"A tale of (ir)rational ignorance, lobbying and fake news: the evolution of the regulation of the Genetically Modified Organisms in the US, EU and beyond"

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Abstract

The regulation of the genetically modified organisms (GMOs), with the GM crops to the fore, has been a long-standing and contentious issue within the public sphere throughout the last two decades. The observed divergence between the countries supporting the cultivation of the GM crops and those restricting its presence (mostly through the stringent GMO regulations) poses a formidable challenge to the political economy scholarship. Building upon the existing body of literature (both theoretical and empirical), I propose several extensions that help account for the aforementioned divergence, especially between the European Union and United States. Furthermore, these extensions shed some light on the informational nature of the processes that govern the belief formation on the GMOs, with far-reaching consequences for the policymaking process. More specifically, I employ the evolutionary account of insitutions proposed by Greif (2006) and the models of information dissemination set forth by Kuran and Sunstein (1999) and Bikhchandani et al. (1992). I find that these perspectives helpful in explaining the persistence of the observed GMO regulatory environments.

I. Introduction

The issue of Genetically Modified Organisms (henceforth: GMOs), although at first glance may seem as something purely biological and technical in nature, during the last two decades has surprisingly developed into one of the fiercest debates within the public sphere, both in the developed and developing world (Kangmennaang et al. 2016). Consequently, the still-ongoing battle over the laws shaping the production, distribution and even labelling of the GMO products constitutes an exciting field of enquiry from a political economy perspective, given the variety of economic, political and social actors and processes that have been shaping the stance of the GMO regulation on both national and international levels.

What has been the most striking in the development of the regulation of the GM crops, however, is the great global divide between the countries that favorable to the cultivation of the GMOs (e.g. USA, Brazil), and the ones that have more stringent regulations surrounding these crops, with an effective ban on the GMO cultivation being an extreme, although not rare, solution (e.g. EU).

In my essay, I strive to combine the accounts and explanations that has been set forth in the literature (the relative scarcity thereof notwithstanding) and expand them by several economic and political insights that I found especially enlightening in the context of the essay's topic. More specifically, building on the empirical analysis of Vigani and Olper (2013) and theoretical insights of Vazquez-Salat (2013), among others, I propose an extended framework that in my opinion is useful in modelling the dynamic socio-economic and political processes that shaped the divergence the GMO regulatory stance across the Atlantic. Furthermore, I believe that the proposed extensions will provide some more general insights on the phenomena in the realm of the information economics (such as the proliferation of the so-called *fake news*) and the political economy of special interest groups, both of which prove central in explaining the developments within the GMO regulation. To this end, I will draw heavily from the works of Grief (2006) and Kuran and Sunstein (1999).

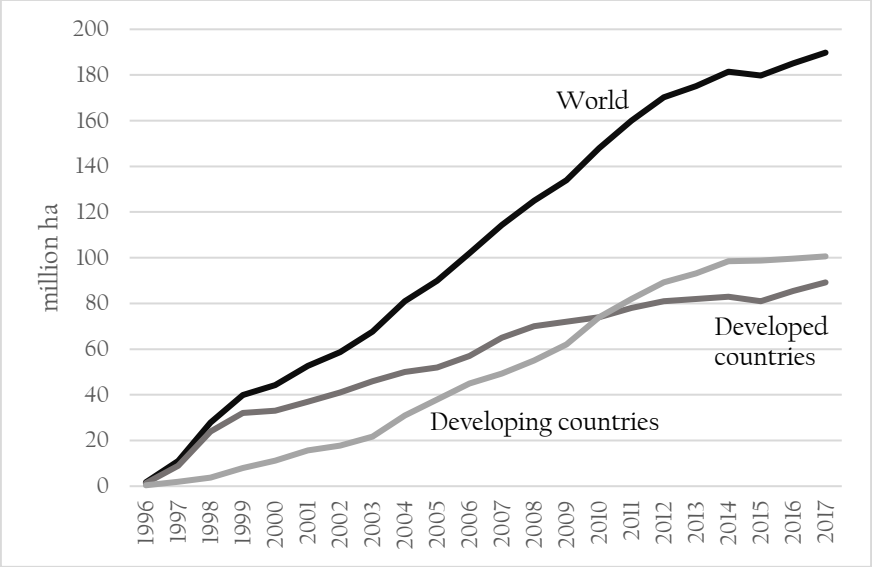
The structure of the paper is as follows: in Section II, I briefly explain the notion of a GMO, illustrate the rise in their popularity since the 1990s, as well as discuss the emergence of the two opposing perspectives on the GMO regulation. In Section III, I process to summarize the debate that has been surrounding the issue of the GMOs since their first commercialization. Section IV provides a brief account on the scientific evidence on the claims used in the debate. In Section V, I succinctly outline the current stance of scholarship analyzing the political economy of the GMO regulation, with Section VI containing my proposed extensions to the existing body of knowledge. Section VII concludes.

