coexistence plans. Moreover, GM crops were officially banned from the territory of several regions prior to the adoption of the national law. Similar bans have been put into effect by regional authorities in Greece and other EU countries.

Table 1. *Ex ante* Regulations and *Ex post* Liability Rules Governing Coexistence among European Union Member States

Policy	EU Member States Apply and Intend to Apply
Ex ante *regulations*	
Prohibition and approval procedures	
Prohibition of planting GM crops in specific areas	AT, DE, HU, LU, PT, SK
Case-by-case approval for each field by local authorities	AT*, HU, IE, SK
Compulsory training of farmers planting GM crops to be paid by the GM farmer	DK, HU, SK
Consent from landowner needed	AT, BE, HU, LU, SK
Consent from neighbors needed	AT, BE, HU, LU, SK
Registration and information duties	
Registration of areas in publicly available database	AT*, DE, DK, EE, LV, LT, SK
Registration of areas in publicly available database, restricted access	AT*, PT, ES, FI, FR, HU, NL, PL
Informing neighboring farmers and landowners	DK, AT, HU, NL, PL, SK
Record keeping	DE, DK, PT, CZ, ES, HU, IT, NL, PL
Technical segregation measures	
Minimum distance requirements	AT, CZ, DE, DK, ES, FR, HU, NL, PL, SK
Buffer zones	AT, CZ, ES, FR, PL, SK
Rotation intervals	EE, LT, SE
Insurance measures	
Compensation fund paid by GM farmers (levy on GM crops) plus support from the central government	DK
Compensation fund paid by private stakeholders	PT, IE, FR, NL, UK
Private insurance against damages	AT*, LU
Ex post *liability rules*	
Legal liability for damages	
Liability based on civil law	CZ, ES, HU, SK
Fault-based liability	AT*, DK, FR, NL
Strict liability for GM farmers	AT*, DE, IE, PL, UK
Joint and several liability	DE
Proving damage	
Burden of proof lies with GM farmer	AT, DE, FR, IT
Burden of proof lies with non-GM farmer	IE, UK
Penalties	
Fines for non-compliance with *ex ante* regulations	AT, CZ, ES, FR, IT, LV, LT, LU, PL, PT, SK

Source: CEC (2006) and additional national documents.

Note: AT = Austria, AT* = specific regions of Austria only, BE = Belgium, CY = Cyprus, CZ = Czech Republic, DE = Germany, DK = Denmark, EE = Greece, EL = Estonia, ES = Spain, FI = Finland, FR = France, HU = Hungary, IE = Ireland, IT = Italy, LT = Lithuania, LU = Luxemburg, LV = Latvia, MT = Malta, NL = The Netherlands, PL = Poland, PT = Portugal, SE = Sweden, SI = Slovenia, SK = Slovak Republic, UK = United Kingdom.

high costs for farmers, particularly if they need the written consent of landowners and neighbors like Hungary proposes.

A common feature for many countries is the introduction of minimum distance requirements. The definition of the minimum distances and their application differ widely. Several countries, so far, differentiate between three types of crops: corn, sugar beet, and oilseed rape. Some countries differentiate

additionally between distances to conventional non-GM crops and organic crops and crops for seed production. Germany does not have mandatory minimum distance requirements, but technology providers have to provide recommendations that do not result in the adventitious presence of GM material beyond the threshold level of 0.9%. Seed companies currently recommend a distance of about 25 m for Bt-maize in Germany.

In general, the minimum distance requirements are lower for corn, followed by sugar beet and oilseed rape and are higher for organic non-GM crops and non-GM seeds. Luxemburg does have very large distance requirements, ranging from 800 m for corn to 3,000 m for oilseed rape. Latvia has even larger distance requirements, 4,000 m for conventional and 6,000 m for organic oilseed rape. Some countries consider greater distance requirements for areas around protected areas. Buffer zones, field surroundings planted with non-GM crops, often of the same species, are also considered by some Member States, either in conjunction with, or as an alternative to, separation distances. Mainly minimum distance requirements impose reversible and irreversible transaction costs to the GM farmer, as the number of neighbors he has to coordinate with depends on the farm size and the minimum distance requirements (Messean et al. 2006, p. 28). The smaller the farm size, relative to the minimum distance requirements, the higher the transaction costs of coordinating the planting of crops. Minimum distance requirements, however, may reduce the *ex post* liability costs significantly.

Luxemburg, so far, is the only country that demands GM farmers to obtain an insurance contract covering damages the cultivation of GM crops could cause. Yet, so far, there is no insurer providing a contract. Two Austrian Federal States, Burgenland and Upper Austria, also consider insurance as part of the approval process for planting GM crops. Some other countries introduce compensations funds paid either partly by the GM farmer and the government, as in Denmark, or by private stakeholders within the agricultural sector, as in the Netherlands, Portugal, and Ireland. These funds usually compensate for damages as long as the GM farmer followed the technical *ex ante* regulations.

