International Trade and Endogenous Standards: the Case of GMO Regulations*

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Web-appendix A.1. GMO index regulatory components

In this online appendix, we provide a full description of the characteristics and economic impact of each regulatory dimension composing the GMO index used in the empirical analysis.
As a general rule, a more restrictive regulatory component would increase production and compliance costs due to comprehensive requirements, and would consequently have a greater effect on trade. We assigned higher scores to more restrictive requirements. All the components discussed below refer to Table 1 of the paper.

Approval process

The first condition that allows any possible handling of a GMO product in a country is its approval status. GM ingredients or foods need specific approval procedures for import and cultivation. These procedures test the safety of GM products. In contrast with other requirements (e.g. traceability and labeling), which act similarly to other trade standards, approval is a measure that directly affects market access: if a GM event is not approved it is not possible to introduce it into the country.

Approval process requirements vary significantly across countries. There are two main groups of countries that share similar approaches. One group follows the EU regulation based

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on the ‘precautionary principle’. It means that any product produced with, or derived from, transgenic crops is subject to GM regulation and the consumer ‘right to know’. The second group follows the US ‘substantial equivalence’ approach, that exempts essentially equivalent products from any specific requirement (Gruère, 2006). Between the two there are other different approaches to the approval process.

We defined five levels of restrictiveness (from 0 to 4) for the approval process. A score of 0 is assigned if there are no constraints on GMO cultivation and marketing; 1 if there exists a mandatory approval process established at legislative level, but not yet enforced; 2 if the mandatory approval process follows the principle of substantial equivalence; 3 if the mandatory approval process follows the precautionary principle; and finally, 4 for GM-free countries (prohibition of cultivation and marketing of GMO).

Risk assessment

Assessments are based on the biological characteristics of the new organism, and test the safety of food and feed containing GMOs and the effects on the environment. The typology of the testing depends on the country’s approach, whether based on substantial equivalent or precautionary principle. In many cases the exporter is the legal entity responsible for the assessment.

Risk assessment is the target for international harmonization efforts for shared methodologies, though still at under discussion. The scheduling and realization of programs for field trials is expensive and for some countries (e.g. developing countries) these costs are prohibitive.

We identified four levels (range 0-3) for risk assessment regulation. Both the two extreme conditions, scored 0 and 3, indicate a lack in the risk assessment framework, but the difference is substantial: a score of 0 (e.g. Ukraine) indicates a normative void that does not affect trade or cultivation as there are no standards; score 3, on the contrary, applies to GM-free countries, hence totally opposed to the importation (and cultivation) of GMOs and imposing the strongest degree of restrictiveness. Between these two scores, we assign 1 if the risk assessment is at proposal stage, and 2 if risk assessment is compulsory.

Labeling policies

In 1997, the EU introduced GMO labeling with the purpose of guaranteeing the consumer’s ‘right to know’. Labels carry indications on the presence of GM ingredients, but also on health safety and product diversification. Labeling has also met environmental issues, playing a major role in consumption decisions of consumers concerned with environmental pollution associated with GM products (Appleton, 2000). A label can act as an hazard warning, affecting the demand for GM and non-GM products (Gruère, 2006).

Labeling is expected to affect trade flows, in particular of important suppliers of GM crops (Gruère and Rao, 2007; Gruère *et al.* 2009b). Costs associated to labeling depend on: the threshold level, the capacity of the public authorities to enforce labeling requirements, and the capacity of industry to comply with labeling rules. GM labels have effects on the whole agri-food chain. Actors have to collect and handle information concerning the presence of GM ingredients until the final consumer. The transfer of this information adds onerous management costs. Ultimately, labeling indirectly affects trade through the imposition of implementation costs, carried by exporters.

Among countries we registered two main approaches: voluntary and mandatory labeling. Mandatory labeling requirements are divided into further two groups: label on the finished product (Australia and Japan), and on GM technology as a production process (EU and China). In the former case, the quantification of GM ingredients is required to be labeled, and, usually, the threshold is higher. In the latter case any product derived from GM crops has to be reported. In this case, thresholds are more restrictive.

We have identified five categories of labeling, based on threshold. Compliance with a restrictive threshold implies an increase in production and commercialization costs. We assigned a 0 score in absence of labeling requirements; 1 with voluntary regime; 2 in the presence of a mandatory regime with a threshold higher than 1%; 3 with mandatory regime with a threshold equal or lower than 1%; finally, 4 in GM-free countries.