II. GMOs – the great divergence

Technically speaking, Genetically Modified Organisms are the ones that have been modified genetically, no matter the method used (e.g. "traditional" breeding methods or "modern" biotechnological methods). However, and for the reasons elaborated upon below, the bulk of the global debate about the GMOs costs and benefits, as well as regulatory policies, has rested upon the genetically modified crops that were created using the biotechnological methods (Kangmennaang et al. 2016). Consequently, in what follows I restrict my definition of the GMOs accordingly.[1]

The GMOs were first commercially introduced in 1992 (*Flavr Savr* tomato), with other plants and crops successfully modified in the subsequent years. The hectarage of the world GMO biotech crops has witnessed a substantial growth in the following two decades: with a mere 1.7 million hectares in 1996, the number rose to a stunning 189.8 million hectares in 2017, as Figure 1 depicts (James 2017).

Figure 1. Total area of the world's GMO biotech crops cultivation.



Source: James (2017).

Despite the seemingly harmonized expansion of the GMO crops in both industrialized and developing world, in reality the distribution within those two categories is highly skewed and in both cases the bulk of the GMO production takes place is a few countries. Table 1 illustrates this phenomenon: within the developed economies, USA and Canada account for over 47% of the total production, whereas in

[1] Note that I will use the terms "GMOs", "GM crops" and "biotech crops" interchangeably.

the developing world, Brazil produces the same amount of GMO crops as the rest of the developing economies combined.

Table 1. Production of the GMO biotech crops in chosen countries in 2017.

Rank	Country	Hectarage of GM crops (million ha)	% of total
1	USA	75	40%
2	Brazil	50.2	26%
3	Argentina	23.6	12%
4	Canada	13.1	7%
5	India	11.4	6%
6	Paraguay	3.0	2%
12	Australia	0.9	<0.1%
16	Spain	0.1	<0.1%
25	Slovakia	<0.1	<0.1%

Source: James (2017)

As far as the types of the GMO crops cultivated are concerned, the detailed world data are unavailable, although the data for the US may serve as a rough approximation. In the US, maize and soybeans account together for roughly 90% of the total arable land devoted to GMO cultivation, with the remainder split between cotton (6%), alfalfa (2%) and other biotech crops, such as canola (2%).

The data presented in Table 1 points to the curious absence of the particular countries and groups of countries in the ranking. Two of the most striking examples are the European Union (EU) and Japan. Indeed, in 2017 EU countries accounted for less than 0.3% of the total GMO hectarage.[2] Japan, on the other hand, had no land devoted to GMO production whatsoever (James 2017). These facts are closely tied to the relatively stringent regulatory regime present in both places Vigani and Olper (2013). Table 2 presents the values of the GMO stringency calculated by Vigani and Olper (2013): the values of this index for the GM crops' producers, such as US (0.35) and Brazil (0.50) are way below those for the EU (0.69) and Japan (0.70).

The approach that evolved over the last two decades in the EU and Japan, which stresses the potential risks of GMOs and calls for increased caution in their adoption (as opposed to the more liberal stance) is referred to as the *precautionary principle* (van der Belt, 2003). This development is even more striking if faced with both EU's and Japan's deeply embedded culture of technological innovation and progress. How did then this sharp polarization take place and, even more so, persist through time?

[2] The three EU countries that produce GMO at the moment are Spain, Portugal and Czech Republic.

Table 2. The stringency of the GMO regulatory regime in chosen countries.