Based on the information available, the approval and registration regulations as applied in Austria and intended to be applied in Hungary and the Slovak Republic can be assumed to hamper the adoption of GM crops most, since they shift decision making from the farmer to public authorities and impose reversible and irreversible regulatory costs on the GM farmer, which may not significantly reduce the costs of *ex post* liability. Technical segregation and insurance regulations, however, although increasing the current regulatory costs, are able to reduce *ex post* liability costs. The effect on adoption depends on the relation between farm size and minimum distance regulations and on the levy to be paid for the insurance or fund. Generally, it is difficult to decide which *ex ante* regulatory costs are irreversible. Obviously, the mandatory training costs can be considered to be irreversible. For the other *ex ante* regulatory costs the degree of irreversibility will depend on the specific implementation of the regulation. To give an example, does the consent from the landowner need to be renewed every year or not? In case it is sufficient to obtain the consent once, the costs can be considered as a one-time irreversible cost as they are sunk costs. In the case of the consent having to be obtained every year for each field, the costs can be considered as annual reversible costs.

Ex post *Liability*

Ex post liability includes possible costs that arise after farmers have planted GM crops. In general, civil law also covers damages due to admixture with GM crops. Nevertheless, most countries want to protect non-GM farmers and have adopted special *ex post* liability rules, in particular, to make it easier for non-GM farmers to claim compensation for damages. From the perspective of the GM farmer, the probability of being sued increases from civil liability over strict liability to joint and several liabilities. The probability of being sued also increases if the GM farmer has the burden of proof, as it becomes easier for the non-GM farmer to sue in case of admixture.

What is important to consider in this context, is the impact of *ex ante* regulations on *ex post* liability. Austria, for instance, combines restrictive *ex ante* regulations with strict liability and puts the burden of poof on the GM farmer.

Two different approaches can be observed towards *ex post* liability and compliance with *ex ante* regulations. Some Member States do enforce compliance with mandatory distance requirements independent of whether or not damage actually does occur, as in the

case of Austria. Other Member States do not explicitly state that a fine for non-compliance with *ex ante* regulations must be paid, where the non-GM farmer does not complain, or in the case of a complaint but no economic damage done. In such circumstances, *ex ante* regulations and *ex pos*t liability do offer more flexibility for farmers to adjust their activities—the handling of the *ex ante* regulations—to their farm-specific circumstances. In particular Latvia does not impose mandatory minimum distances, which relaxes the impact of the high minimum distance recommendation for adoption significantly.

If there is no price mark-up for conventional non-GM crops, economic damage will be difficult to prove[4] and it is reasonable to expect that no compensation must be paid. This actually reduces the problem of coexistence mainly to areas where organic farmers are present. Farmers who would like to adopt GM crops will face more adoption difficulties than otherwise in areas with a higher density of organic farms.

Compliance with minimum distance regulations protects farmers against liability claims. Some countries add a fine to the damage costs, if farmers did not comply with the regulations. The fines can be substantial, up to 750,000€, as in the case of Luxemburg.

The *ex post* liability rules do not result in irreversible costs directly, but indirectly, due to inducing adaptive behavior by GM farmers, such as the planting of windbreaks and negotiations with neighbors about possible damage settlements.

Conclusions

Three years after the European Commission introduced the subsidiary principle to the coexistence issue, it concluded its recent review of the national laws as follows: "The limited experience and the need to conclude the process of implementing national coexistence measures do not seem to justify the development of a dedicated harmonized legislative approach at the present time" (CEC 2006, p. 10). The Commission announced to report to the Council and the European Parliament in 2008 on the progress made.

There may be little progress to report. If the coexistence regulations mainly exclude GM crops from being grown in Europe, little experience is going to be gained. Our analysis shows those countries, like Austria, Hungary, Luxemburg, Poland, and the Slovak Republic, that prefer to ban GM crops totally from their territory, also introduce very restrictive *ex ante* regulations. In combination with relatively small farm sizes and a high share of organic farming, these *ex ante* regulations may also, in the future, prevent GM crops from being grown. Countries can continue their policy of banning GM crops by regulatory means. However, some countries that have less restrictive *ex ante* regulations and more innovative *ex post* liability rules, are more likely to gain experience; like the Czech Republic, Denmark, Germany, The Netherlands, and Spain. Germany, for example, opted for a flexible *ex ante* regulation combined with a strict, joint and several liabilities of GM farms. In this case, GM farms and seed companies can innovate and co-operate to develop practices that reduce the risks of liability.

So far no national regulation considers a compensation for farms that cannot plant GM crops because of national regulations. It may just be the matter of time before the first farmer will claim compensation for foregone benefits for not being allowed to grow GM crops.

[4] On the contrary, in the case of Bt-grain maize, a mark-up for Bt-maize may emerge, due to the lower mycotoxin levels of the grain maize.

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