EU member states' voting for authorizing genetically engineered crops: A regulatory gridlock:

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EU Member States' Voting for Authorizing Genetically Engineered Crops: a Regulatory Gridlock

Das Abstimmungsverhalten von EU-Mitgliedsstaaten hinsichtlich genetisch veränderten Anbaukulturen: ein regulatorischer Stillstand

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Abstract

Several authors suggest a gridlock of the European Union's (EU's) approval process for genetically engineered (GE) crops. We analyse the voting behaviour of EU Member States (MSs) for voting results from 2003 to 2015 on the approval of GE crops to test for a gridlock; no reliable data are available pre-2003 - a time which included the EU's moratorium on GE crops. After the European Food Safety Authority (EFSA) has given a favourable opinion on the safety of a GE crop, the Standing Committee on the Food Chain and Animal Health (SCFCAH) votes on the application. If the SCFCAH reaches no decision, the Appeal Committee (AC) (pre the Treaty of Lisbon: the Council) votes on the application; if no decision is reached here, the final decision is left to the European Commission. All EU Member States (MSs) are represented on both committees; decisions are made by a qualified majority (QM) voting system, the rules of which have changed over time.

Our data include 50 events; and 61 ballots at the SCFCAH and 57 ballots at the Council / AC. A QM has been achieved once only at the SCFCAH, but never at Council. At Council / AC level, Austria and Croatia have consistently voted against an approval, while The Netherlands has always supported approvals. All other MSs showed differences in their voting decisions at the SCFCAH and Council / AC level at least once. MS-fixed-effects are the major factors explaining the voting results supporting the gridlock hypothesis, while crop characteristics and crop use play no apparent role in MSs' voting behaviour. We maintain that a QM is unlikely following the latest directive for MSs to 'opt-out' on GE crop cultivation in their territories.

Key Words

approval process; genetically modified organism (GMO); GE; qualified majority vote; voting behaviour; authorization; Standing Committee on the Food Chain and Animal Health; Appeal Committee; Council; political economy; opt-out

Zusammenfassung

Einige wissenschaftliche Autoren berichten, dass das Genehmigungsverfahren für genetisch veränderte Anbaukulturen in der Europäischen Union ins Stocken geraten sei. Wir untersuchen das Abstimmungsverhalten und die Abstimmungsergebnisse von EU-Mitgliedsstaaten im Rahmen dieser Genehmigungsverfahren im Zeitraum 2003 bis 2015, um diesen „Stau" zu erforschen; für den Zeitraum vor 2003 liegen u.a. aufgrund des EU-Moratoriums keine verlässlichen Daten vor. Nachdem die Europäische Behörde für Lebensmittelsicherheit (EFSA) neue Anbaukulturen für sicher befunden hat, stimmen Mitglieder des Ständigen Ausschusses für die Lebensmittelkette und die Tiergesundheit (SCFCAH) über deren Zulassung ab. Sollte in diesem Ausschuss keine Entscheidung hinsichtlich einer Deregulierung getroffen werden, so stimmt der Berufungsausschuss (Appeal Committee bzw. The Council) über die Regulierung ab; sollte auch hier keine Entscheidung gefällt werden, liegt die endgültige Entscheidung bei der Europäischen Kommission. In beiden Ausschüssen sind alle EU-Mitgliedsstaaten vertreten; Entscheidungen sind einer qualifizierten Mehrheit unterworfen, wobei die entsprechenden Regeln im Zeitverlauf geändert wurden.
Unser Datensatz erstreckt sich auf 50 Anbaukulturen, über die in 61 Abstimmungen durch SCFCAH und in

57 Abstimmungen durch den Berufungsausschuss befunden wurde. Unsere Analyse zeigt, dass eine qualifizierte Mehrheit lediglich in einem einzigen Fall in einer SCFCAH-Abstimmung, aber nie im Berufungsausschuss erreicht wurde. Bei Abstimmungen im Berufungsausschuss stimmten Österreich und Kroatien durchweg gegen eine Deregulierung, während die Niederlande alle Anträge unterstützten. Alle anderen Mitgliedsstaaten wiesen nicht immer ein konsistentes Abstimmungsverhalten in SCFCAH und dem Berufungsausschuss auf. Die Resultate unserer empirischen Analyse legen nahe, dass Ländereffekte den größten Erklärungsanteil für den genannten „Stau“ ausmachen; Eigenschaften einer Anbaukultur und deren Verwendungszweck scheinen lediglich eine untergeordnete Rolle für die Entscheidungen der Mitgliedsstaaten zu spielen. Eine qualifizierte Mehrheit erscheint unwahrscheinlich angesichts der jüngsten Direktive, die Mitgliedsstaaten erlaubt, auf ihrem jeweiligen Staatsgebiet den Anbau von genetisch veränderten Anbaukulturen zu untersagen.