Rank	Country	GMO regulatory index
1	Hong Kong	0.10
2	Turkey	0.15
4	Canada	0.30
5	Chile	0.35
5	United States	0.35
8	Brazil	0.50
8	China	0.50
9	Switzerland	0.55
10	Spain	0.60
10	United Kingdom	0.60
12	European Union	0.69
13	Japan	0.70
15	Zimbabwe	1.00

Notes: the highest index value, the more stringent regulatory regime

Source: Vigani and Olper (2013)

III. GM crops - the debate

Before attempting to answer the question posed at the end of the last paragraph, we have to take a step back and trace the arguments that have been fueling the fierce debate surrounding the GMO crops since their first commercialization in the late 1990s.[3] Although a detailed account of all of the claims made my both sides of the debate is well beyond the scope of this essay, let me succinctly summarize the main arguments used therein.

The proponents of the GMOs' introduction claim that the biotech crops exhibit certain desirable characteristics, such as greater resistance to the adverse weather conditions or immunity to the pests, resulting in a higher yield and lower pesticide use (Klümper and Qaim 2014). This, in turn, increases the farmers' profits and, especially in the developing world, may help alleviate the food shortages. What is more, they claim that the accumulated body of scientific evidence allow us to conclude that the

[3] Interestingly enough, during the first few years after the GMOs became available, there existed a widespread consensus (supported by the WTO) between virtually all major industrialized countries that these developments are beneficial and hence should be further encouraged. It was only around 1999 that EU changed its stance, followed by Japan a few years later. For a detailed account of these processes see Tiberghien (2006).

GMOs are as safe as their "natural" counterparts (Prey et al. 2002). The arguments are hence based on the enhancement of economic welfare.[4]

On the other hand, the adversaries point to the alleged health risks that consumption of the products containing the GMO crops may incur; these include, among others, increased antibiotic resistance, and allergies (Peterson et al. 2000). Furthermore, they point to the potentially unfavorable impact of biotech crops on the environment, especially on the biodiversity and destabilizing particular ecosystems to the fore (Breckling et al. 2011) and that there are multiple risks that are yet undiscovered (Morris 2011). Also, there exists a widespread suspicion to the multi-national corporations in the biotech industry (such as *Monsanto*), as well as the whole process of "mechanization" of food production (Binimelis and Myrh 2016). Finally, the need of purchasing the GMO seeds crops from such corporations by the farmers (especially those in the developing world) is seen as a threat to their independence and economic situation (Maghari and Ardekani 2011).

However, although the proponents of the GM crops use mainly the economic-type of claims listed above (which are certainly testable), the opponents of GMO, beside the science-based claims, employ all sorts of non-falsifiable propositions in their argumentation. Kangmennaang et al. (2016: 42), after thoroughly analyzing the narratives and rhetoric used in the GMO debate in Ghana, concluded that the debate "is engrossed in conspiracy theories, religious exaggeration, mistrust between public and civil society on the one hand, and scientists and government on the other". Indeed, the GMO is often pictured as the "mechanism of neo-colonialism" and even "means of eugenics", a phenomenon Kangmennaang et al. (2016: 46) refer to as "rhetoric of unreason". Surprisingly, it was found to be "dominant in the arguments of most anti-GMO activists".

Finally, Kangmennaang et al. (2016: 38), claim that "the frontiers of GMO debates have expanded" to include new dichotomies. These include *science vs policy* (Varzakas et al. 2007), *technological determinism vs limits to science* (Peck 2009) and even *Americanism vs Eurocentrism* dichotomies. In my opinion, although these concepts may potentially be useful in framing the mentioned debate and in delivering a more precise account of its contents, they are of little use if one tries to address the question of *why* have we witnessed such a dramatic divergence in the stringency of the regulation of the GMOs, especially between countries and regions on the similar level of economic and social development.[5]

[4] However, these gains are bound to be distributed differently in the developed and developing economy setting (Lapan and Moschini 2004, Vigani and Olper 2013). Whereas in the former the main beneficiaries are likely to be the producers (due to the lower costs and hence higher profits), in the latter case the consumers are bound to benefit more (due to the higher availability of food). I will further discuss this point below.

[5] Economically speaking, this setting is likely to be characterized by the so-called *multiple equilibria*.

IV. Benefits and risks of GMOs - some evidence

Before turning to the economic tools that may help in modelling the processes that have led to the aforementioned divergence, it is necessary to survey the available evidence on the issues repeatedly brought up in the GMO debate.

