

Vigani, Mauro; Olper, Alessandro

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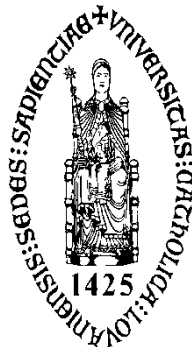
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Mauro Vigani and Alessandro Olper



Katholieke Universiteit Leuven

LICOS Centre for Institutions and Economic
Performance
Waaistraat 6 – mailbox 3511
3000 Leuven

BELGIUM

TEL: +32-(0)16 32 65 98

FAX: +32-(0)16 32 65 99

<http://www.econ.kuleuven.be/licos>

GM-free private standards, public regulation of GM products and mass media

Mauro Vigani *
JRC - IPTS

Alessandro Olper
University of Milano & LICOS

Abstract. This paper provides evidence on private standards on genetically modified (GM) organisms for 44 retailers operating in 54 countries, distinguishing between retailers not using GM ingredients, and retailers using ingredients which are potentially GM in private label products. Using this information, we empirically investigate the drivers that induce retailers to adopting a GM-free private standard. The results show that many of the drivers highlighted in the literature, such as historical factors, communication infrastructure and sectoral conditions affect the likelihood of adopting a private standard. Moreover, we tested additional hypotheses from the political economy of standard formation and of mass media. Key results show that a higher share of public media reduces the probability of adopting GM-free private standards, while a higher heterogeneity in the GMO public standards increase this probability.

Key words: GM-free private standards, vertical differentiation, political economics, media market
JEL classification: D72, Q13, Q16, Q18

* M. Vigani is researcher at European Commission, Joint Research Centre (JRC), Institute for Prospective Technological Studies (IPTS); A. Olper is associated professor at the Università degli Studi di Milano, Department of Economics, Management and Quantitative Methods.

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Corresponding author: mauro.vigani@ec.europa.eu, tel. +34 95 448 7175, European Commission, Joint Research Centre (JRC), Institute for Prospective Technological Studies (IPTS). Edificio Expo, C/ Inca Garcilaso 3. 41092 Seville, Spain.

1. Introduction

In recent years, the adoption of private standards concerning product attributes significantly increased. Producers are increasingly asked to certify their products to comply with specific standards created by firms, standard setting coalitions (e.g. GFSI) and non-governmental organizations (NGOs). The goal of private standards is not only to specify the quality level and safety of food products (e.g. GlobalGAP, BRC, IFS), but also the attributes of the production process and the environmental and socio-economic effect (e.g. Rainforest Alliance and Fair trade). Retailers are driving the creation of private standards as they have first-hand information on consumers' preferences towards different product characteristics. Moreover, they have incentives in developing successful marketing strategies to communicate private label product attributes. However, consumer preferences are not the only factor affecting the retailers' decision of adopting private standards. The structure of the supply chain, the public minimum quality standard (MQS) set by the government and country-specific characteristics also play a fundamental role.

Among the different product characteristics, the presence of ingredients obtained by biotechnology attracted the consumer's attention. Despite the fact that genetically modified (GM) crops are adopted worldwide today, many NGOs and green parties in developed economies point out that GM crops can have negative effects on the agricultural production system in developing countries and that their effects on the environment and health are still unclear (Takeshima and Gruère, 2011). The safety of genetically modified (GM) crops raised sensitive issues at production, consumption and political level, affecting the consumers' willingness to buy products containing GM ingredients (Fulton and Giannakas, 2004). As a response to the demand for differentiated products not containing GM ingredients, some European retailers started in the middle of the last decennium to adopt certified *GM-free*

private standards, meaning to sell private label products not containing ingredients obtained by GM crops. GM-free standards are now increasingly spreading worldwide.

The creation and adoption of private standards has been studied from different points of view. Many authors analyzed the effects that private standards have on producers and smallholders in developing countries. This literature is mainly based on case studies and authors find opposite effects (Maertens *et al.*, 2011). Some studies show negative effects of contract farming for high-quality products on smallholders' employment. For example, Key and Runsten (1999) show that in the Mexican frozen vegetable industry, food companies privilege contracts with large-scale growers to the exclusion of smallholders. Graffham *et al.* (2007), argue that the increased compliance costs of GlobalGAP reduced the participation of Kenyan small farmers in the export vegetable business. On the contrary, others studies argue that contract-farming can provide the agrifood system in developing countries with better access to inputs and technology and reduced production and marketing risks (e.g. Dries and Swinnen, 2004; Swinnen and Maertens, 2007; Minten *et al.*, 2009). This literature suggests that developing countries may gain in productivity and, ultimately, in higher incomes from contract-farming.

Another strand of literature analyzed the factors that induce retailers to adopt private standards in the agrifood sector. The majority of authors provide qualitative studies listing the factors that encourage firms to adopt private standards, however their findings are mainly confined to specific case studies. Within this literature, García Martínez and Poole (2004) review the factors affecting the adoption of private standards on fresh produce in the UK, France and Germany. These factors are firm-specific factors, the social and economic environment where the retailer operates and public policy interventions. Moreover, private standards of European retailers can represent a major entry barrier for Mediterranean exporting countries. Mainville *et al.* (2005) studied the fresh produce market in São Paulo,

Brazil, showing that the relative importance of the product in the firm's business, the retailer's market power, its scale of operations, and its investment in reputation are firm-specific factors enhancing the use of private standards, while the institutional environment and the market characteristics are contextual determinants. Similarly, Codron *et al.* (2005) explain that the level and the monitoring system of public standards affect retailer's strategies about private standards. Moreover, they argue that in countries where food scare crisis occurred, such as the 'mad cow' crisis, retailers are more likely to adopt private standards.

Other authors rely on the organizational innovation theory to explain the diffusion of private standards at the international level. Neumayer and Perkins (2005), using panel data for 130 countries from 1995 to 2001, show under which conditions firms are more likely to adopt ISO 9000. They find that high exports to the European Union, colonial ties with Europe and the telecommunications endowment are significant determinants of ISO 9000 adoption. Moreover, lower regulatory requirements, higher share of manufacturing activity, higher education and lower firm productivity are positively correlated with the number of ISO 9000 certificates.

Particularly relevant for our analysis is the study of Herzfeld *et al.* (2011). In a similar way as Neumayer and Perkins (2005), Herzfeld *et al.* (2011) studied the adoption of GlobalGAP and BRC standards in 188 countries. Results show that established trade relations with home countries positively affect the likelihood of the private standards adoption. Moreover, larger countries and countries with better institutional quality host more certified firms. However, empirical evidence on the determinants of private standards in the agri-food sector is still lacking.