Schlüsselwörter

Genehmigungsverfahren; genetechnisch veränderte Organismen (GVO); GV; EU-Mitgliedsstaaten; qualifizierte Mehrheit; Abstimmungsverhalten; Zulassung; Standing Committee on the Food Chain and Animal Health; Appeal Committee; Council; genetisch veränderte Anbaukulturen; Politische Ökonomie; opt-out

1 Introduction

The advancement of scientific discovery gave rise to the development of recombinant DNA technology (genetic engineering), which has been successfully applied, inter alia, in plant breeding for developing genetically engineered (GE) (also known as transgenic or genetically modified) crops (WESSELER, 2014). Scientists recognised the far-reaching significance of this development, including potential risks and benefits, and consequently initiated steps for the regulation of this type of biotechnology research in the 1970s (MCHUGHEN and SMYTH, 2008). Regulatory oversight was broadened to include its commercial application for ensuring safety for humans and the environment (JAFFE, 2004). MORRIS and SPILLANE (2010) summarise the regulatory history in the European Union (EU) of this technology up to 2010, commenting that its development has been controversial and difficult. It was interrupted by a *de facto* moratorium from 1998 to 2004 (LIEBERMAN and GRAY, 2006), and the redrafting of legislation. In April of 2015 a legislative act was introduced whereby Member States (MSs) can decide whether GE crops authorized for cultivation can be cultivated on their territories (OJEU, 2015), the so-called ‘opt-out’ directive. Subsequently, a similar proposal for GE crops authorized for ‘food and feed’ use was made by the Commission (EC, 2015).

The precautionary principle is the legal instrument used in the EU legislation for preventing and managing risk – connected in the food sector to biotechnology in a multidimensional way via science, ethics, sociology, and religion - thereby treating GE organisms as unique, requiring tailor-made regulations (CARARU, 2009). Thus, in the EU the process of genetic modification is regulated, and not the product (i.e. in the case of GE crops, the new genetic trait introduced to the plant). This means that every GE crop is subjected to regulatory oversight on a case-by-case approach (CARARU, 2009; TWARDOWSKI and MAŁYSKA, 2015) despite numerous high profile sources in the 1980s advocating that regulations in the EU be “product” rather than “process” based (MORRIS and SPILLANE, 2010). One has to note, as BECKMANN et al. (2011) among others have pointed out, what is considered to be GE, conventional, or organic, is a social construct.

The approval processes for GE crops in the EU and other countries have been criticized for their weak scientific support and welfare losses including health costs, and costs to the environment caused by delays in, or lack of, approval (FALCK-ZEPEDA et al., 2013). The temporal disparity in regulatory harmony has resulted in asynchronous approval causing disruptions in international trade (STEIN and RODRIGUEZ-CEREZO, 2010).

The EU is dependent on the import of food and feed, especially sources of vegetable protein such as soybean, for its livestock industry (HENSELER et al., 2013; DE VISSER et al., 2014; DUNWELL, 2014; KALAITZANDONAKES et al., 2014). But, its stringent rules on the low level (adventitious) presence of unauthorized GE crops in imported shipments of food and or feed have caused the segregation of supply chains with concomitant costs, and disrupted trade (PURNHAGEN and WESSELER, 2015; KALAITZANDONAKES et al., 2014; FAO, 2014). The consequences have been strained relations with its trading partners (in some instances escalating to tribunal action at the World Trade Organisation (DE VILLE, 2014; PUNT and WESSELER, 2015), and notable revenue losses to its feed industry (BROOKES, 2008). HENSELER et al. (2013) show that a trade disruption of EU soy imports caused by asynchronous approvals could compromise the competitiveness of its livestock sector and jeopardize agricultural incomes and employment with bidirectional knock-on effects within affected value chains. The EU's unfavourable regulatory environment has caused innovators in the field of green biotechnology to relocate their research and development activities to countries with more accommodating regulatory oversight, where the prospect of commercializing innovations is better. The result for the EU is a loss in human capital, expertise, investment and employment opportunities, and the potential benefits from the commercialization of these products (TRAGER, 2012; DUNWELL, 2014; MALYSKA and TWARDOWSKI, 2014).