First, there exists a vast and differentiated literature confirming the effectiveness of the biotech crops in terms of higher yield and cost savings (e.g. Prey et al. 2002, Morse et al. 2004, Sexton and Zilberman 2012). Indeed, in an extensive meta-analysis, involving the examination of the results of 147 individual studies, Klumper and Qaim (2014) found that the average increase in yield of the GM crop (compared to the non-GM crop) equals 21.6%, whereas the quantity of pesticides and the associated pesticide costs decrease by 36.9% and 39.2% respectively. Furthermore, the farmer's profit was found to be 68.2% higher compared with the situation where the non-GM crop is cultivated. Crucially, the authors address the oft-voiced concern about the potential upward bias in the studies commissioned by the biotech industry.[6] Contrary to these accusations, Klumper and Qaim (2014) concluded that the source of funding does not influence their impact estimates and, on top of that, that the studies published in the peer-reviewed journals exhibit a 12 percentage point *higher* estimates of the GM crops' impact on the yield gains compared to the studies published outside of the journals.

Second, some studies point to the potential risks brought about by the cultivation and consumption of the GM crops. Breckling et al. (2011) identified horizontal and vertical gene transfers, as well as some "higher order" and "indirect" risks posed by the GMOs. Mae-Wan (2000) point to the DNA recombination processes that may lead to allergies and other health problems. There is also some evidence that the consumption of GMOs may lead to the increased antibiotic resistance (Braun 2001). Furthermore, environmental risks may emerge due to e.g. *cross-pollination* of the crops (Binimelis and Myrh 2016). Interestingly, a large body of research warn against unknown risks (de Vendomois et al. 2010).

Second, the research that highlights the risks of GMOs often refers to the *potential* risks, without fully describing and explaining the mechanisms involved.[7] Although I am unqualified to take a definitive stance on this debate, let me make two remarks at this point. First, the literature examining the gains (i.e. in yield and farmer's profits) from the GMO cultivation is well-established and their conclusions generally not contested by the opposite side.

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[6] Ardekani and Maghari (2011) may serve as a case in point. The authors sharply distinguish between the studies carried out by the "independent GM researchers" and the studies commissioned by the biotech industry. They accuse the latter of "inadequate testing methods", "use of inappropriate statistics" and the lack of proper control of the experiments. However, besides this stream of these very serious accusations, the authors do not point to any specific examples of such ill-executed experiments.

[7] The latter is brought to the extreme in the discussion of the *unknown* risks – this line of argumentation was summarized by van der Belt (2003) as "Guilty until Proven Innocent" approach to GMO. In the context of unknown risks, however, it is virtually impossible to "prove the GMO innocent".

V. Political Economy of GMO – what do we know

Based on the structure of the GMO debate and the controversies present within it, it would seem to be expected that the regulatory stance of the GMOs should be ultimately determined by the results of the rigorous and replicable scientific studies (providing the basis for the estimates of the benefits and costs) and some form of cost-benefit analysis undertaken by policymakers. If the benefits would exceed the costs, we would expect the stringency of the GMO regulation to be lower than if the opposite was the case. However, assuming that science determines the policy is often naive (Gluckman 2013). As Wickson (2014: 269) observes:

> In recent years, however, the sense of crisis that this (*the GMO controversy – M.U.*) has generated for the European Union has intensified as several of the larger and more powerful member states (…) have declared national prohibitions on the cultivation of particular genetically modified crops despite the safety approvals from the European Commission and the European Food Safety Authority (EFSA). (…) EFSA has, however, evaluated each prohibition on GM crop cultivation to date and deemed all of them lacking in sufficient scientific support. (…) Despite this, the bans remain in place and this has created a deep and reverberating political impasse that scientific method and process have not been able to resolve, despite several years of intense efforts.

As we can see, the political and social processes influencing the GMO regulatory stance turn out to be much more complex and multi-faceted in reality (Pal 2010). Therefore, in order to model these processes satisfactorily, I build upon the some key political economy perspectives proposed to date.

First, the distinction set forth by Vazquez-Salat (2013), who divided the actors present in the GMO policymaking process into three domains – *the Science*, *the Market* and *the Public* proves useful in framing the subsequent modelling. The first group consists of actors involved with R&D activities (e.g. scientists pursuing the GMO-related research). *The Market* domain, on the other hand, is heterogenous and industry-specific: the actors within this domain comprise the whole spectrum of stakeholders across the GMO production and retail chain and range from small, independent farmers to big, vertically-integrated Multi-National Corporations (MNCs). Finally, *the Public* is formed by the citizens, interest groups, non-governmental organizations and the media. As I will strive to show in what follows, it is a dynamic interaction between the latter two groups, as well as some specific processes happening within *the Public* that determine the stance of the GMO regulation.

