

Institutions and the Societal Acceptance of Genetically Modified Crops in Emerging Economies: The Case of Brazil, India and China

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Abstract

An important aspect of the debate on global inequality is the discussion on food security. Genetically modified organisms (GMOs) play an important role in this debate, because they might provide a way for the economic South to increase their agricultural productivity and subsequently start to close the 'food gap' with the West. This thesis examines how institutions play a role in the societal acceptance of GMOs in emerging economies, in particular in Brazil, India and China. For this thesis twelve expert interviews were conducted. It was concluded that there are three types of institutions that – when over- or underdeveloped – can cause negative externalities for GMOs in emerging economies. The three categories of institutions are intellectual property right protection (1), food safety and environmental regulation (2), and, finally, informal institutions like having a societal debate on GMOs (3). Negative externalities resulting from the under- or overdevelopment of these institutions can affect the societal acceptance of GMOs.

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Introduction

'*Mon\$anto is poisoning you*', '*Monsanto, killing millions since 1901*', '*Seeds belong to nature, not to Mon\$anto*'. These are just a few of the slogans on signs used in the 'March Against Monsanto', which is an international grassroots movement against the biotechnology corporation Monsanto and against genetically modified food. It is an example of the numerous groups that oppose genetic modification of crops like cotton, maize, soy and rice. Why are these genetically modified crops stirring up so much protest? How does this debate fit within the larger debate on global food security? In short: why is the GMO debate an important debate?

Since the economic crisis there has been growing debate about inequality. Books like *The Price of Inequality* by Joseph Stiglitz (2012) and *Capital in the Twenty-First Century* (2013) by Thomas Piketty focus on this issue. A related global phenomenon is the Occupy-movement, which rallied against the '99%'. These discussions are mainly focused on inequality *within* countries, but there is also significant inequality *between* countries (Dasgupta & Ray, 1986). This manifests itself *inter alia* by lower GDP, underdeveloped health care and limited access to food and clean water in developing countries. During the economic and financial crisis, however, emerging economies like China, Mexico, India, Brazil and Turkey have contributed enormously to the economic recovery of the West by importing Western products (Stiglitz, 2009; O'Neill, 2013).

A very significant symptom of global inequality is the difference in access to food. People in the West are in many cases overeating, while millions are starving in developing countries. Furthermore, the demand for food in developing countries, especially in emerging economies, is ever increasing (Abler, 2010). With the advent of biotechnology in the 1970s a potential solution for this problem presented itself. A growth in agricultural productivity was made possible by genetically modifying food. A genetically modified organism (GMO) can be defined as an organism of which genetic material has been altered by adjusting the DNA without traditional crossing (Lotz et al., 2011).

An example of a GMO is a type of cotton known as bt cotton. Genetic engineering has made this type of cotton insect resistant, which has made the use of insecticide superfluous and has consequently made the cotton less hazardous to human health (Lotz et al., 2011). Bt cotton has also been found to often be cheaper and less labour-intensive than regular cotton, because, while genetically modified seeds cost more, using these seeds can save costs on insecticide and time on spraying (Ismael et al., 2002). Currently, there are 27 countries that plant biotech crops worldwide, 19 of which are developing countries (James, 2013). Could GMOs present an opportunity for developing countries to close the 'food gap' with the West?

For a successful introduction of GMOs in developing countries (and to decrease global inequality when it comes to food) it is important to have high societal acceptance of the use of GMOs (Frewer et al., 2004). Without this acceptance, there could be political costs and heavy protests against GM

products. Resistance to applying GM technology occurs with a variety of arguments. An obvious point of criticism from mainly religious groups has been of ethical nature (*i.e.* ‘it is unnatural’). This type of criticism has been shown to be of relatively low importance for the overall societal acceptance of GMOs though. Much more important is public trust in regulatory institutions and scientists, because a high trust in regulatory institutions reduces the perceived risk of GMOs (Frewer et al., 2004; Qiu & Huang, 2006; Curtis et al., 2004).

A different type of criticism addresses potential economic, ecological and health effects. There are concerns that the use of GMOs may reduce biodiversity, cause monopolies or oligarchies, reduce the autonomy of farmers (or even ‘proletarianization’ of farmers as it has been called by some) and that GMOs could be hazardous to human health (Shiva & Jafri, 2003; Mascarenhas & Busch, 2006; Lemmens, 2014). These concerns are related to the food safety and environmental regulation on GMOs and to intellectual property rights, all of which are a part of a country’s institutional infrastructure. An institutional infrastructure can be defined as “...*systems of established and prevalent social rules that structure social interactions. Language, money, law, systems of weights and measures, table manners, and firms (and other organizations) are thus all institutions.*” (Hodgson, 2006).

Researching the validity of these criticisms can be an important step in understanding and improving the societal acceptance of GMOs in emerging economies, because these criticisms might affect the risk perception of consumers in these countries. This thesis focuses on how the institutional infrastructure may affect the risk perception of consumers when it comes to GMOs and how this perception might affect societal acceptance, with an emphasis on intellectual property right (IPR) protection, the role of food safety and environmental regulation and on public debates on GMOs. This thesis focuses on Brazil, India and China specifically.

This research was done in combination with an internship at the LEI institute in The Hague and is a part of the broader European FoodSecure research project, which explores the future of global food and nutrition security.* The research question of this thesis was:

“How do experts on biotechnology, intellectual property rights and the BRICs think about how a country’s institutional infrastructure – specifically the regulations on and the enforcement of intellectual property rights, food safety and environmental regulation and public debates on GMOs – affects the societal acceptance of GMOs in Brazil, India and China?”

* FoodSecure is financed for 75% by the EU and for 25% by the Dutch Ministry of Economic Affairs. It is not affiliated with any NGOs or corporate interests. More information on this research can be found online at <http://www.foodsecure.eu/>.

A discussion on the specifics of this research question will follow in the theoretical framework and methodology sections. To answer this question, qualitative research was performed; more specifically, twelve expert interviews were conducted.

Theoretical Framework

This research was limited to the BRIC countries (Brazil, India and China – Russia was excluded as will be discussed), because they make an interesting case; they combine characteristics of both developed and developing countries (O'Neill, 2013). This is exemplified by a relatively well developed educational system, which is associated with developed countries, but also by relatively low intellectual property right protection and enforcement, which is usually associated with developing non-Western countries. The BRICs are also 'in the lead' when it comes to 'catching up' to the West in terms of wealth. It is interesting to see if the BRICs can take on a leading role politically for other emerging economies in the GMO debate.

The BRICs are also interesting because they are populous emerging economies with enormous economic potential. For example, according to projections made by Goldman Sachs China is expected to have a larger total GDP than the United States by 2027 (O'Neill, 2013). Their GDP per capita still remains relatively low however, so there is still a lot of possible growth ahead. In fact, China is said to still only be in the mid-stages of developing a modern economy (Jacques, 2012).

The recent economic growth in these emerging economies has also led to an increased demand for agricultural products (Abler, 2010). If these countries successfully embrace GMOs on a large scale, it could be an example for other emerging economies and developing nations. Furthermore, Brazil, India and China are among the top ten of GMO producing countries worldwide (James, 2013). This means that potential adverse effects are more likely to be evident here than in countries with a lower output of genetically modified products.

Russia, though one of the BRIC countries, was not a part of this research, because of the time available for this research and the fact that Russia officially doesn't produce any GM crops (James, 2013).^{*} South Africa initially was a part of this research as the fifth BRIC, but was later left out due to a lack of experts to interview on its economy. Also, there is serious debate about whether South Africa

^{*} In fact, recently a draft law was submitted to the Russian parliament that seeks to impose punishment up to criminal prosecution for the producers of GMOs harmful to health or environment. Representative Kirill Cherkasov who co-wrote the bill said the following on the matter: *"When a terrorist act is committed, only several people are usually hurt. But GMOs may hurt dozens and hundreds. The consequences are much worse. And punishment should be proportionate to the crime."* Source: <http://rt.com/>. Accessed on: 05-06-2014.

should even be considered a BRIC country. As originator of the term Jim O'Neill put it: "... *the label BRIC has, for political rather than economic reasons, become BRICS with the inclusion of South Africa. Economically this is a bit odd, as South Africa [...] is not much bigger than Greece. Its size is dwarfed by the four original BRIC countries.*" (O'Neill, 2013: 5). When referring to the 'BRIC countries' or the 'BRICs' in the remainder of this thesis, this term only refers Brazil, India and China.

A lot of research has already been done on the question what factors play a role in the acceptance of GMOs, but so far this research has been strongly focused on Europe and the United States. A focus on populous emerging economies may provide new insights.