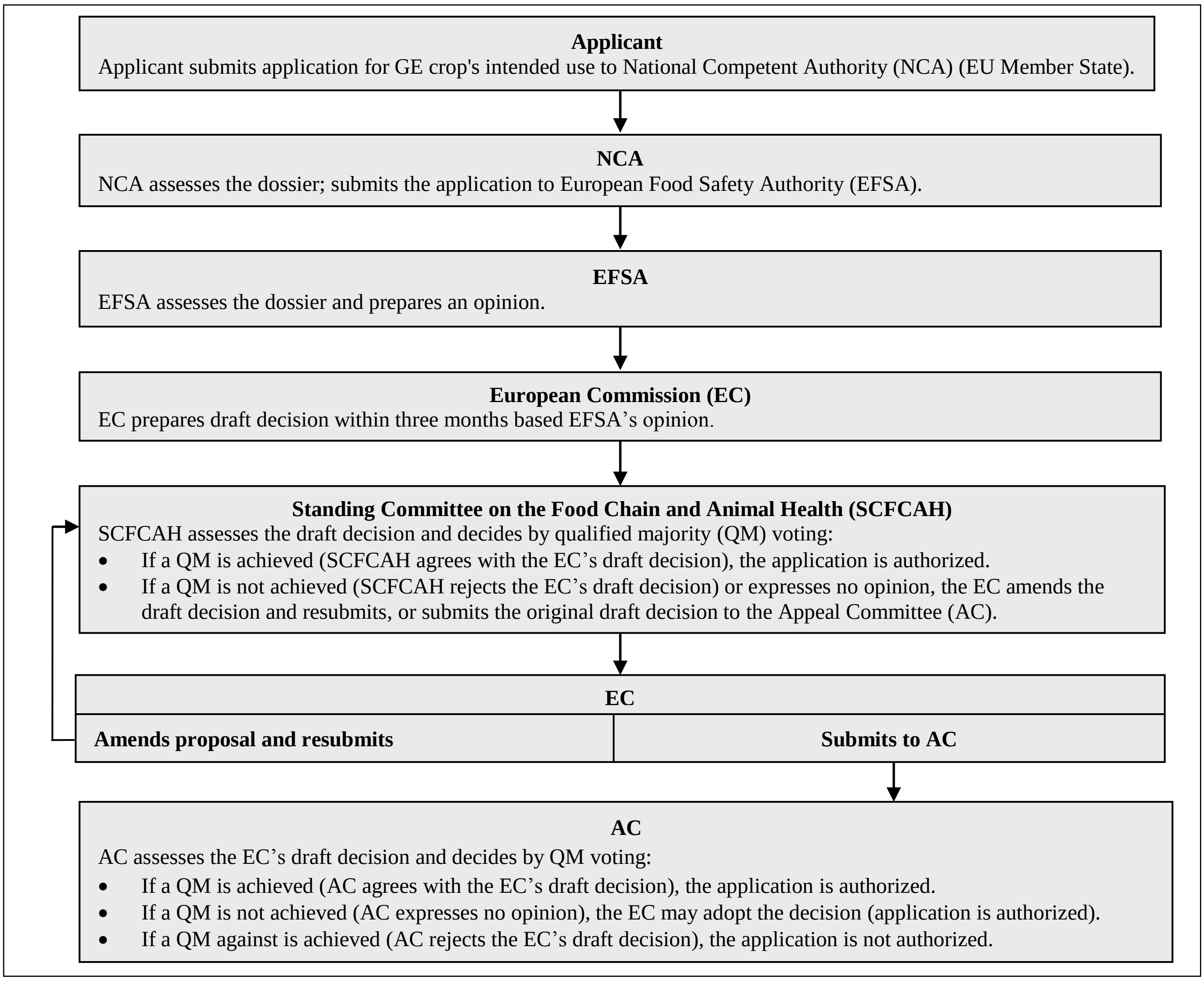
Taking a closer look at the EU's GE crop regulations reveals that authorization is required for one or more of the following purposes: use as food and or feed; import for processing; and cultivation. Authorization is governed by Directive 2001/18/EC (OJEU, 2001) and Regulation (EC) No 1829/2003 (OJEU, 2003), is valid for ten years after which a renewal is required, and follows a consecutive two-tier process starting with risk assessment followed by risk management. The former comprises scientific investigations conducted by the European Food Safety Authority (EFSA) for determining a crop's safety for humans and animals (applications for use as food and or feed, and or import for processing), and the environment (additionally for applications for cultivation). If the EFSA's opinion is favourable, the next step is risk management – a political decision-making process (EUROPEAN FOOD SAFETY AUTHORITY, 2013) during which MSs' representatives vote at the EU for authorization (OJEU, 2001).