Furthermore, due to the multitude of the potential theoretical explanations of the GMO regulatory divergence in place (as the plethora of the aforementioned *dichotomies* demonstrates), it seems crucial to base the further analysis in the thorough (and, as far as I know, the only of such scope) empirical analysis on determinants of the stringency of the given county's GMO regulations. Indeed, in their work

Vigani and Olper (2013) have identified several economically and statistically significant factors that help explain the observed divergence.

Importantly, Vigani and Olper (2013) based their econometric exercise on several theoretical models, with the Grossman and Helpman's (1994) *Protection for Sale* model to the fore (the latter was later extended by Swinnen and Vandemoortele (2011) to the GMO issue).[8] Correspondingly, they anticipate the crucial impact of lobbying activities on the stringency of the GMO regulation (which may explain why "government policies are biased in favor of urban consumers' interests in poor countries and farmers' interests in rich countries" Vigani and Olper (2013: 37)). Furthermore, they employ the "market for information" framework and test whether media (more specifically: the structure of the media market) has an impact on the consumers' attitudes toward the GMO. The latter prediction is based on the growing political economy of the media literature, such as Stromberg (2004). More specifically, the more privately-owned the media are, the more responsive to the citizen's tastes they become. Finally, Vigani and Olper (2013) expect the quality of environmental regulation to positively impact the stringency of GMO standards, with the opposite effect for the proportion of rural population.[9]

Vigani and Olper's (2013) econometric analysis largely confirm the listed claims; both amount of lobbying activity and the quality of environmental regulation are found to be positively related to the GMO regulations' stringency. Furthermore, the share of private media is found to be statistically significant, however, with a following non-linear relationship: in the poor countries, the media target mostly the farmers (of which there is a majority) resulting in a less stringent regulatory regime. However, at the certain level of economic development, the media start to target consumers, and the mentioned "bad news" incentives kick in, leading to the public opinion gravitating toward the anti-GMO positions. Finally, the non-linear impact of the proportion of rural population is shown to be statistically significant as well.

Finally, let me complement this brief survey by pointing to an insightful Wunderlich and Gatto's (2015) analysis of the consumer perception of GMOs. They conclude that despite the proliferation of the GM products, the consumer awareness of them remains low. Crucially, they have shown that the self-reported "GMO familiarity" (acquired from e.g. the media and NGOs' materials) leads consumers to be more skeptical towards the GMOs, while "GMO scientific understanding" results in the opposed effect.

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[8] Swinnen and Vandemoortele (2011) build a model in which two interest groups (producers and consumers) lobby the government to achieve the preferred standard of a given policy. Importantly, the levels of their contributions to the lobbying activity depends on the interplay between the marginal impact of the change in a stringency of the policy on the producer's profits and consumer's surplus. Here, we can already see that in the three domains identified by Vazquez-Salat (2013), only the *Market* and the *Public* play a role in the determination of the GMO standards.

[9] Interestingly, a quadratic relationship is fitted in the latter case. This is rationalized by claiming that the trade-off is there in this case: small farmers' associations are expected to be disproportionately successful in lobbying activities (the claim that follows from the seminal work of Olson (1985)). However, as the proportion of the rural population grows, the total impact of the rural labor on the government's policy should rise as well.

VI. Political Economy of the GMO - extending the framework

Although I consider the Vigani and Olper's (2013) analysis as the most robust and insightful to date, I strongly believe that it can be meaningfully extended in several directions. First, let me point to the absence of the temporal dimension in the analyses I outlined so far.[10] Indeed, this is even more striking as the field of political economy has recently witnessed a rapid development of the literature dealing with the dynamic evolution of the social and institutional phenomena, with Greif (2006) being the prime example thereof. The notions of *self-enforcement* and *self-reinforcement* introduced by Greif (2006) seem to be a useful tools in explaining the GMO regulatory persistence (which, as I mentioned in Section II forms a formidable puzzle).[11]