The three-legged chair

This thesis argues that if GMOs are to be embraced, it should be done with the institutional framework necessary to avoid negative externalities. In the case of GMOs, the key point in attaining high societal acceptance is about decreasing perceived risk. There are three types of institutions that need to be properly developed in order to attain high societal acceptance of GMOs. Each of these three types is vital: it is a three-legged chair that falls over if one of the three legs is missing. Under- or overdeveloping these institutions can cause negative externalities.

The first type of institution concerns intellectual property rights and market concentration. IPRs were originally instituted to stimulate innovation, but have in practice turned out to also facilitate monopolies. Some authors even say that IPR protection may in fact harm innovation in practice by creating these monopolies (Stiglitz, 2008). This will be elaborated more upon below. The second type of institution concerns food safety regulations and environmental policy. Too much bureaucracy on this point may cause market concentration as well, because it complicates getting a new seed variety approved, but a lack of policy on this point may also incite a feeling of unsafety (or actually allow unsafe foods on the market!), lowering acceptance of GMOs. On this second point, knowledge and R&D institutions also play an important role, as will be discussed.

The third and final type of institution that needs to be addressed concerns a public debate on the issue of GMOs. There are cases where the public wasn't sufficiently aware of the concept of biotechnology and didn't even understand what genetic modification entailed, but still rejected the use of GM technology on a large scale (Bánáti & Lakner, 2006). It is therefore important that consumers get a chance to be educated about genetic modification by having a debate. Also, increased public participation can increase trust in related institutions and thus create more support for GMOs (Frewer et al., 2004). In short, a public debate between the political elite, scientists, consumers, NGOs and the business sector is needed to inform the public and to reach a consensus on sensible GMO policies.

The first and second of these three legs address *formal* institutions, namely the regulations and policies on food safety, the environment and the protection of intellectual property rights. Though not a part of the formal institutional infrastructure, the third point was included, because it is what is known as an *informal* institution that in this case is vital to make the institutional infrastructure as a

whole function properly: if a country has balanced and well founded food safety and environmental policies and if a country has a well balanced IPR system, it may still amount to low societal acceptance if it doesn't have a societal debate on the issue (Lauth, 2007). It is a three-legged chair that needs all three legs: a public debate and a well-balanced IPR system may not do the trick if there are lacking or too stringent regulations, and good regulations in combination with a public debate may also be insufficient if the IPR system causes monopolies. The consequences of under- or overdevelopment of the three legs of this three-legged chair will be discussed in more detail below.

Intellectual property right protection, GMOs and innovation

The first leg concerns intellectual property rights (IPRs). The goal of IPR protection is to spur innovation by allowing innovators to restrict the use of the knowledge they produce by charging others for the use of this knowledge (Stiglitz, 2008). Low IPR protection can be harmful to an economy when it trades with a country with strong IPR protection: if country (A) has strong IPR protection and another country (B) doesn't, then companies in (A) can copy innovations made in (B) and sell their products both on domestic markets and on markets in (B). When a company in (A) makes an innovation, however, (B) can only sell a product resulting from a copied innovation on domestic markets, since (A) is likely to create barriers for this stolen product (Auriol et al., 2012). A country that wants to attract foreign direct investment for R&D could thus benefit from strong intellectual property right protection because it gives the innovators more rights and it creates opportunities to export products that result from innovation (Bird & Cahoy, 2007).

To prevent this type of trade barriers and to promote global free trade, all members of the World Trade Organization (WTO) signed the TRIPS agreement on intellectual property rights in 1994. In this agreement goals were set to harmonize regulation on IPRs in all countries that signed the agreement (Stiglitz, 2008). Developing countries were hesitant and at first India even refused to sign the agreement, but later gave in after being pressured by the US (Bird & Cahoy, 2007). The reason for this hesitation is that strong IPR enforcement can have socially undesirable results.

An example from the world of medicine is the crisis preceding the Doha Declaration (2001). Signing the TRIPS agreement had led to a huge increase in prices of AIDS medicine (because local manufacturers of the medicine could no longer pirate the technology and get away with it). This led to thousands of Africans dying because they couldn't pay the higher prices. The Doha Declaration amended the TRIPS agreement by adding a provision that makes an exception for IPR protection when it comes to public health (Stiglitz, 2008). The TRIPS agreement extends to IPRs on GMOs (Busch, 2010).

There are two types of intellectual property rights that are relevant to GMOs: patent rights and plant breeder's rights: *"Plant breeder's rights give the developer of a new variety the right to exclude others from commercialization. The breeder's exemption ensures that other breeders may in sort of 'open innovation' use such a protected variety in their own breeding programme, making the best*

properties of these varieties available to the breeding programmes of competitors.” (Louwaars et al., 2009: 2). Patent rights are different because they don't have the breeder's exemption, making it more restrictive than the plant breeder's rights.

Though signatories of TRIPS, the BRICs and other countries from the economic South in practice developed strategies to evade or postpone having strict IPR regulation, such as creating bureaucratic nightmares for patent requests (Bird & Cahoy, 2007). In Brazil and India a lack of IPR protection and a slow approval system for GMOs has led to cases of black market trading of genetically modified seeds. China doesn't have strong IPR protection either, but this hasn't led to significant black markets, because new seed varieties and patents are being approved quickly enough. Neither India nor Brazil was actively battling these black markets at the time they first emerged (Scoones, 2008; Pelaez & Da Silva, 2009). These black markets are making these countries less attractive to investors. Black markets are also interesting with regard to food safety: if GMOs are being produced that are not (yet) approved by the government, how can their impact on public health and the environment be monitored?

An IPR system that incites innovation and an IPR system that focuses on creating the greatest efficiency aren't necessarily the same. Information is nonrivalrous: if one person shares information with a second person, the ability of the first person to use that information is not diminished. Freely sharing information increases efficiency because innovators can build on previous innovations. By completely removing IPR protection, however, researchers are discouraged to innovate. Therefore, in order to spur innovation, it is important to find equilibrium between the two extremes that has strong enough IPR protection to *motivate* innovation, but also has enough open sharing of information to *facilitate* new innovations (Stiglitz, 2008).

Too strong IPR protection may also harm competition and lead to *market concentration* or even monopolization within the field of innovation, because large companies own most of the patents and can charge money for the use of these patented innovations by other companies for their own innovations. In other words: with strong IPRs other companies can't always easily use existing knowledge to build upon but often have to start from the same basic genetic plant-information each time. This creates a *competitive asymmetry* between companies.

Another important question on this front could be whether research is being financed by the public or private sector. Researchers funded by the public sector may be more inclined to share information than researchers funded by the private sector. Case in point, in China and Brazil, most of the GMO research is being funded by and performed in the public sector, and there is relatively little market concentration (Huang et al., 2004; Mendonça-Hagler et al., 2008). In India GMO research is mainly being funded and performed by the private sector, with a high degree of concentration (Pray et al., 2005; Pray & Nagarajan, 2012; EASAC 2013).

Intellectual property rights and competitive asymmetry

An argument against strong IPR protection is that it may hurt competition in the seed market, causing monopolization. This section discusses what this may look like in the case of GMOs.

The situation appears indicative of *Schumpeterian competition*. In Schumpeter's model of innovation, technological innovation leads to temporary monopolies with abnormal profits. Competitors eventually catch up and can then start to innovate as well and then gain the temporary monopoly. In this model, monopolies are seen as a necessary incentive for innovation (Stiglitz, 2009). As discussed, with the introduction of IPRs, an asymmetric relationship is created between existing companies and newer, and often smaller, companies, who aren't able to 'catch up', because they simply don't have the knowledge necessary to use or create new innovations and because they can't easily build on previous innovations. This might cause the monopoly to become less temporary and has ostensibly led to *market concentration* in the seed sector: in 2009, the top three seed companies owned a combined market share of 44,8% in the global seed market (Hubbard, 2009).*

When talking about market concentration it is important to make a distinction between *contestable* markets and *incontestable* markets. A contestable market is served by only a few companies, but is nevertheless still competitive. It has three main features: the market has no entry or exit barriers; there are no *sunk costs* (*i.e.* costs that cannot be recovered, such as machinery made specifically for an industrial plant. Sunk costs can impede free exit from the market), and; companies have access to the same level of technology (Baumol, 1982). Basically, a contestable market is a market where, even when there is strong market concentration, it is possible for new companies to come in and compete with existing companies. In an incontestable market it is impossible to break this market concentration. Even though truly contestable or incontestable markets don't exist, using these concepts is useful in analysing markets. Intellectual property rights may hamper the access to the same level of technology by limiting the access to new innovations, thereby making the market less contestable.

In an incontestable monopoly, there may be some negative externalities (Mussa & Rosen, 1978). The most important ones in the case of GMOs are related to seed prices, quality of seeds and diversity of products. These risks associated with monopolies in the seed sector may create risks that could affect the acceptance of GMOs.