Specific analyses on GM food private standards are provided by Gruère (2006) and Gruère and Sengupta (2009). Gruère (2006) conducted a qualitative survey on labeled GM and GM-free products in supermarkets in Canada and France, in order to analyze the effects of new

labeling regulations adopted in 2004 in the two countries. He found that after the introduction of the voluntary labeling in Canada, retailers were selling labeled no-GM organic products, while in French supermarkets no products were labeled as ‘containing GM ingredients’ although the new public regulation allows for product differentiation. The author concludes that both regulations failed in providing ‘right to choose’ among different products to consumers at retail level. Gruère and Sengupta (2009) studied the effects of *GM-free* private standards adopted by food companies in developed countries on the policymaking of biosafety regulation in developing countries. They found that *GM-free* private standards can indirectly induce irrational policy decisions in developing countries because the fear of export losses can induce excessively precautionary decisions. However, neither of these two studies on *GM-free* private standards provides quantitative analysis.

This paper significantly contributes to the above literature on the drivers of private standard formation in different ways. First, we obtained an original sample of GM private standards for 44 retailers operating in 54 countries distributed in all continents. Second, using this wide sample we test the hypotheses highlighted by the empirical literature, finding that historical, geographical, infrastructure, trade and institutional condition significantly affect the retailer decision in adopting *GM-free* private standards. Finally, we also test additional hypotheses formulated by the theoretical literature on vertical differentiation, on the political economy of private standard formation and on the political economy of mass media. Our results show that public ownership of media reduces the likelihood that retailers adopt *GM-free* standards. On the contrary, different biotech regulations between home and destination countries induce retailers to adopt *GM-free* standards.

The reminder of the paper is organized as follows. In next section we review the theoretical literature explaining the formation of private standards and studying the political economy of mass media. In section 3 we present and discuss our original sample on retailers GM private

policies. In sections 4 and 5 we provide hypotheses from the empirical literature and we explain the variables and methodology used in the econometric analysis. Section 6 provides the results of the econometric analysis and discuss major finding. Finally, section 7 concludes.

2. Theoretical background

In what follows, the theoretical literature studying the strategic adoption of private standards will be summarized. The objective is to distil some key findings and predictions useful to rationalize the empirical exercise proposed in the next section.

Models that study the strategic adoption of private standards by firms follow two main approaches. The first approach analyzes the interaction between retailers and producers to explain the incentives of introducing private standards in the supply chain. The second approach focuses on the interaction between retailers and governments, comparing the welfare effects of public versus private standards. In the following paragraphs we provide a review of the theoretical literature explaining the drivers of the adoption of private standards according to these two approaches. Moreover, we review also the role of mass media in influencing consumers' preferences towards GMOs, which is highlighted in the literature on the political economy of mass media.

The interaction between retailers and producers has been explained mainly using vertical differentiation models, where alliances and bargaining processes in the supply chain are a tool to soften the price competition between retailers and to increase profits by product quality differentiation (Spence, 1976). These alliances enhance private standards depending on the structure of the production sector and of the supply market. The studies of Giraud-Héraud *et al.* (2006) and of von Schlippenbach and Teichmann (2012) provide important explanations of the interactions along the supply chain.

Giraud-Héraud *et al.* (2006) propose a vertical relationships model between producers and retailers to explain the adoption of private label products, taking into account two different supply sources: the competitive spot market where the retailer buys products with a public minimum quality standard (MQS); and supply contracts through which the retailer obtains higher quality products from the producer. In this framework, the role of private labels is to attract consumers by offering higher safety and quality products. The authors show that at higher MQS the profitability of the private label decreases but the retailer total profit increases. On the contrary, the producer total profit decreases at higher MQS. Thus, in absence of market imperfections, producers prefer a smaller increase of the MQS and to supply a private label, while retailers and consumers would prefer regulated MQS.

In the study of von Schlippenbach and Teichmann (2012), private standards are a tool to improve the retailers' bargaining position with respect to producers. In the vertical structure, the authors consider two competitive downstream retailers making strategic use of the private standard: if one retailer sets a relatively high private quality standard, the other retailer has an incentive to undercut the private quality requirement such that the supplier complying with the lower quality standard loses its outside option, and *vice versa*. This results in improved bargaining position of the low-quality retailer. These strategic uses of the private standards generate inefficiencies in the upstream production that can be mitigated by a public MQS. The vertical differentiation approach is particularly relevant in the case of GM-*free* standards, given that the supply of no-GM ingredients is conditional to identity preserved (IP) supply channels, that are driven by supply contracts and product quality certifications.

The interaction between firms and governments has been studied by a wide theoretical literature, suggesting that private standards are strategically used by firms to preempt government regulations and to induce low (and less costly) public MQS. Using a political economy approach, Maxwell *et al.* (2000) argue that private standards increase consumers'

welfare in absence of the public standard. Lutz *et al.* (2000) use a vertical differentiation model to show that firms may set a voluntary quality level before the government, in order to induce the regulator to weaken costly public MQS. McCluskey and Winfree (2009) show that firms may voluntarily adopt a private standard when there are uncertainties on the public regulation outcome, because different types of standards may have different effects on the firms' revenues. Therefore, the firm is incentivized in adopting a private standard before the public one is in place, in order to choose the quality level that minimizes the negative effects on firm's revenues. Moreover, they argue that private standards are more efficient in responding to changes in technology and in consumer preferences than public ones.

Vandemoortele (2011) uses a political economy model based on Grossman and Helpman (1994) to show in which circumstances the retailer chooses a stricter standard than the public one. The decision depends on the retailer's market power and on the political influence of producers. If producers use their political power to induce a lower public standard, then retailers may use their market power to set a higher private standard. Moreover, other factors affect the decision of the retailer, such as the possibility for the retailer to transfer a smaller rent and to shift the implementation cost to producers.