After the EFSA completes its involvement in the risk assessment (which is criticised for ignoring any potential benefits (MORRIS and SPILLANE, 2010)) of a given GE crop's application, its overall opinion of the crop's safety is published in the EFSA Journal. Risk management is triggered when the EFSA passes its favourable opinions on to the European Commission (EC) for adoption, which the latter uses for preparing a proposal called a draft decision. A body comprising representatives (national experts) from all MSs, the Standing Committee on the Food Chain and Animal Health (SCFCAH), then assesses the draft decision. Approval of the draft decision is put the vote via a qualified majority (QM) voting system (for an explanation of QM voting, see section 2.1 below) under Regulation 1829/2003 (if submitted under Directive 2001/18, then by the Regulatory Committee) (EUROPEAN COMMISSION, 2015a). If the SCFCAH agrees with the EC's draft decision (i.e. a QM is achieved), then the GE crop is authorized for the specific use/s applied for. However, if the SCFCAH rejects the draft decision (via a qualified minority) or expresses no opinion (a QM is not reached), the EC either amends its draft decision and resubmits it to the SCFCAH or submits the original draft decision to the Appeal Committee (AC) for a decision. The AC affords MSs the opportunity for "a second discussion at a higher level of representation" (EUROPEAN COMMISSION, 2015b); comprises representatives from MSs; is chaired by the Commission; and uses QM voting. If the AC rejects the EC's draft decision, authorization is declined. If the AC expresses no opinion, the authorization will be granted as the EC may then adopt the decision (Figure 1).

The time taken for a GE crop's application successfully passing through the political step of the overall authorization process is of socio-economic importance as the quicker it takes, the sooner society can benefit from using it, i.e. the loss of foregone benefits is reduced. The losses can be substantial (WESSELER and ZILBERMAN, 2014). A full consensus (unanimity) within the EU at MS level for authorizing GE crops has never been reached - an unusual result considering a high and stable level of consensus over time at Council level on other topics (JENSEN, 2010). So far, one GE crop has approval for cultivation in the EU and 61 GE crops for import and processing, while in the United States, 115 crops have been approved for cultivation as of 2014.

While a number of scholars have assessed consumer, farmer, and farm-level, coexistence and labelling issues for GE crops, the literature assessing the EU's policy on approving these crops is limited. GRAFF et al. (2009) explain the low number of approvals by political economy factors whereby the political economy forces that oppose the approval of GE crops are stronger in the EU than in other countries. It would be expected that these forces would have weakened with time here, tempered by the positive experiences of the technology in other regions and the catching-up of the European plant breeding and chemical industry on the technology. As SWINNEN and VANDEMOORTELE (2010) argue, a change in voting behaviour, not to mention a change in regulation, will become more difficult once a regulation has been in place. The forces establishing a policy gridlock (VOGEL, 2003) are further strengthened if the uncertainty about the political outcome of a change in policy is strengthened (WESSELER and ZILBERMAN, 2014).

Figure 1. Approval process in the EU for GE crops with a favourable EFSA opinion and a positive draft decision by the EC



Source: modified from WESSELER and KALAITZANDONAKES (2011)

In this contribution we report and analyse the voting results for approving GE crops from 2003 to 2015 at the SCFCAH, and the Council and the Appeal Committee (C/AC), respectively. Reliable voting data pre-2003 (a time during which the moratorium occurred) were unavailable.