The first point is the possibly higher price for seed. In the case of India there is some evidence that the seeds for GMOs are more expensive than regular seeds. There is also evidence of less spraying, lower labour costs and a higher yield as a result of GMOs however, which may very well

* The six biggest pesticide and GMO corporations worldwide are known as the 'Big Six'. They are: Monsanto, Syngenta, BASF, Bayer, Dow and Dupont Pioneer. In 2009 they had a combined market share of 58% of the global seed market and 71% of worldwide agrochemical sales. Source: <http://www.seedsavers.org/>. Accessed on 05-06-2014.

compensate for the higher seed price (Subramanian & Qaim, 2009). In the case of Brazil there isn't any evidence for a significant increase in yield due to the use of GMOs though (EASAC, 2013) It is difficult to definitively say anything on potential higher seed prices, since the GMO and non-GMO seed markets are deeply intertwined and because there is also market concentration on the 'regular' seed market, which makes it difficult to make a good comparison. Furthermore, besides different case studies it is hard to find useful hard data on the effect of GMOs or monopolization on seed prices in general. It is also hard to conclusively say anything on the relevance of these case studies since the yield of a specific harvest is very dependent on contextual factors such as weather conditions, soil and climate.

The second possible negative externality is that monopolization may reduce the quality of products and the third is that monopolization may reduce the diversity of products by overpricing products for which there is a lower demand. These two points – the potential lower quality and lower diversity of products – are related to each other in the case of GMOs. The reduction of product diversity may lead to loss of biodiversity. The lower quality of products – especially in the economic South – becomes apparent when talking about *technological bias* of GMO seeds; seeds become less equipped for the specific area it's being used in. This technological bias is also related to the biodiversity issue, because there is a more limited amount of seed varieties (that are usually aimed at Western climates) available due to market concentration. These points are expanded upon more in detail when talking about biodiversity in the theoretical framework and when talking about technological bias in the results & analysis section.

GMOs and regulation

The second leg of the three-legged chair addresses food safety regulations and environmental policies concerning GMOs. Banning unsafe GMOs and thereby safeguarding public health will increase societal acceptance (Frewer et al., 2004; Pray et al., 2005). This is related to the risk perception of consumers: if consumers trust their government (and the government is pro-GMO), the perceived risk of GMOs will be smaller (Qiu & Huang, 2006).

China's an interesting case in this respect. In China there's lacking regulation, with unsafe research facilities and situations hazardous to human health as a result, but the Chinese GMO acceptance is relatively high (Hong et al., 2011; Qiu & Huang, 2006). This is related to the state controlled media, which rarely allow adverse policy effects to come to light, decreasing the *perceived* risks in the case of GMOs (Curtis et al., 2004; Jacques 2012; Shirk 2007). A different example of suboptimal regulation can be found in India, where only a few genetically modified types of seeds are approved for use. This has led to use of the same seed varieties all over the country, which harms biodiversity. Contrary to the situation in China, there is heavy resistance in India against GMOs as a result (Qaim et al., 2006; Subramanian & Qaim, 2009). The approval of few different seed varieties combines with strong IPR protection can also lead to monopolization, as will be discussed below.

Besides policies aimed at safeguarding public health there are also policies aimed at protecting the environment. Due to the use of very few different seed varieties there are concerns that GMOs may mix in with the indigenous plant varieties, which could increase the risk of diseases spreading (Qaim, 2009). This contamination could furthermore make weeds and the like harder to exterminate (De La Perriere & Seuret, 2000).

These environmental and food safety policies can have an effect on the contestability of the GMO market: too much bureaucracy or too stringent rules can create entry barriers into the market that favor large companies over smaller companies, because only they have the means to cross these barriers. An example can be found on the European GMO market. According to some, the pressure of NGOs has led to such stringent food safety and environmental regulations that small businesses can't get past all the red tape, while big companies *do* have the time and resources necessary to do that (Versluis, 2008; Qaim, 2009). In a way you could say NGOs are unwillingly helping big business in these types of situations.

This movement towards fewer seed varieties is also the result of monopolization: big companies get rid of less-bought products by overpricing them. By standardizing the seeds they sell they can make more profit. These standardized seeds are associated with the intensification of agriculture and are planted on a large scale. This is known as using *monocultures* (Garcia & Altieri, 2005; De La Perriere & Seuret, 2000). The use of these monocultures also results in a loss of biodiversity by decreasing the use of different plants and different plant varieties (Cao & Li, 2013; Garcia & Altieri, 2005). Creating monocultures in practice also often means that seeds aren't as well equipped to local circumstances as when there is a broad selection of seeds to choose from. Differences in climate, soil and weather conditions require different types of seeds, which is hard to come by when all the seeds being sold are standardized for mass production.

Knowledge, innovation and regulation

Also a part of the second 'leg' of the three-legged chair is government policy with regards to knowledge and R&D institutions. In the case of developing countries versus developed countries there is often an asymmetry *between* (national) markets (as opposed to the earlier discussed asymmetry caused by IPR protection which occurs *within* markets): some (usually developed) countries have better education and R&D institutions than other (usually developing) countries.

This part of the institutional infrastructure is important because a lack of skilled experts may impede the formulation of policy and regulations on GMOs, which can cause other problems, as described above, the most important of which being the decreased contestability by the creation of a regulatory system that presents barriers for smaller companies with few resources to enter the market. A lack of proper regulation of GMOs and a lack of the means to establish proper regulation may cause long-term market concentration (Qaim, 2009).

As discussed, it is vital for the societal acceptance of GMOs to have regulation in place that ensures a minimization of the associated risks. A scientific community is key in informing these regulations. The case of Brazil exemplifies this point rather well. Due to a scarcity of experts in Brazil there is a slow approval process for new variations of genetically modified seeds, which resulted in a black market for these seeds (Fontes, 2003; Mendonça-Hagler et al., 2008).

An educated workforce may also open up the market to foreign companies. When GMOs were first introduced in the United States, there was a serious shortage of scientists trained in the field of biotechnology, which for a while slowed progress in developing GMOs (Kenney, 1986). A tight labour market could create entry barriers for new companies, harming the contestability of the market. Having an educated workforce relevant to the biotechnology sector may reduce these barriers.

In short, for the second ‘leg’ it is important to find a middle way between extremely restricting regulations and having barely any regulation at all in order to safeguard public health and decrease the associated risks in order to create broad support for GMOs. When there is a big knowledge gap, developing countries are often at a clear disadvantage when it comes to formulating these policies. In order to be competitive in the field of GMOs, it is important to have proper and accessible higher education, proper R&D institutions and companies able to use and innovate knowledge (Cooper, 2013).

Introducing GMOs in a participatory process

The third leg of the three-legged chair concerns a participatory process in formulating policy on GMOs. It is important to have a participatory process where policy makers, scientists and companies engage in a debate with NGOs and consumers before developing these products in order to create trust in regulatory institutions and to create a consensus on policy (Frewer et al., 2004). By engaging in a participatory process, consumers will get a chance to be informed and a consensus on policy and regulations can be reached between policy makers, NGOs, consumers and the business sector. In order to do this, a relevant scientific community is necessary to inform policy makers, farmers and consumers. A relatively vibrant scientific community has been argued to be an important reason why South Africa is the leading country in GMO production on the African continent (Cooke & Downie, 2010).

It is also important to have a participatory process for another reason related to what is known as *soft power*. The term ‘soft power’ was first coined by Joseph Nye, it “... *is the ability to get what you want through attraction rather than coercion or payments. [...] When our policies are seen as legitimate in the eyes of others, our soft power is enhanced.*” (Nye, 2004: x). The reason soft power is important in this case is that – with the new information technologies – there is a surge of non-state actors wielding significant amount of soft power (Nye, 2004).

In the case of GMOs, these non-state actors may be NGOs such as Greenpeace and the Third World Network, but also companies in the biotech or plant breeding sectors. If governments work

together with these NGOs and businesses it may increase their soft power by increasing the perceived legitimacy of their actions. Furthermore, NGOs or companies involved in formulating policy will be less likely to protest against this policy later, eliminating big potential adversaries in this debate.

Too much debate may harm the successful introduction of GMO products though. Case in point is the European debate on GMOs, which has been going on for a long time and has resulted in very little progress, because policy makers are afraid to make a controversial move: *“The basic problem is the need or the failure to recognize that, while proposed actions may have consequences, inaction may also have outcomes, seen or felt by other parties, affecting other variables: the negotiation of precautionary restrictions has led to some simplistic and damaging legislation, whose implications are initially clear only to limited professional circles.”* (Cantley, 2012: 42).

Another example is the case of India. Though GMOs are being produced on a large scale, there is heavy opposition against GMOs. This resistance has been led by NGOs and, in particular, by Vandana Shiva. This has hindered the quick introduction of new GMOs after bt cotton was first introduced in India in the late nineties (Scoones, 2008; Kaur et al., 2013).