Another important factor affecting the retailers' decision of adopting a private standard are consumers' preferences and quality perception. An important strand of literature has been studying the importance of the structure and ownership of mass media on information distribution, policy outcome and economic welfare (Besley and Burgess, 2001; Stromberg, 2001). Starting from this literature, some authors analyzed the political economy of mass media and the consumer's perception of biotechnologies. McCluskey and Swinnen (2004) pointed out that mass media ownership in developed countries progressively shifted from public to private. As a consequence, mass media objectives also shifted, from political to commercial objectives. The authors argue that, according to the "bad news hypothesis" - i.e.

the marginal value of an information with negative welfare effects is higher than the marginal value of an information with positive welfare effects - private media tend to publish negative aspects of news items in order to maximize their profit. Thus, private media are more likely to deliver potential risks associated with biotechnology rather than potential benefits, affecting the consumers' perception of products obtained with this technology. Curtis *et al.* (2008) show that differences in media organization and consumption between developed and developing countries can explain the differences in consumer attitudes on GMOs, *ceteris paribus*. They argue that the higher cost of information in developing countries, and the consequential lower consumption of information on biotechnology, can induce more favorable consumer's perception of GMOs.¹ This because media in developing countries are often government controlled, and the ideological influence of governments can increase positive coverage of information in order to lower the risk perception of consumers.

The central aim of our empirical analysis is to test the main hypotheses of the above theoretical literature. Specifically, the effects of the interactions between retailer and producers will be tested using certifications as a proxy of the level of integration of the supply chain. We expect that a greater number of certifications available in the country promote the adoption of GM-free private standards. Second, the interaction between the retailer actions and the government behavior will be tested by accounting for differences in the level of restrictiveness of public GMO standards. A strong heterogeneity in the public GMO regulation between destination and home country may induce the adoption of the private GM-free standard to overcome uncertain effects on retailers' revenues due to different levels of the public standard across countries. Finally, the influence of the mass media structure on private

¹ Kalaitzandonakes *et al.* (2004) provided evidence on the media coverage of biotech food in two rich markets, the Netherlands and the US. They show that in both markets media were generally negatively reporting on the potential health risks of biotech food, despite the fact that these risks were not confirmed. Vigani and Olper (2012) empirically tested the role of mass media in the formation of public GMO standards, finding that in rich countries, competition between commercial media induces information bias on food safety issues that translates into a policy bias, namely more stringent GMO standards.

GMOs standards will be also taken into account. In this respect, we expect that the public ownership of mass media provides less incentives in delivering ‘bad news’, reducing consumers’ aversion to biotechnology, and, in turn, reducing the incentive for the retailer in adopting private *GM-free* standards.

3. Retailers’ private GMO standards

3.1 Sample selection

We collected an original sample of GMO private standards of the most important retailers worldwide. We collected information of 44 retailers groups, consisting of 174 different supermarkets brands that include all types of stores from hypermarkets to express stores. Our sample represents 75% of the top 100 world food retailers, ranked according to the value of retail sales in 2008 (Deloitte, 2010). Table 1 reports the complete list of retailers in the sample.

We rely on retailers’ statements on their internal GMO policies available to the public, applying three different strategies in gathering data. First, we collected retailers statements reported on annual financial and sustainability reports of the year 2009 (published in 2010) or of the closest year available. Second, we collected similar statements from retailers’ web pages accessed in the period between April and July 2010. Finally, we directly contacted the retailers’ customer service by e-mail in the same period, asking for explanation of unclear statements and for missing information.

The focus of the sample is on *GM-free* standards on private label products. These products represent a direct link between supermarkets and suppliers, stressing the monopsony that small producers face due to the stronger market power of retailers. Organic products are not treated in the sample, assuming that all organic products are *GM-free* since these products are subject to certification processes that do not allow for the use of GM ingredients.

We distinguish between countries where the retailer groups are based (home countries) and countries where the retailer groups have stores (destination countries). Retailers are concentrated in 12 home countries. 26 retailer groups are based in Europe, 16 in North America (United States and Canada) and 2 in Oceania. The overall 44 retailers have stores in 53 destination countries distributed over all continents. Table 2 shows the destination markets of our retailers. Almost half of the destination countries are developing or emerging, the majority of them are located in Asia and Latin America. In Africa we record one retailer having stores in Madagascar (the French retailer Casino).

European retailers have a wider geographical diffusion with stores in 44 countries in all continents. The high internationalization of European retailers can be due to the internal market structure as well as to historical factors such as past colonial expansion.

In contrast, North American retailers are mainly focused on their domestic markets, since they are present in only 15 countries of which 7 in South and Central America. This difference can be due to different domestic market size. North American retailers can rely on a larger domestic market, which reduces internal competition and the need to consider internationalization as a growth strategy. The North American retailer most active in foreign markets is Walmart, that is also the largest retailer in terms of annual sales. Moreover, Walmart invests in several developing and emerging countries in South and Central America.

3.2 Retailers' private GMO standards

We divide the sample of retailers into three categories based on their statements about GM products and ingredients (see Table 2). Category 1 includes retailers not adopting GMOs private standards in the destination country. In the second category there are retailers who do not have a specific *GM-free* standard, but that do not label their products as “Containing GMOs” following the destination country’s regulation on labeling threshold. This means that

the retailers in category 2 potentially adopt GM ingredients. In the third category we included retailers stating not to use GM ingredients in their private label products in the destination country (*GM-free*). Not all the retailers in this category adopt *GM-free* labels. Indeed, many retailers are reticent in adopting a *GM-free* label, even if they are relying on no-GM IP supply chains to ensure no-GM ingredients in their products. In order to provide a more comprehensive picture in our analysis, we choose to collect retailers' internal policies statements and not the adoption of specific *GM-free* labels that can show just partial *GM-free* private strategies.

Only 3 out of 44 retailers state that they do not have objections in the use of GM ingredients (Table 3). Two of them, Safeway and Kesko, operate only on the local market, hence it is likely that their decisions are closely linked to local consumers preferences. On the other hand, Koninklijke Ahold operates in the Netherlands and in the US. Consumers in both countries are more open to the use of GMOs. Moreover, the Ahold's position takes into account the local regulations (see Table 4), showing the need to adapt to the preferences of consumers in different countries. The top ten world retailers included in our sample (Table 1) are divided over the categories *GM-free* standards and potential use of GM ingredients. None of them are oriented to the use of GM ingredients.

Retailers in category 2 are 20 and the largest majority of them are based in North America. The behavior of retailers in category 2 is particularly sensitive. Many retailers are not willing to take a defined position on GMOs (i.e. adopting a private *GM-free* label) because of uncertainties both on the supply and on the demand side. On the one hand, the firm who adopts a *GM-free* label must purchase constant amounts of no-GM IP ingredients from one year to the other, and this is not easy to achieve on the traditional markets. To be provided with constant amounts of no-GM IP ingredients, the firm must create new and reliable supply channels that are conditional on business-to-business contracts and on certifications.