We use the voting results to test whether or not individual MS characteristics are more relevant for explaining the voting behaviour in support of the aforementioned argument of a policy gridlock (VOGEL, 2003, SWINNEN and VANDEMOORTELE, 2010), than other factors such as the crop type, e.g. maize or oilseed rape, or the transgenic trait, e.g. insect resistance or herbicide tolerance. Our investigation does not, however, attempt at identifying and testing which MS characteristics, if any, can be used to explain voting behaviour as MÜHLBÖCK and TOSUN (2015) have done. Further, we use the results to identify possibilities for achieving a QM in favour of approval, i.e. which MSs would need to change their voting behaviour, and discuss the results in light of the Directive (EU) 215/412 for MSs to restrict or prohibit the cultivation of GE crops in their territories - the 'opt-out' directive (OJEU, 2015)[1] – as a change in regulation to overcome the policy gridlock.

Our analysis shows that a MS's identity (i.e. endogenous factors) and not specific characteristics of the GE crop is statistically the most significant factor driving voting behaviour, putting into question the success of the 'opt-out' proposal to overcome the policy gridlock.

[1] We concentrate on achieving a QM in favour of approval as this has been the objective for revising the legal framework.

2 The Voting Process in the EU for Authorizing GE Plants

2.1 Qualified Majority Voting

The number of MSs comprising the EU has increased since its inception (originally known as the European Economic Community: ECC) from six core states to 15 – when GE crops first appeared in the mid-1990s – to the current 28. Each MS's vote is weighted according to its population (with the less-populous states having a proportionally larger weighting). A QM is achieved when the number of votes cast ('for' or 'against') equal or exceed a threshold value calculated as a percentage of the maximum possible number of votes. Threshold values and the vote weights for individual MSs have changed over time (see Table 1 and

Table 1. Member States (MSs) of the European Union, year joined, and their vote weights for the QM voting system from 1995 to 2015

MS[1] with official abbreviation	Year joined[1]	EU-15 (01.01.1995-30.04.2004)[1]	EU-25 (01.05.2004-31.10.2004)[1]	EU-25 (01.11.2004-31.12.2006)[1]	EU-27 (01.12.2007-30.06.2013)[1]	EU-28 (01.07.2013-31.10.2013)[1]	EU-28 (from 01.11.2014) (%)
Austria (AT)	1995	4	4	10	10	10	1.67
Belgium (BE)	1952	5	5	12	12	12	2.21
Bulgaria (BG)	2007				10	10	1.44
Croatia (HR)	2013					7	0.84
Cyprus (CY)	2004		2	4	4	4	0.17
Czech Rep. (CZ)	2004		5	12	12	12	2.08
Denmark (DK)	1973	3	3	7	7	7	1.11
Estonia (EE)	2004		3	4	4	4	0.26
Finland (FI)	1995	3	3	7	7	7	1.07
France (FR)	1952	10	10	29	29	29	12.98
Germany (DE)	1952	10	10	29	29	29	15.93
Greece (EL)	1981	5	5	12	12	12	2.19
Hungary HU)	2004		5	12	12	12	1.96
Ireland (Rep) (IE)	1973	3	3	7	7	7	0.91
Italy (IT)	1952	10	10	29	29	29	11.81
Latvia (LV)	2004		3	4	4	4	0.40
Lithuania (LT)	2004		3	7	7	7	0.59
Luxembourg (LU)	1952	2	2	4	4	4	0.11
Malta (MT)	2004		2	3	3	3	0.08
Netherlands (NL)	1952	5	5	13	13	13	3.32
Poland (PL)	2004		8	27	27	27	7.62
Portugal (PT)	1986	5	5	12	12	12	2.07
Romania (RO)	2007				14	14	3.97
Slovakia (SK)	2004		3	7	7	7	1.07
Slovenia (SI)	2004		3	4	4	4	0.41
Spain (ES)	1986	8	8	27	27	27	9.24
Sweden (SE)	1995	4	4	10	10	10	1.89
United Kingdom (UK)	1973	10	10	29	29	29	12.61
Total		87	124	321	345	352	100.01
Qualified Majority[2]		62 (71.26%)	88 (70.97%)	232 (72.27%)	255 (73.91%)	260 (73.91%)	65% ≥16 MSs[3]
Qualified Minority[2]		26	37	90	91	93	35% ≥ 4 MSs[4]

[1] EUROPEAN COMMISSION (2004), EUROPEAN UNION (2015)

[2] A majority of the MSs must vote in favour when a proposal has been presented by the Commission, or two thirds of the MSs must vote in favour in all other cases. The QM shall cover at least 62% of the EU's population (EUROPEAN COMMISSION, 2004).