Institutions, competitive asymmetry and power shifts

Asymmetries created by the discussed institutions such as intellectual property right protection and food safety regulation can lead to power shifts on a couple of levels. One such a shift is a partial loss of control of the production process for farmers. In agriculture farmers have traditionally saved and traded their seeds to be used in years to come. This created independence, because they didn't have to rely on outside help for resources, which in turn hindered capital accumulation in this sector (Mascarenhas & Busch, 2006). With the innovations in biotechnology however, farmers often *have* to use patented seeds to keep up, which they can't always save for years to come due to IPR protection.

This means that the farmer is now dependent on – often very large – seed companies for resources, which can cause further capital accumulation (Mascarenhas & Busch, 2006). This is related to what has been called the *proletarianization* of farmers (Lemmens, 2014). It has been argued that there is a power shift leading to the expropriation of farmers by destroying their way of life and by alienating them from the traditional system of care associated with farming.

The increased importance and power associated with knowledge exemplified by the IPR discussion is symptomatic of the post-industrial society. As Alvin Toffler (1990) argues, there are three sources of power: violence, wealth and knowledge. Each type was dominant in a historical period: violence in feudalism, wealth in the industrial age and now knowledge in the post-industrial information age. Furthermore, a change in the main source of power can be the prelude to a global power shift. If the currently leading nations want to maintain their dominance, it is vital that they stay in the lead in the knowledge industry (Toffler, 1990). Strong IPRs may help in guarding their position. The important role that knowledge plays in the case of GMOs is evident and strong IPR protection is increasing the power of large multinational companies, who are usually Western.

This means that strong intellectual property right protection may in fact increase global economic and geo-political inequality (Korthals & Timmermann, 2012). This increased inequality described here is mainly related to ‘hard’ power though, which is military and/or economic power (which according to Toffler were dominant during feudalism and the industrial age) and not so much related to the earlier discussed soft power.

Soft power rests on institutions, values, culture and policies. When the values of a government reflect the values of citizens in its own country and in other nations, it can increase its soft power on the global stage: *“Government policies can reinforce or squander a country’s soft power. Domestic or foreign policies that appear to be hypocritical, arrogant, indifferent to the opinion of others, or based on a narrow approach to national interests can undermine soft power.”* (Nye, 2004: 14). When the West strongly promotes strong intellectual property right protection, it can create a competitive asymmetry favoring Western countries and companies, as discussed earlier. Though this would probably increase the West’s economic hard power, this could harm the influence the West has on emerging economies, such as the BRICs by diminishing its soft power in these countries. This could create support in these countries for coming up with alternative ways of dealing with these issues that are less favorable to Western companies.

In short, using hard power to push for stronger IPR protection may mean a loss of soft power for the West (specifically the United States in this case) if it is perceived to be indifferent to the economic ‘South’. As Nye writes: *“Smart power is neither hard nor soft, it is both.”* (Nye, 2004: 32).

Towards a balanced GMO market?

Societal acceptance of GMOs is mainly determined by risk perception and trust in regulatory institutions. Too much IPR protection may harm competition by giving too much power to companies to guard their innovations, but too little IPR protection will harm progress by discouraging R&D. There is a role for government in creating the right institutions to facilitate innovation without harming competition and there is also a role for the government in creating a well-educated public and a relevant scientific community that can stimulate a public debate about GMOs. If institutions are over- or underdeveloped, this might cause negative externalities that may lower the acceptance of GMOs.

The question asked here is concerned with finding out how these institutions influence the acceptance of genetically modified crops. The research question posed in this thesis is:

“How do experts on biotechnology, intellectual property rights and the BRICs think about how a country’s institutional infrastructure – specifically the regulations on and the enforcement of intellectual property rights, food safety and environmental regulation and public debates on GMOs – affects the societal acceptance of GMOs in Brazil, India and China?”

It is important to note here that this thesis didn't assess the *specific* role that separate aspects of the regulatory system play in the societal acceptance of GMOs, and didn't assess the *specific* role of low IPR protection when talking about market concentration. To conclusively demonstrate such a role, concrete hypotheses would have to be tested and quantitative research would be more appropriate. The goal here was to find and describe the *mechanisms* that are in play when it comes to the societal acceptance of GMOs in Brazil, India and China.

Furthermore, the difference in GMO acceptance of transgenetically or cisgenetically modified crops* and the difference in acceptance between GMOs like cotton, maize and soy on the one hand and rice on the other hand† aren't discussed (explicitly) here. Though there is very likely a significant difference in acceptance between these types of GMOs, this thesis doesn't focus on the specific *effect* institutions have on the acceptance of specific crops. It focuses on the mechanisms at work determining the acceptance.

Methodology

This thesis is qualitative in nature and has two dimensions. On the one hand, it is a case study. In this type of research a case is considered in its specific context (Boeije, 2005). Here, the case would be that of BRIC countries as a whole. Considering a case in its entirety can provide the research different relations relevant to the case that may not surface when looking at one particular part. Another aspect of this type of research is examining different perspectives of the case. So for example not just the viewpoint of policy makers or politicians would be considered, but also of companies, NGOs and/or scientists (Boeije, 2005).

On the other hand, this thesis is also a comparative macro socioeconomic inquiry. More specifically, it compares institutions in the different BRICs. The goal of this aspect of the research is

* *Transgenetically* modified crops are crops that are modified by inserting genes from one organism into another organism in a way that *could not* have happened by way of conventional breeding. *Cisgenesis* is the process of inserting a gene from one organism into another in a way that *could* have happened by conventional breeding. The societal acceptance of cisgenesis is usually much higher than the acceptance of transgenesis since it is perceived to be more natural and risk-free. In this thesis the focus is on mechanisms, so this difference is not made explicit in this here.

† Usually, GMOs such as cotton, maize and soy have a higher acceptance rate because they are not used directly for human consumption, but are mainly used for feeding animals or producing clothes. GMOs intended for direct human consumption such as rice are often much more controversial. Furthermore, genetically modified plants have a higher acceptance rate than genetically modified animals (Frewer et al., 2013).

the parallel demonstration of theory (Skocpol & Somers, 1980). This means that the different countries are juxtaposed to show the reader that theories and/or hypotheses can repeatedly show their fruitfulness.

Research method

The research method used for this thesis was that of conducting expert interviews. The reason for this method was that the LEI institute had already done several meta-analyses of literature on the subject. Furthermore, interviews with most direct stakeholders (except for representatives of biotech companies) were infeasible due to the geographical distance. Expert interviews allowed data to come to the fore that wasn't yet available from the meta-analyses performed earlier by the LEI institute.

An extensive literature study was used to inform the research question and to provide a theoretical framework. Literature was also used to cultivate extensive knowledge on the subjects to be discussed during the interviews beforehand, so that the researcher could get much more specific and relevant answers (Merton & Kendahl, 1946). Within a week after the interview, a transcribed version of the interview was to be sent to the interviewee for approval, possible corrections and possible additional information. Though not always within a week, transcriptions of all interviews were sent to the respondents. Eventually two respondents embraced this opportunity to add or correct certain details.

Literature was acquired in a few ways. Initially, some articles were provided by the LEI institute for a general orientation on GMOs and the societal acceptance of GMOs. Furthermore, initially used literature on the economic aspects of the theoretical framework, like Schumpeterian competition, was read by the researcher for unrelated purposes during the time of the literature study. As introductory literature, the original article by Jim O'Neill in which the term 'BRIC' was coined and his book *The BRIC Road to Growth* (2013) were read as well. The book *Brave New Seeds* (2000) by Robert Ali Brac de la Perriere and Franck Seuret was also read as introductory literature.

After that, literature was found by using the Scopus and Google Scholar search engines. Keywords that were initially used include 'GMOs', 'biotechnology' and 'intellectual property rights'. As the literature study proceeded, searches became more specific. For example, keywords included 'Baumol + contestability', 'institutions + biotechnology', 'GMOs + societal acceptance + debate' and 'GMO + black market + Brazil'. Additional literature was acquired during the research from several respondents that recommended reading specific articles.

The interviews

The aim was to conduct ten to fifteen interviews for this thesis. Eventually twelve interviews were done. The idea was to get as many different combinations of expertise and background as possible. The goal of using a diverse group of respondents was increasing the reliability of the data (Boeije et al., 2009). Since every stakeholder has a different interest in the way he or she represents the facts, it

was important to find people with different perspectives in order to show all sides of the story. Finding and contacting respondents for this research was done with assistance from the LEI institute, in particular from Volkert Beekman and Erik de Bakker, who work there as a senior scientists in the fields of social innovation and applied ethics. Some additional respondents were found by contacting NGOs through their website and through recommendations from other respondents.