However, these supply channels increase economic and logistic burdens due to IP and products traceability. On the other hand, the label “Containing GMOs” can be perceived by consumers as a hazard warning, even if the GM ingredients have been approved by the regulatory institutions after a health and environmental risk assessment. This warning effect can affect not only the sales of the labeled product, but also the consumer’s perception of the overall retailer’s “way to do business”. Hence, many retailers prefer to remain on the “safe side”, continuing to purchase the ingredients for their private label products on the traditional market and building the consumer’s confidence relying on the public regulation².

Retailers who have a GM-free standard (category 3) are 21, the large majority of them are based in Europe. European retailers have driven the adoption of GM-free labels since the early 2000s. In 2004 Austria and Germany adopted the *Gentechnik-frei erzeugt* (grown GM-free) label for animal products, like dairy, poultry and pork, which progressively spread in other EU countries. In 2008 Germany adopted the *EGGenTDurchfG* Act that provided a legal base to GM-free labels. More recently, in January 2012, France adopted a new decree (*Sans OGM*) that establishes rules for GM-free labels at national level. The example provided by these regulations at government level will likely significantly boost the adoption of GM-free labels also in other European countries.

Taking into account that most European retailers have a GM-free standard and that the European retailers included in category 2 remain below the 0.9% threshold, it suggests that GM private standards in Europe are stricter than public ones, in line with the theoretical findings of Vandemoortele (2011). However, this is not the case for North American retailers. According to the public regulation, the US and Canadian supermarkets do not adopt specific standards on GM ingredients, neither do they have specific statements on their use.

² The threshold established by the European regulation (above which a product must be labeled as containing GMOs) is 0.9%, while it is 1% in China, Australia and Brazil, 3% in South Korea and Malaysia, and 5% in Japan and Indonesia. The US and Canada have a voluntary labeling regime.

Retailers' private standards may change in different markets, adopting the best strategy according to consumer preferences and public standards. For example Tesco, which has its core business in Europe, adopts a *GM-free* standard globally, but with the exception of China and US where Tesco allows the use of GM ingredients (Table 4). In the same way, Delhaize avoids adopting specific GM standards, except in Europe where it adopts a *GM-free* private label.

Moreover, some retailers belonging to the same group apply different approaches. For example, the Walmart Group has stores all over the world, but only in the UK a *GM-free* standard was implemented under the brand of ASDA stores. In the same way, DIA, which is part of the Carrefour Group, declares to comply with public regulation while Carrefour sells *GM-free* private label products.

Finally, also hard discounters like ALDI have a *GM-free* statement. Hard discounters sell cheaper products and usually have less (or lower) private standards. However, since the global economic crises of 2008-2009, the retailers' strategies to increase sales are both to implement their discount format and to focus on value-oriented consumers. In this context, hard discounters are shifting towards higher quality products in order to capture a larger share of consumers.

4. Hypotheses and data description

From the discussion of our sample above, we developed a binary dependent variable based on the retailers' statement about GMOs private standard. The categorical variable is called *GM-free* and describes the behavior of the retailer concerning GMOs private standards in destination countries. Hence, the base of our analysis is the country pair retailer-destination. Despite in the previous section we show three categories of private policies (i.e. *GM-free*, potential adoption of GMOs and no objection to GMOs), for the econometric analysis we

decided to distinguish retailers in two groups: the ones which adopt *GM-free* standards from those who do not do it. This decision has been taken because on the one hand the meaning of a *GM-free* standard is straightforward, but on the other hand it is not similarly relevant the distinction between the two categories ‘potential adoption of GMOs’ and ‘no objection to GMOs’ given that both may lead to the use of GM ingredients. Hence, the dependent variable takes values equal to 1 if the retailers reported that they do not use GM ingredients in their private label products in the destination country; and 0 otherwise.

The explanatory variables are selected on the basis of the theoretical literature and previous evidences. In particular, we followed the conceptual framework proposed by Herzfeld *et al.* (2011). According to this framework, the key factors influencing the choice to adopt or not private standards are four. The first factor includes historical and geographical conditions, the second explains the retailer’s choice as a function of infrastructure, while the third factor is a function of sectoral conditions. Finally, the fourth factor accounts for the quality of institutions and economic development. Table 5 reports summary statistics of the variables used to proxy for these determinants, adding also some new key variables that should be relevant for the case under study.

Historical and geographical factors affect the information flows between countries. Common cultural characteristics between countries, that may derive both from historical and geographical conditions, may affect consumers’ preferences as well as firms behavior, easing the spread of new technologies and standards and explaining their potential adoption. To test for historical and geographical conditions, we used two variables. First, we use a dummy variable on *Common language* to control for cultural and historical factors, which is equal to 1 if the official language is common to the retailers’ home country and to the destination country. We expect that sharing the official language may increase the likelihood of the adoption of the standard also in the destination country. Moreover, we control for the size of

the destination country using the logarithm of the population (*Population*). The common language dummy variable is taken from the CEPII Gravity dataset developed by Head *et al.* (2010); while the data on population come from the World Bank's WDI database.

Infrastructure factors may affect the adoption of a private standard in different ways. A lack in both transportation and information infrastructures can significantly increase the costs of adoption of the private standard and of the integration of the retailer in the supply chain. The destination country's provision of transport infrastructure, such as road and rails, affects both the internal and the export transports costs, influencing firms' competitiveness both on the domestic and on the international markets. The development of the destination country transportation infrastructure is taken into account using the *Road* density per square kilometer. Moreover, information and communication infrastructures are vital to have access to information on export requirements and on competitiveness strategies of other firms. Access to telephones, faxes, e-mail, and internet increases the likelihood of interactions between adopters and potential adopters in different countries, promoting the diffusion of business strategies and new technologies also at long distances. As a proxy of information and communication infrastructure we use the *Telephone* lines per 100 people. Both data on road and telephone lines come from the WDI database. Finally, the introduction of a private standard is conditional to the existence of certifications. Certifications are fundamental to transmit credence attributes along the supply chain, as a quality signal to the final consumers but also to transfer products with the desired characteristics from suppliers to retailers. The absence in the destination country of local auditors may negatively affect the decision of the retailer to adopt the private standard, due to higher transaction costs and lack of knowledge on the local supply conditions (Barrett *et al.*, 2002). GlobalGAP, British Retail Consortium (BRC) and International Food Standard (IFS) are the most common international certificates on agri-food products. We use the variable *Certification* that ranges between 0 and 3, where 0

means that none of the three certifications have offices in the destination country, 1 and 2 that there are one or two certifications respectively, and 3 that all the three certifications have offices in the destination country. Data for the certification variable are taken directly from GlobalGAP, BRC and IFS international websites.