[3] A QM is reached when 55% of MSs vote in favour (16 out of 28) and MSs representing at least 65% of the EU's population (EUROPEAN COUNCIL, 2015).

[4] A blocking minority must include at least four Council members representing more than 35% of the EU population (EUROPEAN COUNCIL, 2015).

Source: based on EUROPEAN COMMISSION (2004), POPTCHEVA and DEVANEY (2014), EUROPEAN COUNCIL (2015) and EUROPEAN UNION (2015) its footnotes) (EUROPEAN COMMISSION, 2013a).

We give our mathematical description of the QM voting as follows:

At any given time, the EU MSs comprise a set N denoted i. We denote the votes of MS i as V_i:

$$V_i = \begin{cases} 1 & if\ MS_i\ votes\ 'for' \\ 0 & if\ MS_i\ votes\ anything\ but\ 'for'\ as\ described\ below \end{cases}$$

$V_i = 0$ if a MS i votes 'against' including any form of 'against' (i.e. an abstention, or absent from the ballot). Each MS i, has a vote weight, w_i

For each ballot, the total number of 'for' votes, Q is calculated as follows

$$Q = \sum_{i \epsilon N} w_i V_i.$$

A positive decision (i.e. approval) is reached if $Q \geq t$, where t is the QM threshold value of 'for' votes for a given decision (ballot). For the period 1 December 2007 to 30 June 2013, for example, a decision required at least 255 votes (73.91%) out of the 345 total, for adoption (Table 1). The weighting arrangements are the result of a compromise reached between MSs in a "degressively proportional system" where smaller and larger MSs are over- and under-represented, respectively - a compromise reached between federalist and intergovernmental elements within the EU of the 'one man, one vote' and 'one country, one vote' principles, respectively (MOBERG, 1998: 350). The current weighting of votes, enshrined in The Treaty of Nice, came into force on 1 November 2004. Subsequently, The Treaty of Lisbon (Article 16 of the Treaty on EU) introduced a new definition for the rule of QM with a three-stage implementation (for details, see Table 2).

MS voting is a continuous process involving strategy and "a stream of interconnected decisions" where synergies and opportunities are sought for initiating so-called package deals. MSs practice vote trading and log-rolling (exchange of political favours), simultaneously defending national interests and promoting common European ones. Occasionally, domestic pressure is too high for sustaining this balanc-

Table 2. Descriptive statistics for voting results at the SCFCAH and the C/AC for authorizing GE crops in the EU (referring to models 8 and 16 from Tables 3 and 4, respectively)

	Voting Body							
	SCFCAH				C/AC			
Parameter	Mean	SD	Min	Max	Mean	SD	Min	Max
Vote 'for'	0.44	0.5	0	1	0.43	0.50	0	1
Year	2009.63	3.22	2003	2014	2009.8	3.26	2004	2015
Import	0.65	0.48	0	1	0.79	0.41	0	1
Food, feed	0.82	0.38	0	1	0.69	0.46	0	1
Cultivation	0.08	0.27	0	1	0.02	0.13	0	1
Multiple trait	0.34	0.47	0	1	0.34	0.47	0	1
Single trait	0.66	0.47	0	1	0.66	0.47	0	1
Herbicide tolerance	0.71	0.45	0	1	0.69	0.46	0	1
Insect resistance	0.45	0.5	0	1	0.45	0.50	0	1
Other	0.15	0.36	0	1	0.14	0.35	0	1
Foreign (ex-European)[1]	0.62	0.48	0	1	0.65	0.48	0	1
Domestic (European)[1]	0.38	0.48	0	1	0.35	0.48	0	1
Cotton	0.07	0.25	0	1	0.09	0.29	0	1
Flower	0.02	0.12	0	1	0.02	0.13	0	1
Maize	0.53	0.50	0	1	0.54	0.50	0	1
Oilseed rape	0.11	0.32	0	1	0.10	0.30	0	1
Potato	0.03	0.18	0	1	0.04	0.19	0	1
Rice	0.02	0.13	0	1	.	.	.	.
Soybean	0.21	0.40	0	1	0.22	0.41	0	1
Sugarbeet	0.02	0.13	0	1	.	.	.	.