The experts were divided up into a couple of categories. There were three fields in which the research attempted to find experts: biotechnology, intellectual property rights and the agricultural economy of the BRICs. Within these three fields of expertise, attempts were made to find respondents in the policy area (such as government officials and policy makers), the sciences, social enterprises (such as NGOs) and in the business sector (for example at biotech companies). Eventually most respondents were found with an expertise in IPR (seven respondents) and the fewest with an expertise in the BRICs (two respondents). In practice it turned out that there was a huge overlap in expertise, especially between biotechnology experts and intellectual property right experts. The lack of BRIC experts can be ascribed to the lack of expertise on the subject within the Netherlands.

With regards to background, most interviewees were found with a background in the scientific community and in the business sector. However, also on this point there was a lot of overlap. Government representatives would have a professional academic background or a former university teacher/researcher would now be a representative of a company. The biggest challenge in finding respondents from different backgrounds was finding respondents working at NGOs.

The interviews were mainly conducted face-to-face, but two interviews were done over the phone and one was done through Skype. The face-to-face interviews were typically conducted in the offices of respondents with an occasional interview outside in cases of good weather. A total of twelve interviews were conducted that lasted between 40 and 70 minutes per interview. This translated to transcribed versions of 6 to 13 pages per interview, which is about 4,000 to 8,200 words. The reason for the interviews over Skype and over the phone is that it made scheduling a lot easier and that it partly solved the problem of geographical distance. The face-to-face interviews were easier to conduct because non-verbal communication was easier to detect than on the phone or over Skype. Most interviewees didn't need much encouragement for giving in-depth answers to the questions asked, because they were used to talking about their topic.

With regards to ethical issues, the researcher initially didn't think anonymization of the interviews was necessary, because the respondents weren't asked to divulge any confidential or personal information. As the interviews progressed however, some interviewees asked to be made anonymous. Eventually, no individual person has been named or described recognizably.

Operationalization and topic list

The interviews were semi-structured. This means a topic list was constructed that listed specific topics to be discussed during the interviews. The most important concepts in this research were operationalized and integrated into this topic list. This topic list can be found in Appendix A.

A ‘*GMO*’ was operationalized as an organism of which genetic material has been altered by adjusting the DNA without traditional crossing (Lotz et al., 2011). ‘*IPR protection*’ was operationalized as patents and plant breeding rights. These are the two relevant types of IPR protection on the topic of GMOs (Louwaars et al., 2009). ‘*BRICs*’ were operationalized as Brazil, India and China. Russia and South Africa weren’t included, because these countries weren’t a part of the research (discussed earlier) (O’Neill, 2013). ‘*Trade barriers*’ were defined as barriers for import and/or export (Auriol et al., 2004) ‘*FDI*’ was operationalized as foreign direct investment in research and development in the BRICs. ‘*Food safety and environmental regulation*’ was operationalized as regulation aimed at safeguarding public health (by allowing or not allowing new foods on the market) and at the safeguarding of the environment (by preventing GMOs from getting mixed in with other plants) (Perriere & Seuret, 2000).

‘*Knowledge gap*’ was operationalized as the asymmetry in the amount of people educated in the field of biotechnology and the knowledge available on biotechnology in the BRICs compared to Western countries. ‘*Technological bias*’ was operationalized as the bias of certain GMOs to a specific context (relating to climate, soil and weather conditions)*. ‘*Participatory process*’ was defined as engaging in a societal debate in order to formulate policy and regulations related to GMOs. There are different tools to engage in such a debate, such as citizen panels, focus groups and future search conferences (Frewer et al., 2004). ‘*Soft power*’ was defined as power that works “*through attraction rather than coercion or payments.*” (Nye, 2004: x). ‘*Hard power*’ was defined as military or economic power (Nye, 2004).

Data analysis

All interviews were transcribed in their entirety before analysis. The data was analysed in three stages: open, axial and selective coding (Boeije, 2005). This means that first all data was read carefully and broken down into fragments. The relevant fragments were labelled with different codes (based on the topics from the topic list) and were then compared. Secondly, the data was put back together in new ways to make connections between the categories. The meaning of important concepts and the ideas behind specific lines of thought were made explicit and these topics were combined into categories.

* This item was initially not included in the topic list and was thus not a part of the theoretical framework. It came up during the first few interviews and was included in later interviews. It is discussed further in the ‘results & analysis’ section. This operationalization is based on the results of the interviews.

Finally, all data and categories were structured. Relations between the different categories were described and verified. In this stage the researcher was also concerned with looking for explanations by for example answering the question how a specific variation in data has occurred (Boeije, 2005). An example of a variation in the data is the answers respondents gave to the question of how important a societal debate is when allowing GMOs on the market. Analysis of the data was done by using NVIVO software.

During the interviews, new topics and ideas came to light that are relevant to the research, such as the *technological bias* of GMOs. In the results section these new topics are discussed as well as the topics already on the topic list. The results of the interviews have been placed in what is known as a *code tree*. This is a method of hierarchical coding in which some ‘main’ codes are described. Each of these main codes has a number of sub-codes. For example, ‘homogenization of the seed market’ is a sub-code of the main code ‘consequences of low contestability’. By constructing this code tree, the relation between the different topics became clear. The code tree can be found in Appendix B. Finally, the data was analysed by placing it in the framework of the three-legged chair. Implications of the data and the validity of the earlier presented arguments are discussed.

Measures were taken to ensure the *reliability* of the data, such as sending the interviews to the respondents for approval and interviewing experts from different backgrounds and with different expertise to get different perspectives on the matter at hand. Attaining high reliability can be tricky when doing semi-structured interviews; there was a lot of room for ‘improvisation’ by the interviewer due to the open nature of the interviews. The *validity* of the research was increased due to this open nature of the interviews however. Interviewees tended to keep going back to talking about their own specific subject, which sometimes led to going off point, but in other cases the open character of the interviews led to the introduction of new ideas and concepts that increased the validity of the research by pointing the researcher more specifically to the core of the issues at hand.

Results & Analysis*

In this section, the results of the interviews are discussed and interpreted. The subject of GMOs is neither a clear-cut nor a black-and-white issue, which is reflected in the diversity of answers on the different topics. In this case this also meant that some new topics that came to the fore. These topics have been linked to existing topics and have been integrated into the framework of the three-legged chair. The need for a public debate was the only topic on which there was unexpected disagreement among the respondents. Results are first discussed below and subsequently an interpretation of the

* Quotes in this section are translations from Dutch done by the author of this thesis.

data is provided. All existing and new topics have been merged into a *code tree*. This code tree can be found in Appendix B.

Intellectual property rights and market concentration

All respondents agreed on the fact that there was significant market concentration in both the biotechnological sector and the seed market. As already mentioned, the GMO market is controlled by only a few companies that have enormous influence – ‘The Big Six’. There were different answers to the questions whether this concentration was: (a) contestable, and, if yes; (b) what caused the lack of contestability, and; (c) what the problems with an incontestable market are.

Proponents of the idea that the market was contestable were mainly found in the business sector. One respondent pointed to the competition law as a possible way to break a monopoly when too much IPR protection hampered innovation. Competition laws are designed to create fair competition, so when a small company feels it cannot compete with the larger companies due to monopolization, and if this claim recognized by the courts, the competition law could be used to get access to the necessary information (such as the plant-information of specific varieties protected by patents) in order to be competitive. This would be a possible way of breaking market concentration caused by overdevelopment of institutions of the first leg.

In response other respondents pointed to the fact that this law has been barely or not at all used in the GMO debate. In the specific countries considered – Brazil, India and China – the competition law turned out to be of no interest in this discussion. The law has been used in cases related to medicines ‘a few’ times in India, but not in the GMO discussion. The problems with too much market power due to IPR protection were somewhat tempered in the case of the BRICs by the fact that it is very hard to get a patent for a GMO in these countries anyway. According to some respondents, this was due to the fact that the countries under consideration have a different agricultural tradition from the West, namely one that is much more about open sharing. As a respondent noted, the IPR system doesn’t work as it does in the West, because farmers aren’t used to this perception of plants as a commodity or possession, which goes against their tradition.

An interesting point to mention here is the fact that China doesn’t have central intellectual property right legislation, but has different policy in each province or region. This is related to the fact that China is what Martin Jacques calls a *civilization state* as opposed to a *nation state* (2012). What Jacques refers to is the fact that China is an enormous country with a long and fluid history. The thing that makes China a unity is not the fact that it is a nation or a state, but rather the long shared history that goes back 3,000 – or according to some even 5,000 – years. This manifests itself in a flexible and diverse bureaucratic system: “*Because China is so vast and embraces such diversity, as a matter of necessity it must be flexible: ‘one civilization, many systems.’*” (Jacques, 2011).