Second, the work of Timur Kuran and Cass Sunstein seems highly relevant to the topic as well. Building on the Hayekian (1945) intellectual tradition, Kuran and Sunstein (1999) introduce the concept of the so-called *availability cascades*, which they define as "self-reinforcing processes of collective belief formation by which an expressed perception triggers a chain reaction that gives the perception increasing plausibility through its rising availability in the public discourse." In other words, some phenomena may quickly gain a lot of media coverage and public attention, even despite their relative unimportance or even falsehood. Availability cascades operate through the mechanisms of mental shortcuts (*heuristics*) our minds use when faced with abstract and complicated issues. Interestingly, Kuran and Sunstein (1999) underline the importance of the *availability entrepreneurs* in the process: these are people or organizations whose aim is to render a given issue central to the public debate. As they show, availability cascades may lead to drastic mistakes in public perception of the e.g. environmental risks. Finally, the process of public the dissemination of this kind of information is prone to the phenomena of another type of cascade – an *informational* one. The latter occurs when a person is making a decision based on the decisions and actions of other people (which constitute *signals*), and not on the fully-deliberate thought process (Bikhchandani et al. 1992). The combination of these two types of cascades operating in the public sphere may easily lead to the dissemination of the phenomena nowadays referred to as *fake news*. Kuran and Sunstein (1999) use a powerful example from the environmental sphere of the infamous *Love Canal* case to illustrate their claims.

Equipped with these tools and concepts I am ready to shed some light on the processes that led to the different GMO regulatory frameworks and that have solidified these divisions.

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[10] Vigani and Olper (2013) admit that this is one of the shortcomings of their work – the GMO stringency index is purely cross-sectional, preventing any time-series exercise from being undertaken.

[11] Technically speaking, an institution is self-enforcing, when behavior of an economic agent (driven by the incentive system set by an institution) leads other economic agents to behave in line with the incentive structure itself. The institution is self-reinforcing, when over time this feedback mechanism renders the deviation from the incentivized behavior more and more costly and hence gradually less likely (Greif 2006).

In Europe, the integration of the GMO issue into the general environmental policy framework the consistent efforts from the NGOs to underline the alleged risks they pose toward the end of 1990s, managed to quickly alter the public opinion on the topic (Tiberghien 2006). Crucially, both informational and availability cascades seem to have characterized this shift (in this setting, NGOs such as Greenpeace acted as a availability entrepreneurs). The process was exacerbated by the technical nature of this issue and the *(ir)rational ignorance* on behalf of citizens in relying upon the information available in the media, instead of engaging in the costly self-education (as Wunderlich and Gatto (2015) confirms). This has created a bottom-up pressure on the politicians to oppose the introduction of the GM crops (e.g. by increasing the environmental factors' impact in the cost-benefit analyses – see e.g. Binimelis and Myrh (2016)), despite limited scientific basis for these actions. Crucially, this was possible due to the weakened the incentives for the European famers to lobby for the less stringent GMO regulation, with the high productivity and hefty subsidies system (Common Agricultural Policy) in place (Paalberg 2010). Ichim (2018) confirms this view in the analysis of the Romanian GMO experience. This have resulted in the self-reinforcing process: more lobbying from the NGOs side made it even more costly for the farmers to engage in these activities, due to the low probability of success and limited potential gains.

In the case of the USA, on the other hand, the existence of the MNCs and large-scale farmers with high potential gains and lobbying power prevented the European scenario from materializing, despite the same levels of anti-GMO attitudes within the general public (Wunderlich and Gatto 2015).

Crucially, it is within the developing world that the cascade mechanisms spreading the distorted picture of the GM crops that may prove the most harmful. As Kangmennaang et al. (2016: 38) note: "Europe can afford to ignore the GMOs, but Africa cannot". Indeed, despite the relatively strong farmers' lobbies in the developing world, the high levels of ignorance and superstition in the debates surrounding the GMOs, as well as the process of the media potentially shifting to more consumer-centric positions as economic growth and urbanization continue, the welfare enhancements provided by the GM crops may fail to materialize. Indeed, t*his* may prove to be the biggest cost of *fake news*, as opposed to their impact on the electoral outcomes. Quite ironically, the media worldwide seem to disagree.

VII. Conclusion

The GMO regulation forms one of the most controversial issues in the public sphere in the last two decades. As I strived to show in my essay, the processes that govern the GMO regulatory stance pose a formidable challenge to the political economy literature. Consequently, I have proposed several perspectives that may help in the analysis of the GMO debate and the observed divergence between the countries that are friendly and antagonistic to the GM crops.

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