[1] applicant's domicile
Source: AgraFacts and AgrFocus (see http://www.agrafacts.com/home.html)

ing strategy (TRZASKOWSKI, 2009). Thus, "decision making" is a bargaining act (MOBERG, 2007) where reciprocity is likely (JENSEN, 2010). It is therefore evident that voting takes place in a complex environment in which many interactions play a role in each ballot's result, including MSs bargaining with lobbyists (e.g. the GE crop and nuclear energy trade-off between France and ecologists (FICEK, 2013)).

Scholars have assessed the ramifications of various voting arrangements for, inter alia, 'balance' or fairness, and tactical arrangements amongst voters such as forming coalitions (PENROSE, 1946; BANZHAF III, 1964; COLEMAN, 1971; FELSENTHAL and MACHOVER, 2000; LEECH, 2002; ALONSO-MEIJIDE et al., 2009; PLECHANOVOVÁ, 2011). SLOMCZYNSKI and ZYCZKOWSKI (2006) comment that analysing coalition formations is highly complex for the EU – demonstrated by the high number (134 mill.) of possible coalitions for the EU-27 – and show that the difficulty of forming winning coalitions is positively correlated with membership number.

2.2 Description of the Data Set

We sourced our data from two publications: AgraFacts and AgraFocus (see http://www.agrafacts.com/Home.html), which published most of the voting results for the SCFCAH and the Council and the AC for the period December 2003 to January 2015; no reliable data were available for earlier ballots, and little voting took place during the moratorium. We captured the ballot results in the following categories for the aforementioned voting bodies: 'for'; 'against'; 'abstain'; and pooled the results for 'absent', 'no representative', and 'no position taken due to "parliamentary reserve"', and 'no result published' as 'no vote cast' because of their infrequent occurrence and their failure to contribute to a QM.

The EU's membership has grown over time. Therefore, the number of voting opportunities per MS is a function of: (1) how long it has been a member of the EU, and (2) the number of ballots during its membership. Generally, the longer a MS has been a member, the higher its number of voting opportunities. The Netherlands, Sweden, Finland, the UK, the Czech Republic, Estonia, Romania, and Spain; and Austria, Luxembourg, Greece, Hungary, Cyprus, and Lithuania voted 'for' and 'against', respectively, with a frequency of at least 80%; while Italy, France, Bulgaria, and Ireland abstained at least 40% of the time at the SCFCAH. Finland and The Netherlands always voted 'for', and Austria always 'against', at both the SCFCAH and the C/AC. Croatia, Luxembourg, and Latvia never voted 'for' at the C/AC (Figures 2 and 3).

The data summarised in Figures 4 and 5 essentially represent the binary outcome of each ballot. However, the weighted outcome is the important result of each voting event as this determines whether or not a QM vote is achieved. We applied the weights given in Table 1 to each successive ballot at the SCFCAH and the C/AC, and calculated the minimum number of additional 'for' votes needed for a QM (last column in Tables A1 and A2).

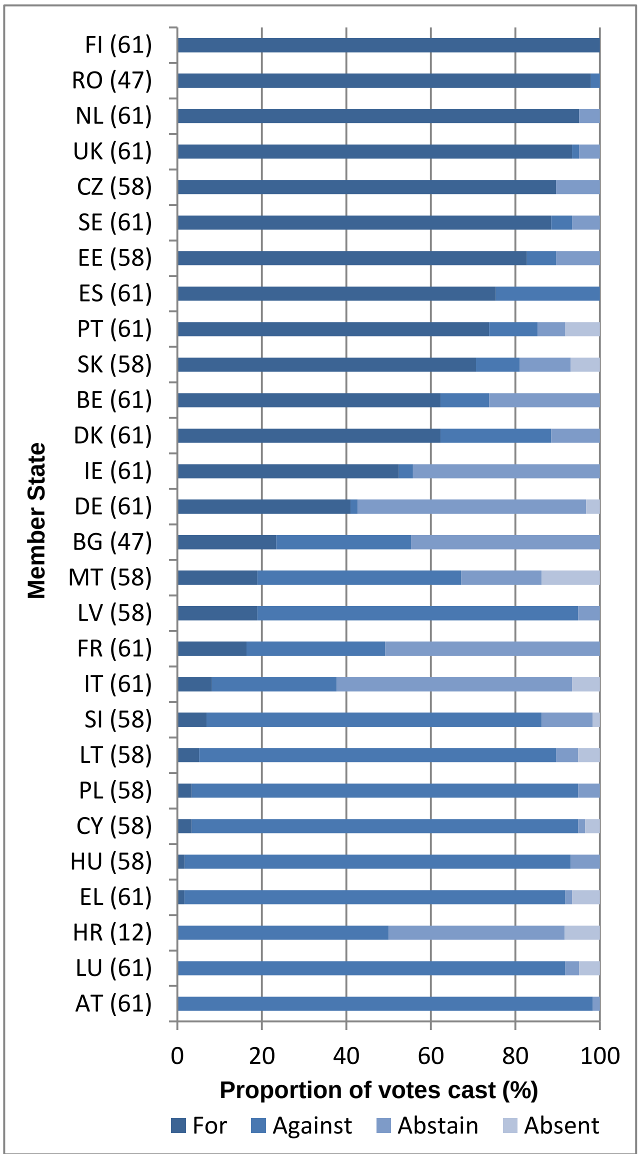
2.3 Empirical Analysis of the Voting Data