An argument from proponents of the idea that the market was contestable as far as IPRs go that was supported more broadly than the competition law argument was the argument that patents

expire after a period of twenty years. This would mean that the monopoly gained by technological innovation would be temporary. After this period the company that made the innovation would be on the same level as new companies in the same field. The problem with this argument however, as pointed out by other respondents, is that by the time patents expire, the companies that made the original innovations have usually already taken over large portions of the market. These respondents said it for example was unlikely that the cotton market – which is of special importance to India – would open up significantly to new companies after the patent on bt cotton expires in a few years. Also it was pointed out that companies like the Big Six create new applications of the original patents, thereby making the innovation patentable again for a new period of time.

Another point that came to the fore on this issue is the increased rapidity of the succession of new biotechnological developments. A respondent argued that the entire system of patents would cease to be of practical use in the field of GMOs because (a) approving patents takes too long, which is bad for companies and (b) the period of twenty years is too long considering the high tempo of innovation. The second point is mainly harmful to smaller businesses that want to compete with larger businesses. This respondent argued:

“With the genome project you can unravel certain micro-organisms with several patentable genetic properties within 24 hours, but getting the patent takes at least four years, and then you have protection for twenty years. Within seven years there will be so many computers at work that can probably find analog genes in our systems within 24 hours, and then they have to wait for seven years for a patent. That is a bleak perspective. So you see that there is now a speed of information production and information exchange that contradicts the intellectual property system. This contradiction can only be solved by creating new developments in the system of knowledge production.”

Many respondents from different backgrounds agreed that – in general – a more open IPR system like a system with a larger role for the plant breeder’s rights was desirable in order to increase the contestability of the market and to spur innovation. Some respondents even argued that patents were completely unnecessary or that it was only a matter of time before the patent-system would cease to be.

In Brazil, India and China it is hard to get patents on organisms (including GMOs) recognized at all. Furthermore, agricultural tradition and culture play an important role here, making this issue less pressing in these cases. The IPR institutions aren’t seen as completely legitimate by the farmers, in practice leading to – compared to the West – limited protection of intellectual property rights. It could however be argued that this actually constitutes a balanced IPR regime for these countries, since this regime is developed enough to combat large infringements, but at the same time is not so overdeveloped that it hampers innovation or competition.

Underdevelopment of the first leg of the three-legged chair didn't appear to play a big role in the case of the BRICs. Respondents generally agreed that investments in innovation aren't hindered by too little IPR protection. In the case of Brazil and China, the government also actively invests in biotechnology, which makes potential lacking IPR protection a less pressing issue anyway.

Monopolization, GMOs and negative externalities

The higher pace of succession of new types of seeds mentioned before is also related to a spiral of better resistance of crops to insects and the subsequent adaptation of insects to the new resistance, as some respondents with scientific and NGO backgrounds pointed out. When, for example, bt cotton plants start to produce their own insecticide because of the genetic modification, insects will in time adapt to this insecticide, making the plant's insecticide less effective in the long run. The increased resistance of insects provokes developing a form of cotton that produces even more insecticide, causing even more adaptation by the insects, et cetera. * This spiral is contributing to faster subsequent introductions of seeds on the market, and according to one respondent also to higher seed prices. In defense, some respondents replied that insecticide was also being used before the introduction of GMOs, but that only the application method was different. In response it was noted that the use of GMOs has increased the rapidity of the process.

A broadly shared but not unanimous opinion among respondents was that the biggest problem with monopolization on the seed markets was not that seed prices were higher, but that farmers were often confronted with a lack of choice when it comes to seeds due to a less diverse market. As one respondent described a case in India:

"[...] at the moment that they wanted to go back to their old seeds those weren't there anymore, because the farmers hadn't collected them themselves and the gene banks and the sellers were only selling Monsanto seeds, because they have a good selling system. So then there suddenly is a lot less freedom of choice. That worries me."

This point is also related to biodiversity and *technological bias*.

What this bias refers to is that the technology of, for example, bt cotton is inherently biased towards certain countries and/or regions. In this case, the seed would be biased to favor the North

* This is in fact the same discussion as is currently being held about excessive use of antibiotics in the food for farm animals; because of the increased use, bacteria become more resistant to the antibiotics, making the antibiotics less effective. Source: 'Resistentiename door subtherapeutische concentraties antibiotica als gevolg van versleping'. As found on: <http://www.vwa.nl/>. Accessed on: 24-06-2014. A comprehensive book on this topic was also released recently: *Missing Microbes: How the Overuse of Antibiotics Is Fueling Our Modern Plagues* (2014) by Martin J. Blaser.

American climate. Most GMOs marketed so far have been biased towards Western countries by the very thing they have been genetically altered to provide: insecticide and pesticide resistance is much more relevant in Europe and the US than in India, China, Brazil and the rest of the economic South. Something that would be much more useful in especially India or China would be drought resistance for example. Technological bias furthermore also concerns the products that are produced. While consumers all over the world consume products like rice and maize, people in the economic South usually have to add different vegetables to their diet if they want to be healthy due to poorer living conditions. Standardizing agricultural production makes it harder for inhabitants of poorer countries to maintain the diversity of their diet.

Some respondents skeptical towards GMOs noted that climate change is making this point of technological bias more pressing: changing circumstances call for a flexible and adaptive approach to agriculture. The use of a limited diversity of patented seeds does not fit within such an approach. Some respondents critical of GMOs stressed that the creation of specific varieties relevant to the local circumstances is much more important in these three emerging economies than in the West, because the agricultural sector in the West is already much more developed than the agricultural sectors in the BRICs. In the BRICs there is still a lot of natural richness and biodiversity that can be cultivated to breed new plant varieties that are more adept to local circumstances. Using a limited selection of GMO seeds on a large scale may cause this indigenous diversity to be lost.

Food safety and environmental regulation & knowledge

Some respondents pointed to the fact that China appears to have found a strategy related to the second leg of the three-legged chair to deal with these biodiversity and technological bias issues. The government actively funds R&D in the seed sector. This R&D is aimed primarily at domestic production and the domestic market. Because of this R&D, the technological bias plays a smaller role in China than in other countries in the economic South, because varieties relevant to the local circumstances are developed. In Brazil the government also actively invests in R&D, but according to respondents the Brazilian agricultural sector is more strongly focused on export than the Chinese sector. This means that the technological bias plays a smaller role here as well: because Brazil mainly produces GMOs that produce soy, the products can more easily be marketed by exporting it, because the soy plants that are used are usually already allowed on Western markets.

Respondents agreed that it was important to invest in the education of farmers on the use of GMOs before letting them use the seeds. Respondents also agreed about the fact that this education was in the “*enlightened self-interest*” of the companies selling the seeds: if farmers know how GMO seeds work, they’ll better be able to use them, which decreases risks of contamination and increases yields. If the yields are smaller, other farmers that could potentially buy GM seeds might be scared away. Respondents didn’t agree to what extent this education of farmers was already happening in the BRICs though.

Overall, the respondents thought that the role of a knowledge gap with the West was relatively small in Brazil, India and China compared to other developing countries: in Brazil the government actively stimulates education in the field of biotechnology and in the case of China the government funds R&D as already discussed. In all three countries the general level of education was also higher than in (other) developing nations.

On the issue of overregulation or underregulation, respondents said that in the cases of Brazil, India and China that the culture was also different from the West in the sense that there was less compliance with regulation on what seeds were and what seeds weren't approved for use by the government. This is related to the power of the state in these countries: while there is a lot of *infrastructural power* in Western states, there doesn't appear to be as much in the BRICs. What this term refers to is the capacity of the state to penetrate civil society and to use this penetration to enforce policy throughout its entire (Mann, 1993). Low infrastructural power makes it easier for farmers to ignore regulation and get away with it.

This relatively small knowledge gap and this low infrastructural power means that the second leg of the three-legged chair also plays a relatively small role in the BRICs. An exception is India, where, due to a lot of resistance led by NGOs, it is very hard to get new seed varieties approved for production as already discussed in the theoretical framework. This point was confirmed during the interviews. As discussed however, the relevance of this lack of approval is rather small due to the lack of infrastructural power.

Societal debate and power shifts

The importance of having a societal debate and a participatory process in formulating policy was met with a mixed response throughout all the categories of respondents. A likely reason for this is that this issue might be very political for the respondents themselves as citizens of a democracy: do I want to have the right to choose what I eat? There are three main arguments that were used on this point; a political one, a practical one and a legitimacy-related one.

The political line of argument was mainly, to put it bluntly 'as citizens, people have the right to know what they are putting in their mouths'. These respondents also pointed to the fact that it is especially important because it's about our food, which is a day-to-day necessity:

"I think it is good if the society philosophizes about these questions, because it's not just about GMOs, but also about the global food supply. We may be on the side of the world where it is alright, but it has enormous effects on parts of the world where people have less to eat."