Traceability requirements

Traceability is an instrument to create a network to 'retrace history, use or location of an entity by means of recorded identification', and to guarantee efficient withdrawal from the food and feed market if any unexpected effect occurs to health and environment. In the case of GMO products, the traceability system is based on identity preservation (IP) for the diversification between different productions, ensuring to the consumer the origin and the characteristics of the product. Moreover, producers, processors and retailers have to collect, retain and transmit information at each stage of the agri-food chain (Bailey, 2002).

Countries with a comprehensive traceability regulation must create procedures for the identification of industry chain participants who supply and demand products. Agents of the food chain must transmit information on the identity of the product and whether it contains GMOs, and they must retain the information for a period of time (post-market monitoring), i.e. 5 years. All these information must be available for applicants (Wilson *et al.*, 2008).

At the producer level, farmers have to be certain of the absence of cross-pollination between neighboring crops, and must comply with certified storage and harvesting. Elevators, processors and retailers must keep information on product identity and transmit this information by lot numbers and test results.

All these requirements induce increasing costs, but also benefit the market niche gains. Cost increase is difficult to establish because traceability has long term implications, and variable costs depend on crops (e.g. soybean and maize provide a great number of byproducts in different agri-food industries). Moreover, liability and compensation schemes are crucial. Main costs are due to certification, record collection and information keeping, and are carried by GMO producers and suppliers, with a potentially higher final market price for both GMO and GM-free products.

For traceability we defined the following scores: 0 if the regulation does not require traceability or IP; 1 if traceability is at proposal stage or if IP is enforced; 2 if traceability is mandatory; and 3 if the country is GM-free.

Coexistence guidelines

The purpose of coexistence is to guarantee consumers and farmers the possibility of choosing what to consume or produce among GM, traditional and organic products. This is feasible only if there is IP among crops, which must be segregated in space and time. Coexistence procedures require mechanisms preventing pollen flows (such as distances or pollen barriers between fields of GM, traditional and organic crops), refuge areas and dedicated machineries, but also

compensation and liability systems. It also requires strong cooperation between farmers in close proximity.

Production costs rise due to isolation, monitoring, purity testing, dedicated equipment and/or its cleaning. Costs may vary at different purity levels, taking into account that zero threshold of transgene in GM-free crops is not feasible in some agricultural systems. Some policy makers in developing countries assume that coexistence is not feasible or can be done only by facing prohibitive costs.

Because of the difficulties in establishing coexistence strategies, the level of implementation of coexistence policies varies widely across countries, and in several cases requirements are not stated clearly. For this reason we decided to score 0 those countries without any coexistence rule; 1 if coexistence policies are still far from enforcement; 2 if there are partial guidelines; 3 if exhaustive coexistence guidelines are adopted; and 4 if the country is GM-free.

Membership in international GMO related agreements

The purpose of the Codex Alimentarius is to define standards for consumer protection, and to promote fair relationship in international trade practices. It successfully reached an agreement on safety assessment procedures for GMOs, but no formal labeling standards were adopted.

The aim of the Cartagena Protocol on Biosafety (BSP), which is part of the United Nations Convention on Biodiversity, is to introduce a shared procedure for risk assessment, risk management and trans-boundary movement of Living Modified Organisms (LMOs). The BSP acts between importer and exporter, introducing an Advanced Informed Agreement (AIA) for the intentional introduction of LMOs into the environment. In particular, it requires a comprehensive risk assessment and risk management framework provided by the exporter before the first introduction of the LMO into the importer territory. Rules from the BSP are on bundling, transport, packaging and identification during any LMO trans-boundary movement.

The compliance with the BSP can impose higher production and marketing costs, on both GM and non-GM products, because of the creation of domestic structures for annual testing.

If the country does not adhere to either one of the two international agreements, the score is 0; otherwise the score is 1 or 2 when the country subscribes to one or both agreements.

It is important to note that, until the Codex Alimentarius reaches an agreement on GMO labeling, and the BSP comes actively into force in all member countries, neither international institution will influence trade flows. However, we decided to consider also this category on the ground that the expected future enforcement will have a trade effect.