Sectoral factors are mainly captured by the destination country position on the international markets. International trade is not only a mean for the exchange of goods and services, but it is also the first source of networks that links together customers, suppliers, and governmental and non-governmental organizations, enhancing interaction for the transfer of knowledge and new practices. Through the interactions coming from trade, firms may learn the practices and standards of successful foreign counterparts. In order to study the effect of international trade on the adoption of GM-free private standards we use three variables. First, we use the agricultural export share (*Agexpsh*) that measures the relative importance of agricultural exports with respect to total exports. Countries with well-established agricultural exports have also a greater integration in the international market and show a higher comparative advantage in agricultural production. Second, we use the logarithm of the agricultural bilateral exports (*Agbilexp*) between destination and home country, given that intense trade relations can induce homogenous organizational practices (Eichengreen and Irwin, 1998; Guler *et al.*, 2002). Finally, we consider the export share of agricultural products on total exports of the destination countries to three high-income countries, namely European Union, the US and Japan (*AgexpEIJ*). The agri-food market in these countries is highly competitive, promoting product differentiation strategies across retailers. Moreover, the high-income consumers can be more willing to pay a price premium for higher-quality differentiated products. Data on exports are taken from the UN COMTRADE database, through the World Integrated Trade Solution (WITS) service provided by the World Bank.

The fourth factor, the institutional environment, can shape market characteristics and firm-specific actions by influencing the choice between public and private standards. Private standards can be complementary to existing public regulations or can act as substitutes if public regulations are not enforced. In particular, legislation and liability laws play a fundamental role in the redistribution of market failures (e.g. food safety failures), motivating private firms to adopt individual measures of risk mitigation. Moreover, public institutions are less reactive than private firms in adapting to changes of demand and technological adoption. To control for the role of public institutions we use the most representative index of the quality of institutions, *Rule of law*, taken from the World Bank Governance Indicators data base (see Kaufmann *et al.*, 2007). This is an aggregate index accounting for: the extent of property rights protection; the enforceability of contracts; the independence of the judiciary system; and the effectiveness of the legal system. The index provides an overall indication on the effectiveness and the predictability of the judiciary system and the enforceability of contracts. It ranges between 0 and 5, with higher values indicating higher institutions quality. Empirical evidences suggest that quality management systems at firm-level are fostered by high-quality institutional environment (Correa *et al.*, 2008), hence, similarly, we expect that better institutions promote the adoption of the private standard.

Within the explanatory variables, we also include the logarithm of the GDP per capita (*GDPpc*) to control for the level of economic development. For retailers in developing countries there can be potential disadvantages in adopting private standards due to prohibitive transaction costs in the supply channel. We test also a possible non-linear relationship of the level of the economic development using the squared logarithm of the GDP per capita (*GDPpc²*).

In addition to the variables mainly used by the empirical literature on the drivers of private standards, we also include two new variables with the objective to test the hypotheses formulated by the theoretical literature in Section 2.

More precisely, we first include a variable on the share of the public press on total press (*Press*) taken from Djankov *et al.* (2003). The relevance of the structure of the mass media in inducing restrictive public GMO regulations has been shown, both conceptually and empirically, by Vigani and Olper (2012). The authors explained that private media are more consumer oriented than public ones, having a tendency in delivering “bad news” that enhance the consumption of media. The rationale is the following: consumers that are worried on important issues (such as food safety) consume more media to increase the level of information, and private media are biased in delivering bad news in order to increase sales (McCluskey and Swinnen, 2004). This mechanism can have an important role in shaping consumers preferences (see section 2), given that GMOs represent a highly sensitive issue in terms of food safety (Kalaitzandonakes *et al.*, 2004). As a consequence, the retailer’s decision in adopting or not GM ingredients can be affected by the ownership structure of mass media. Following the theoretical arguments of Curtis *et al.* (2008), we expect that a higher share of public press negatively affect the adoption of GM-free standards.

Second, in order to account for the interaction between private and public GMO standard, we use an index on the restrictiveness of the GMO public regulation (*GMO index*), developed by Vigani *et al.* (2012). The GMO index is a composite index accounting for 6 dimensions of the GMO regulation, namely, approval process, risk assessment, labeling, traceability, coexistence and subscription to international agreements on GMOs. It ranges between 0 and 1, where higher values indicate a more restrictive regulation on the use and commercialization of GMOs. We compute a bilateral measure of this index, obtained by taking the absolute deviation of the GMO index between destination (i) and home (j) country, namely $GMO_{ij} =$

$|GMO_i - GMO_j|$. With this bilateral index we obtain a regulatory distance between destination and home country on the use and commercialization of GMOs. We expect that a strong heterogeneity in regulation between countries induce the retailer to adopt the private standard in order to select its optimal quality level. Moreover, different levels in the restrictiveness of the regulation may incentivize the retailer to not use GM ingredients in order to avoid product transfer interruptions due to asynchronous and asymmetric approvals.

All the data of the explanatory variables are taken for the year 2005 (or closest to that year). This lagged period with respect to the dependent variable, which refers to information collected in 2010, allows us to clean for potential endogeneity issues between our determinants and the dependent variable.

5. Econometric strategy

To explain the retailers' choice between different GMOs private standards we use a binary response model to measure the retailer's probability to opt for the GM-free private standard, taking into account the destination country's characteristics. The dependent variable y_{ij} , can take on the following values:

$$y_{ij} = 1 \text{ if the } i^{\text{th}} \text{ retailer in the } j^{\text{th}} \text{ country choose a GM-free standard;}$$

$$y_{ij} = 0 \text{ otherwise.}$$

The binary response probability is given by:

$$P(y_{ij}=1|\mathbf{x}) = G(\beta_0 + \beta_1 x_1 + \dots + \beta_{13} x_{13}) + \varepsilon_{ij} = G(\beta_0 + \mathbf{x}\boldsymbol{\beta}) \quad (1)$$

Where \mathbf{x} represents a vector of country j characteristics.

We test three different specification of this model. The first specification include in the vector \mathbf{x} the following variables: (1) *Common language*; (2) *Population*; (3) *Road*; (4) *Telephone*; (5) *Certification*; (6) *Agexpsh*; (7) *Agbilexp*; (8) *AgexpEUJ*; (9) *Rule of law*; (10) *GDPpc*; and (11) *GDPpc2*.