This is a purely political stance that doesn't provide a useful explanation of the mechanisms at work here like the other two lines of arguments do. It is an important discussion to have, but it is one for philosophers and politicians, not for historians and social scientists.

The practical line of argument was aimed at potential consequences of having a societal debate. One respondent pointed to the examples of the US and the EU. In Europe there was a lot of discussion on the desirability of GMOs from day one, which led to (according to some) a much too precautionary approach to GM products, while in the US there was a lot less debate, and GMOs were ‘just introduced’. As one respondent put it:

“... With every new technology, synthetic biotechnology, or nanotechnology, there has to be a large societal debate, everybody has to be able to say his part, everybody has to listen to it, because otherwise you may get a new GMO debacle [...] I think that that diagnosis is wrong. [...] That’s why the example of the US is interesting. GMOs are accepted there, maybe not actively, but they are accepted.”

In short, this line of argument holds that *overdevelopment* of these informal institutions may hamper the successful development of GMOs. Respondents agreed that this overdevelopment of informal institutions was significant in India, as already discussed.

The third type of argument is most in line with the argument presented in the theoretical framework. Namely that having a societal debate will increase the legitimacy of institutions. One respondent pointed to a case of emerging black markets of GMOs in China. In this case, the Chinese government worked closely with Greenpeace to combat these black markets. The likely reason for this cooperation this respondent gave was that the Chinese government was afraid of getting a bad reputation, both nationally and internationally, which would mean a loss of soft power. This directly supports the analysis that soft power is important for the legitimacy of institutions and it is mainly related to the potential *underdevelopment* of informal institutions.

Under- or overdevelopment of institutions and the three legged-chair

When looking at the results, it can be concluded that the three legs of the chair represent different types of institutions that, when either overdeveloped or underdeveloped, can amount to negative externalities or risks that can cause low societal acceptance of GMOs. Diagram 1 shows the possible consequences of *underdeveloped* institutions for each leg of the three-legged chair.

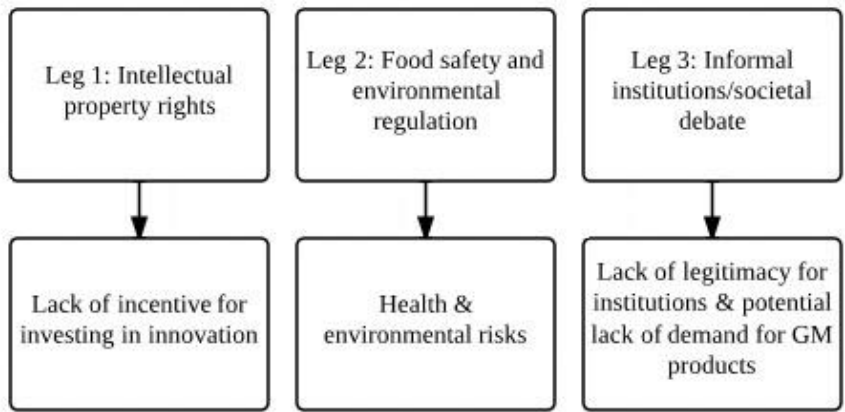


Diagram 1: Possible negative consequences of underdeveloped institutions related to GMOs.

This diagram is pretty straightforward. If there is a lack of intellectual property right protection, companies can't make money on their innovations as easily, which leads to a lack of incentive to invest in innovation. A lack of food safety and environmental regulation can lead to public health and environmental risks. A lack of relevant informal institutions may lead to a lack of legitimacy and/or a lack of demand for GM products. All these factors are risks that can contribute to low societal acceptance of GMOs.

A comparable, though a bit more extensive diagram can be made for the *overdevelopment* of these institutions:

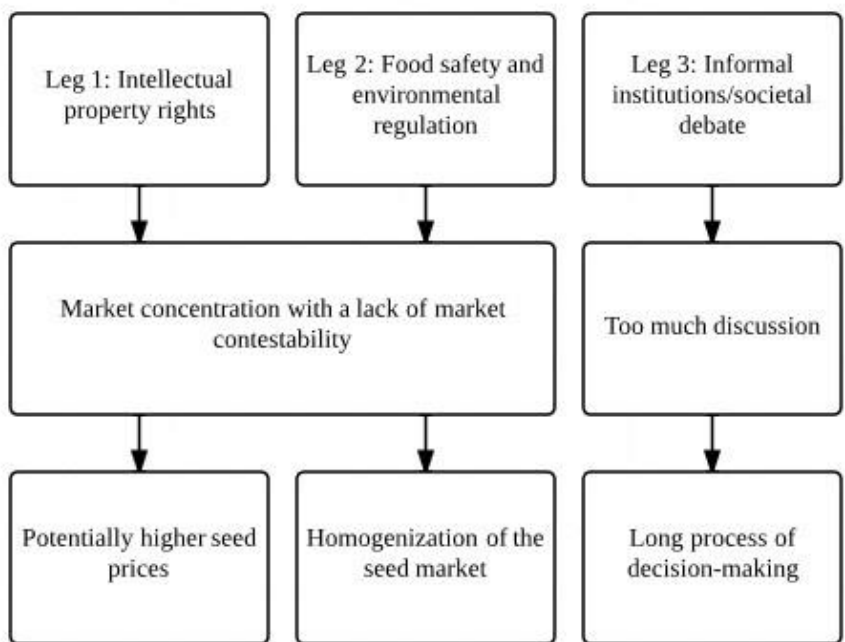


Diagram 2: Possible negative consequences of overdeveloped institutions related to GMOs.

The first and second leg may cause an incontestable market when these institutions are overdeveloped. This may lead to potentially higher seed prices (though – as discussed – this has not always been conclusively demonstrated in every context). It may also lead to ‘homogenization of the seed market’, which refers to the same varieties being used on large acres (the use of *monocultures*) as well as to the technological bias issue (the same seeds and innovations being used in different climates and soil-circumstances). The third leg is interesting in this diagram. A long process of decision-making resulting from too much discussion may in fact result in lacking IPR regulation or lacking food safety and environmental regulation, which may in turn cause the other negative externalities already described here. Too much discussion may also amount to having too much non-experts getting mixed in in the debate, which can harm the goal of informing the public. This once again underlines the importance of informal institutions in this debate.

The underdevelopment or overdevelopment of institutions in these three legs is put together in Table 1 for Brazil, India and China. The first column (IPR) is based on a ranking known as the International Property Right Index 2013*. The second and third columns are based on scientific literature and information acquired during the expert interviews (*i.e.* Aleksejeva, 2012; Mendonça-Hagler et al., 2008; Pray & Nagarajan, 2012; Qiu & Huang, 2006; Scoones, 2008; Kaur et al., 2013). Scores that were given are: -- (very underdeveloped), - (underdeveloped), +/- (average/neutral), + (overdeveloped), ++ (very overdeveloped).

| | Leg 1: Intellectual property rights | Leg 2: Food safety and environmental regulation | Leg 3: Informal institutions/societal debate |
|---------------|--|--|---|
| Brazil | - | +/- | +/- |
| India | +/- | + | + |
| China | +/- | +/- | - |

Table 1: Development of GMO-related institutions in Brazil, India and China

The scores in first column are debatable; scores are based on a ranking that assesses different aspects of IPR that can have different consequences when under- or overdeveloped. Also, it is based on a ranking of 130 countries, so an ‘average’ score on this list does not necessarily mean a well-balanced IPR regime. Similar footnotes can be placed at the other two columns. The point of this table is merely to give a better general understanding of the state of these institutions in Brazil, India and China.

The most over- or underdeveloped institutions can be found in the final column. In the case of China the media play a different role than in the other two countries though, because China is the only

* This index can be found at the following location: <http://www.internationalpropertyrightsindex.org/>. Accessed on 28-06-2014.

non-democratic country here and the only country that has completely state-owned and state controlled media. If there are potential adverse effects of GMOs, these remain largely unknown for the general population, which decreases the perceived risk and thus increases the acceptance of GMOs. This means that, even though China has underdeveloped informal institutions, there can still be high acceptance of GMOs in spite of it.

The acceptance of GMOs is highest in Brazil and China, as came to the fore in the interviews. This is in line with our expectations based on the development of their institutions, since India has the most over- or underdeveloped institutions, especially if China's 'third leg' is disregarded here. This acceptance rate is also reflected by the amount of approved GM varieties in each country: 55 in China, 38 in Brazil and a mere 8 in India.*

The three legs aren't separate entities of course. The first two legs are formal institutions mainly related to the contestability of the market in this discussion, while the third leg is about informal institutions that may help balance the first two legs and create legitimacy for the institutions being discussed. The importance of the third leg may be lower if the first two legs are already well-balanced; after all, perceived risk will likely be low anyway when there are few negative possible externalities. In the case of India, a lot of discussion and resistance to GMOs have led to a rather stringent approval process for new varieties. This is an example of the third leg influencing the second leg.

Respondents argued unanimously that the BRICs could play or is already playing an important role in the global GMO debate. The reasons that were given for this were somewhat varied however. There was a common theme though, namely that they are the superpowers of tomorrow (some might even argue that China already is a superpower of today) and that they are non-Western superpowers. In this case this means that they represent economic power largely independent from the West. In the GMO debate this gives them a unique position; they are very influential economically, but they are regarded with less suspicion than economies of comparable size because they don't have the same interests in this debate as Western countries, where most biotech and seed companies originated. It will be interesting to see if this leading role in the debate is going to be realized by the BRICs, especially in the case of China and Brazil, who actively invest in GMO research and thus take a clear stance on the issue. These two countries are also interesting because they have relatively balanced institutions in the three categories discussed here).

* Source: <http://www.isaaa.org/>. Accessed on 29-06-2014.

Conclusion & Discussion

To create broad support for the use of GMOs, there need to be relevant and balanced institutions on three fronts: intellectual property right protection, food safety and environmental regulation, and informal institutions related to having a participatory process for formulating policy on these issues. Each of these three is important; it is a three-legged chair that falls over if one of the three legs is missing. It is vital that these institutions aren't under- or overdeveloped. If they are, each of these legs has potential negative externalities.

In the case of IPR protection, it is important to have enough open access to plant information to prevent market concentration. In the case of the BRICs it is particularly important to prevent monocultures that may result from too strong IPR protection and market concentration, because this might entail a loss of natural richness and biodiversity that could otherwise contribute to increasing agricultural productivity. Underdevelopment of IPR protection may lead to a drop in investments in innovation.

The second type of institutions concerns food safety and environmental regulation aimed at safeguarding biodiversity and public health. Too much regulation may in practice turn out to be a barrier for companies trying to get new seed varieties approved. This may, just like too much IPR protection, lead to market concentration. On both these issues – IPR protection and food safety and environmental regulation – an important point for the case of the BRICs is that these countries have a different tradition and culture from the West; regulation isn't always followed to the letter and infringement of intellectual property rights isn't seen as a big crime, since farmers in these regions are used to centuries of open sharing. This tradition is related to the low infrastructural power of the state in these countries.

The last category of institutions discussed in this thesis are informal institutions related to having a societal debate on GMOs. This debate is important, because it can on the one hand inform consumers and increase the legitimacy of related institutions on the other hand. Too much debate can lead to a stalemate that can also harm progress however. In short, it is important that all of these institutions are well-balanced and thus not over- or underdeveloped. This way, negative externalities of GMOs can be minimized, which will likely lead to a higher acceptance of GMOs.

The BRICs are already well on their way to creating balanced institutions, and according to respondents the BRICs could very well be an example in the GMO debate for other developing countries. If these developing countries also embrace GMOs with the institutional infrastructure necessary, this could be a prelude to closing the global 'food gap' between the West and the economic South.

These results provide a clear answer to the research question posed at the beginning of this research:

“How do experts on biotechnology, intellectual property rights and the BRICs think about how a country’s institutional infrastructure – specifically the regulations on and the enforcement of intellectual property rights, food safety and environmental regulation and public debates on GMOs – affects the societal acceptance of GMOs in Brazil, India and China?”

The concrete effect of specific individual parts of the institutional infrastructure remains unclear, but a clear image of the mechanisms at work and the way they influence the societal acceptance of GMOs in Brazil, India and China has emerged.

The concepts of ‘market concentration’ and ‘contestability’ in particular have turned out to provide a good conceptual framework for analyzing the subjects of intellectual property rights, food safety and environmental regulations and GMOs. The concept of ‘soft power’ has also turned out to be useful, both in the discussion about the need for a participatory process as in the discussion on the power and global inequality aspects of the debate.

Discussion and further research

This research provides a good framework for going forward with creating the institutional framework necessary for a successful introduction of GMOs. The case of Brazil, China and India has provided insights into the potential adverse effects that under- or overdevelopment of institutions may have on the seed market and the biotechnological sector as well as provided insight into the role of populous emerging economies in the global GMO debate.

There are two big limitations to this research, one is inherent to the way the research was set up and one concerns practical limitations. The limitation that’s inherent to this research is that it’s a master thesis that only looks at how mechanisms function because of its limited scope. It doesn’t conclusively say what the *effect* of this or that policy or regulation is. The result is that this thesis has little hard data to offer the reader. This thesis opens doors for further research in which specific hypotheses can be tested about for example contestability and the influence that contestability has on seed prices and product quality however. Research can also be done to establish the presence of the described mechanisms in other emerging economies and developing countries.

The practical limitation of this research was a lack of available experts in some areas, such as experts on the BRICs and experts with a background in NGOs. This was partly due to a lack of time and partly due to the huge geographical distance to most experts on the BRIC countries (who often live *in* the BRIC countries). This was partly compensated for by conducting interviews through Skype and on the phone. A further upside on this point was that there was a lot of overlap in expertise, which also partly compensated for this limitation of the research.

This thesis provides a framework for creating the necessary institutional infrastructure for a successful introduction of GMOs in emerging economies. Some of the recommendations are for policy

and regulation on a national scale (such as instituting the proper food safety laws and environmental regulation and engaging in a participatory process in formulating these regulations) and some recommendations are aimed at a larger multilateral context (such as the broader intellectual property right legislation debate). In the broader international debate it is vital to have a participatory process as well. As Joseph Nye notes, non-state actors such as NGOs are becoming ever more important in the information age and including these actors in formulating new policy may increase support for these policies by using soft power. Further research on how the debate on GMOs vis-à-vis intellectual property rights differs from other IPR discussions would also be interesting.

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Appendix A – Topic list

Introduction

Introduction of:

- The interviewer;
- The research;
- The respondent.

Use of GMOs: is the respondent a proponent/opponent and why.

- Potential risks;
- Ethical considerations.

Leg 1: Intellectual property rights

IPR protection:

- What is the current state of IPR protection in the BRICs;
 - o Laws;
 - o Enforcement.
- Where would the respondent like to see what type of IPR protection and why;
 - o In general and in the BRICs;
 - o Role IPRs in market concentration;
 - o Trade barriers.
- Role of IPR protection in attracting FDI.

Leg 2: Food safety & environmental regulation and the role of a possible knowledge gap

Food safety/environmental regulation

- Where would the respondent like to see this regulation;
- What are potential negative externalities with too little regulation;
- What are potential negative externalities with too much regulation.

Knowledge/scientific community

- What is the current role/status of education/scientific community in the BRICs;
- Is there a knowledge gap;
 - o Size of scientific community;
 - o Size of available workforce educated in the field of biotechnology.
- Does a potential knowledge gap result in technologically biased innovations?
- What role does this gap play & how can this asymmetry be resolved.

Contestability

- Can a lack of contestability (either by IPR or regulation) cause black markets;
 - o What's the link to food safety.
- What role can/does contestability play & how can problems be resolved for the BRICs.
 - o Prices;
 - o Quality & monocultures;
 - o Availability.

Leg 3: Societal debate & potential power shifts

Participatory process in establishing policy on GMOs

- Societal debate;
 - o Who should participate;
 - Role scientific community in creating policy.
 - o Who should take initiative.
- What's the influence of a societal debate on acceptance of GMOs.

(Potential) role of BRICs in the GMO debate

- Could the BRICs lead the developing world in the GMO debate;
 - o Soft/hard power.
- Role of BRICs as a demand market;
- Role of BRICs as a supply market to other developing countries & the West;
- Role of BRIC investments in for example Africa.

Appendix B – Code tree

Leg 1: IPR

- Contestability
 - o Equal access to knowledge/information
- Black markets of seeds protected by IPR
 - o Trade barriers
- IPR stimulating investment in innovation/FDI
 - o Other possible incentive structures

Leg 2: Food safety & environmental regulation

- Contestability
 - o Long process of approving new varieties
- Black markets of non-approved seeds
 - o Food safety
- Education
 - o Role scientific community in informing policy
 - Knowledge gap
 - Technological bias
 - o Role of education farmers
 - Business or government as educator

Leg 3: Informal institutions & power shifts

- Power relations
 - o Power relation farmers \leftrightarrow business
 - Choice freedom farmers
 - Seed prices
 - o Position BRICs in debate
 - Economic position
 - Political position
- Informal institutions/societal debate
 - o Who should take the lead in the debate
 - o Risk perception
 - Labeling of GMOs

Consequences of low contestability

- Seed prices
- Homogenization of the seed market
 - o Monocultures/biodiversity
 - o Technological bias
 - o Flexibility & climate change

Separate codes

- Introduction interviewee
 - o Pro/anti GMOs
- Nutritional value GMOs
- Relation to sustainability
- Remarks on China
- Remarks on India
- Remarks on Brazil