In the second and third specification we augment the vector \mathbf{x} adding first the variable (12) *Press*, and subsequently adding also the bilateral variable (13) *GMO index*.

Moreover, in all the specifications we include regional dummies (for EU countries, Asia, Latin America, North America and Middle East) to check for any other omitted factors.

Equation 1 is estimated using a Probit model, with maximum likelihood estimators (MLE), where G is the normal cumulative distribution function taking on values strictly between 0 and 1:

$$G(\beta_0 + \beta_1 x_1 + \dots + \beta_{13} x_{13}) = \Phi(\beta_0 + \mathbf{x}\boldsymbol{\beta}) \equiv \int_{-\infty}^z \phi(\beta_0 + \mathbf{x}\boldsymbol{\beta}) dv$$

Where the standard normal density is given by:

$$\phi(\beta_0 + \mathbf{x}\boldsymbol{\beta}) = (2\pi)^{-1/2} \exp(-(\beta_0 + \mathbf{x}\boldsymbol{\beta})^2 / 2)$$

6. Results and discussion

We run three different specifications of the Probit equation. In the first one we test four groups of hypotheses about the drivers of private standards adoption by firms, along the line of Neumar and Perkins (2005) and Herzfeld *et al.* (2011). Differently, the second and third specifications test new hypotheses by adding two key variables of interest, and checking also the robustness of the first specification results. Specifically, in specification 2 we add a variable on the ownership structure of the press in the destination country, testing the hypothesis formulated by the literature on the political economy of mass media and perception of biotechnologies (McCluskey and Swinnen, 2004; Curtis *et al.*, 2008). In specification 3 we add a variable capturing GMO regulations with the objective to test the possible interaction between private and public standards (Maxwell *et al.* 2000; Lutz *et al.* 2000; McCluskey and Winfree, 2009; Vandemoortele, 2011).

Results of the econometric model are shown in Table 6. In general, the estimates and the marginal probability effects are similar across specifications, thus the results of columns 2 and 3 tend to confirm the stability of the basic model. The most important difference is in *Telephone* and *AgshEUJ* variables, which become highly significant on passing from the basic model to specifications 2 and 3.

Starting from historical and geographical variables, we find that when the destination country share a common language with the home country the likelihood that the retailer adopts a GM-free standard increase of about 35-40%. The common language can ease the spread of the standard, both as a result of easier transfer of new commercial strategies and of shared consumers and firms characteristics. However, the destination country size has a significant negative effect on the likelihood of adopting GM-free standards. This can be due to a more complex stratification of the (large) population that makes difficult the identification of clear standards preferences.

Looking at the results for infrastructure variables, we can obtain deeper understanding of the effect of the destination country size. Countries with a higher share of roads for squared km are less likely to adopt GM-free standard. Each additional km of roads for squared km reduce the likelihood of adopting GM-free private standards of about 12%. This is in line with the result of Herzfeld *et al.* (2011) on the spread of GlobalGAP certificates across countries, but with respect to them we find a significant negative effect. This suggests that a more complex infrastructure (in particular in large countries) can reduce the incentive of adopting a GM-free standard due to higher compliance costs of segregation measures between GM and no-GM IP ingredients. However, a greater endowment of information infrastructure, such as telephone lines, significantly increases the likelihood of adopting a GM-free standard, confirming the hypothesis that more information facilities enhance the firm's integration on the international competitive markets. Despite the variable *Telephone* is not significant in specification 1, it is

significant at 1% level in specification 2 and 3, substantially increasing also its marginal probability effect.

The variable on *Certification* is of particular interest in our study. Results show that the presence of each additional certification (i.e. GlobalGAP, BRC and IFS) in the destination country increases the likelihood of adopting the GM-free standard from 12% to 17%, depending on the specification. This confirms our hypothesis and also the findings of the theoretical literature on vertical differentiation strategies (see, Giraud-Héraud *et al.*, 2006 and von Schlippenbach and Teichmann, 2012). A more integrated supply chain promote more reliable sources of no-GM IP ingredients, enhancing the interaction between producers and retailers in terms of supply contracts. Moreover, certified products induce in the retailer a greater confidence on the local supply conditions (Barrett *et al.*, 2002).

Passing to the next group of variables, we show that the destination country trade position is an important factor affecting the retailer's decision of adopting a GM-free standard. First, a country with a higher comparative advantage in exporting agricultural products it is less likely to adopt the private standards. This can be explained by the fact that countries with higher agricultural comparative advantage are those adopting innovation in the agricultural sector, such as biotechnologies. The retailer can face higher IP costs in these countries due to the diffusion of biotech crops, reducing the incentive of adopting the GM-free standard. Note that the marginal effect is particularly high, suggesting a great sensitiveness of the likelihood of adopting GM-free standards for each unitary increase of the agricultural export share. Second, also high agricultural exports from the destination to the home country have a negative effect on the probability of adopting a GM-free standard. Indeed, the introduction of a standard that significantly increases the trade costs due to IP chains can negatively affect well established bilateral trade relationships and supply channels. Finally, we show that a higher share of agricultural exports to rich markets (i.e. European Union, Japan and the US) have a strong

positive effect on the likelihood of adopting a GM-free standard in specifications 2 and 3. These markets drive the global demand for no-GM IP products. As we have seen, *GM-free* standards have been introduced first in Europe. Consumers in these countries are highly sensitive to the GMOs issue, they are more concerned on food safety and they are more willing to pay for an extra premium for no-GM IP products. Moreover, in these countries green campaigns and anti-GMOs non-governmental organizations are more active, having potential effects on consumers demand for products containing GM ingredients (Gruère *et al.* 2009).

The effect of the quality of institution is negative and highly significant. This suggests that in countries with lower legal protection the retailer adopts its own policy to recover from market failures, such as food scares. Thus, we confirm the hypothesis that the *GM-free* private standard can be complementary or can substitute the public regulation.

We tested also the level of development of the destination country as a potential determinant of *GM-free* standards adoption. We find that in countries with higher GDP per capita retailers are more likely to adopt GM-free private standard. However, this result is not statistically significant, nor in the case of a no-monotonic effect.

In specification 2, we test the effect of the public press on the likelihood of adopting the *GM-free* private standard. The hypotheses coming from the political economy of mass media are confirmed. Indeed results show that the public ownership of the domestic newspapers decreases the likelihood of the adoption of a *GM-free* standard, and that this effect is particularly strong. This suggests that, because public media tend to transmit information with a less negative view with respect to private media in order to soften food safety concerns (Curtis *et al.*, 2008), the consumers' aversion towards GM products is lower, reducing the incentives for retailers to sell no-GM IP products.

Finally, we tested the effect of the distance in biotech regulation between destination and home country. The results show that an increase in the regulatory difference between home and destination country strongly increase the probability that the retailer adopts *GM-free* private standards. This result confirms the hypotheses of the theoretical literature on the interaction between private and public standards. In the presence of heterogeneous GMO regulations, the retailer is more likely to adopt its own private standard, setting the quality level that minimizes the negative effects on revenues. Moreover, in order to exploit their private label products in different markets, the best strategy is to sell products not containing GM ingredients. This allow the retailer to avoid problems such as asynchronous or asymmetric approval while transferring private label products from one country to the other, exploiting the no-GM IP supply channel to a larger (international) scale, without incurring in different labeling thresholds. The adoption of a single (restrictive) private standard at large scale permits to overcome compliance and logistic costs due to different public MQS levels in different countries, having homogeneous products for markets with different regulations.

7. Conclusions

This paper contributes to the empirical literature on the factors driving the formation of private standards. In particular, we study the determinants driving the retailers in the adoption of *GM-free* private standards.

First, we provide an original ‘hand-made’ sample on GMOs private standards for 44 retailers, showing that these standards can be clustered in three groups: retailers not adopting GMOs private standards; retailers who do not have a specific *GM-free* standard, but that do not label their products as “Containing GMOs” following the public regulation on labeling thresholds; and retailers not using GM ingredients in their private label products (*GM-free*). Importantly, we show that many retailers prefer not to take a defined position on GM ingredients, building

the consumer's confidence on the public regulation rather than on private standard, depending on the supply channel and on the demand structure in destination countries.

Second, we tested several hypotheses coming from the empirical literature on the private standard formation. We start from the framework proposed by Hertzfeld *et al.* (2011), testing the effects of four groups of factors: historical and geographical factors; infrastructure; sectoral conditions; and the quality of institutions and economic development. We find that the common language between home and destination countries, a higher endowment in communication infrastructure and higher exports to rich markets increase the likelihood of adopting GM-free private standards. Most importantly, we show that a greater integration in the supply chain given by more certifications induce the adoption of GM-free private standards. On the contrary, the country size, more transportation infrastructures, greater agricultural comparative advantage and the quality of institutions negatively affect the probability of adopting GM-free private standards.

Third, we tested additional hypotheses coming from the theoretical literature on the political economy of mass media. We show that a greater share of public newspapers decrease the likelihood of the adoption of a GM-free standard. This is in line with the theoretical arguments of McCluskey and Swinnen (2004) and Curtis *et al.* (2008), as well as with the empirical findings of Vigani and Olper (2012). The result suggests that, because public media tend to transmit information with a less negative view with respect to private media that are biased in delivering 'bad news' in order to increase media consumption, the consumers' aversion towards GM products is lower, reducing the incentives for retailers to sell no-GM IP products.

Finally, we tested the hypotheses of the literature on the political economy of private standards formation, showing that uncertainties at public regulation level in the form of heterogeneous public standards between home and destination countries induce the retailer to

adopt private standards in order to voluntarily choose the quality level that minimizes the negative effects on revenues.

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Tab. 1: List of retailers groups and private GM standards, ordered by retail sales according to Deloitte, 2010.

	<i>Home Country</i>	<i>Retailer</i>	<i>Main Markets</i>	<i>GMO Private Standard</i>
1	USA	Walmart	US, Latin America	Potential use of GM ingredients
2	FRA	Carrefour Group	Europe, Latin America	GM-free
3	DEU	Metro Group	Global	Potential use of GM ingredients
4	GBR	Tesco	Global	GM-free
5	USA	The Kroger Company	US	Potential use of GM ingredients
6	DEU	Aldi Group	Europe, US	GM-free
7	DEU	Rewe Group	Germany, Austria	Potential use of GM ingredients
8	FRA	Auchan Group	Europe	GM-free
9	FRA	E. Leclerc	Europe	GM-free
10	DEU	Edeka Group	Germany	GM-free
11	USA	Safeway	North America	No objection to GM ingredients
12	FRA	Casino Group	Europe, Latin America	GM-free
13	NLD	Koninklijke Ahold	US, the Netherlands	No objection to GM ingredients
14	AUS	Woolworths	Oceania	Potential use of GM ingredients
15	USA	SuperValu	US	Potential use of GM ingredients
16	AUS	Coles Group	Australia	GM-free
17	GBR	J Sainsbury	UK	GM-free
18	GBR	Morrison Supermarkets	UK	GM-free
19	BEL	Delhaize "Le Lion"	US, Europe	Potential use of GM ingredients
20	FRA	Systeme U	France	GM-free
21	USA	Publix Supermarkets	US	Potential use of GM ingredients
22	CAN	Loblaw Companies	Canada	Potential use of GM ingredients
23	CHE	Migros Group	Switzerland	GM-free
24	ITA	COOP Italy	Italy	GM-free
25	GBR	Marks & Spencer	Global	GM-free
26	CHE	Coop Switzerland	Switzerland	GM-free
27	USA	Meijer	US	Potential use of GM ingredients
28	DEU	Tengelmann Group	Germany	GM-free
29	SWE	ICA Group	Sweden, Norway	Potential use of GM ingredients
30	FIN	Kesko	Finland	No objection to GM ingredients
31	USA	Dollar General	US	Potential use of GM ingredients
32	GBR	Somerfield Stores	UK	GM-free
33	USA	Giant Eagle	US	Potential use of GM ingredients
34	USA	Whole Foods Markets	US	GM-free
35	ITA	Esselunga	Italy	Potential use of GM ingredients
36	USA	Winn-Dixie	US	Potential use of GM ingredients
37	FRA	Cora Group	Europe	GM-free
38	USA	ShopRite	US	Potential use of GM ingredients
39	USA	Hyvee	US	Potential use of GM ingredients
40	ITA	Mdo	Italy	GMO-free
41	USA	Roundy's Supermarkets	US	GM-free
42	USA	Nash Finch Company	US	Potential use of GM ingredients
43	ITA	Selex Group	Italy	Potential use of GM ingredients
44	CAN	Sobeys	Canada	GM-free

Source: own data collection. See text for explanation.

Tab. 2: Number of destination countries per geographical regions.

<i>Destination Markets</i>	<i>Developing\Emerging</i>	<i>Developed</i>	<i>Tot</i>
Africa	1	0	1
Asia	8	2	10
Europe	5	21	26
Middle East	2	0	2
North America	0	2	2
Central America	4	0	4
South America	6	0	6
Oceania	0	2	2
<i>Tot</i>	26	27	53

Note: Classification based on the International Monetary Fund's World Economic Outlook Report, April 2012.

Tab. 3: Number of retailers per GMO private standard and geographical regions.

Origin	Numbers of Retailers		
	GM Free	Potential Adoption of GM	None objections to GM ingredients
<i>Europe</i>	18	6	2
<i>North America</i>	2	13	1
<i>Oceania</i>	1	1	0
<i>Total</i>	21	20	3

Source: own data collection. See text for explanation.

Table 4 – Examples of retailers’ statements on GM private standards

<i>Retailer</i>	<i>Home Country</i>	<i>Statement on GMOs</i>	<i>Source</i>
ALDI Australia (ALDI Group)	Germany	"We have achieved 'green' status for our Genetically Modified (GM) policy in Greenpeace's True Food Guide. ALDI complies with all existing regulatory requirements pertaining to GM as stated in the Australia New Zealand Food Standards Code. ALDI does not stock any products which are labeled as containing GM ingredients."	ALDI Australia Website (accessed 28/05/2010)
DIA (Carrefour Group)	France	"...DIA complies with current legislation, guaranteeing that its products do not consist of, nor have they been produced from, ingredients that contain more than 0.9% GMO. To guarantee its compliance, the company demands certificates from all its suppliers and carries out periodic analyses of all its products."	DIA Annual Report 2007
J Sainsbury	UK	"At Sainsbury's we do not permit the use of genetically modified crops, ingredients, additives or derivatives in our own-brand food, drink, pet food, dietary supplements and floral products. We work closely with our suppliers, who are subject to our strict approval and audit processes, to ensure that our GM policy is adhered to at every step of the supply chain. We require the supply chain to be identity preserved."	Media FAQs November 2009
Royal Ahold	Netherlands	"Where there are clear, demonstrable benefits to consumers, Ahold has no objections to the responsible use of safe biotechnology. Products we offer which are made with this technology are products which are approved by the authorities, based on a safety and environmental impact assessment. We differentiate our assortment from country to country in line with consumer demand."	Ahold Website (accessed 07/04/2010)
Safeway	USA	"Today's agricultural and food industries are using genetic engineering to develop new and better foods and food-related products. [...] You may not be able to tell when you're buying GM foods, because the FDA generally doesn't require manufacturers and producers to label them as such. That's because GM foods are considered no different in quality or safety from conventionally produced foods."	Safeway Website (accessed 05/06/2010)
Tesco	UK	"We have a non-GM ingredient policy for our own-brand foods in 11 of the countries in which we operate.[...] In China and the US we do allow some GM ingredients in our own-brand products. In the US, due to high levels of GM soy and maize, it would be virtually impossible to segregate products according to whether they did or did not contain GM ingredients. "	Corporate Responsibility Report 2009

Tab. 5 – Summary statistics of dependent and independent variables.

Variable	Obs	Min	Max	Mean	Std. Dev.
Dependent:					
<i>GM-free</i>	338	0	1	0.57	0.50
Independent:					
<i>Common language</i>	338	0	1	0.11	0.31
<i>Population</i>	338	13.05	20.99	17.62	1.52
<i>Road</i>	338	0	4.96	1.01	0.91
<i>Telephone</i>	338	1	69.00	38.57	18.05
<i>Certification</i>	338	0	3.00	2.48	0.79
<i>Agexpsh</i>	338	0.005	0.81	0.12	0.12
<i>Agbilexp</i>	338	0	30.31	19.70	11.83
<i>AgshEIJ</i>	338	0.002	0.87	0.16	0.18
<i>Rule of law</i>	338	1.28	4.45	3.20	0.90
<i>GDPpc</i>	338	5.37	11.09	9.40	1.32
<i>GDPpc2</i>	338	28.79	123.07	90.00	23.13
<i>Press</i>	313	0	1	0.04	0.19
<i>GMO index</i>	321	0	0.60	0.12	0.15

Note: See text for variables explanation.

Table 6 – Results from the Probit model.

Dependent: <i>GM-free</i>	(1)		(2)		(3)	
	Coeff.	dy/dx	Coeff.	dy/dx	Coeff.	dy/dx
<i>Historical and geogr. conditions</i>						
Common language	1.300*** (0.332)	0.407	1.096*** (0.366)	0.357	1.122*** (0.366)	0.358
Population	-0.318*** (0.108)	-0.126	-0.299** (0.129)	-0.118	-0.289** (0.132)	-0.114
<i>Infrastructure</i>						
Road	-0.285** (0.133)	-0.113	-0.290** (0.145)	-0.115	-0.303** (0.145)	-0.119
Telephone	0.016 (0.012)	0.010	0.052*** (0.016)	0.020	0.049*** (0.016)	0.019
Certification	0.293* (0.163)	0.116	0.373* (0.206)	0.147	0.431* (0.222)	0.170
<i>Trade</i>						
Agexpsh	-2.027** (0.919)	-0.802	-3.200** (1.475)	-1.265	-3.718** (1.585)	-1.464
Agbilexp	-0.046*** (0.010)	-0.018	-0.037*** (0.010)	-0.015	-0.045*** (0.010)	-0.018
AgshEUJ	0.715 (0.593)	0.280	1.914*** (0.704)	0.757	2.433*** (0.743)	0.958
<i>Instit. quality and GDP per capita</i>						
Rule of law	-0.582** (0.233)	-0.230	-0.743*** (0.256)	-0.294	-0.604** (0.265)	-0.238
GDPpc	1.390 (0.888)	0.550	0.989 (2.117)	0.390	1.756 (2.148)	0.690
GDPpc2	-0.079 (0.055)	-0.031	-0.079 (0.121)	-0.031	-0.119 (0.122)	-0.050
<i>Additional variables</i>						
Press			-2.402*** (0.667)	-0.950	-2.328*** (0.698)	-0.917
GMO index					2.973*** (1.026)	1.171
Constant	1.460 (4.545)		3.529 (10.460)		-1.187 (10.620)	
Regional fixed effects	YES		YES		YES	
Log-likelihood	-180.840		-160.230		-159.101	
Pseudo R-squared	0.219		0.251		0.273	
Observations	338		313		311	

Note: In parentheses robust standard error. ***, ** and * indicate significance level at the 1%, 5% and 10%, respectively. Each regression includes regional fixed effects for Asia, the EU, Middle East, North and Latin America.