The SCFACH represents the first step in the political decision-making process. Should MSs not vote in favour of an application here, the political process continues with the Commission becoming involved as shown in Figure 1. Descriptive statistics presented in Table 2 indicate that the voting behaviour of the SCFCAH and the C/AC is similar (see also Figures 4 and 5).

We treated every 'for' vote as a positive statement for supporting a GE crop's authorization. The 'against' and 'abstain' votes, and several forms of absenteeism were interpreted as negative statements opposing authorization as they prevented a QM (JENSEN, 2010).

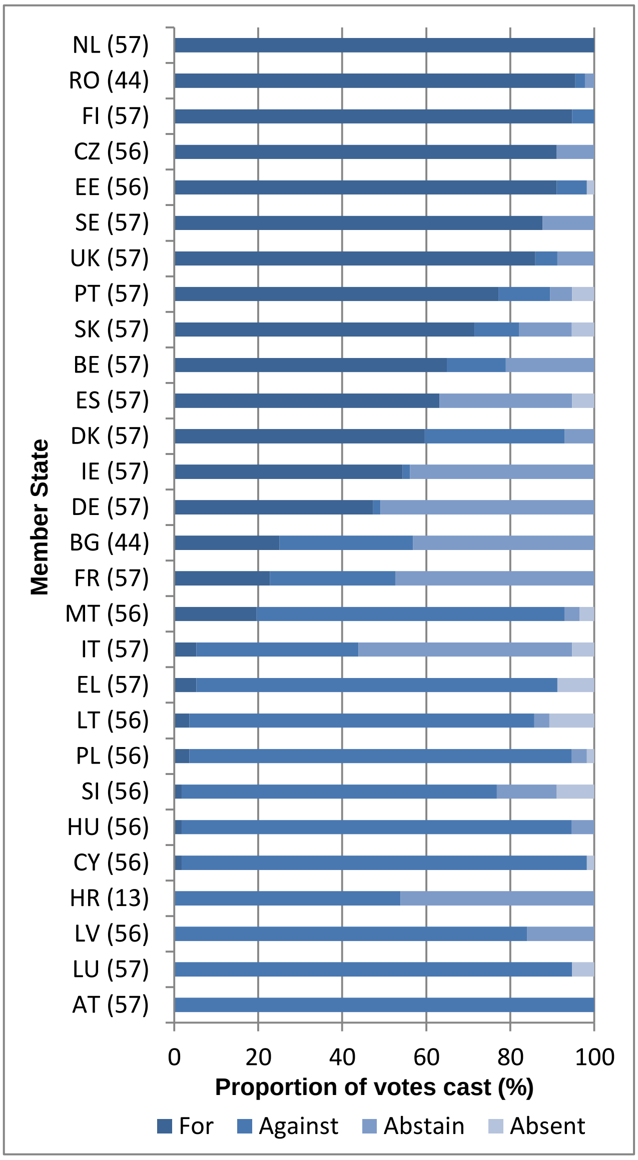
We used odds ratios in a set of logistic regressions for testing whether a MS's identity, an applicant's domicile, and a crop plant's genetic trait are suitable explanatory variables for explaining a MS's voting decision. This was done by first testing a MS's identity, and then stepwise adding additional explanatory variables. The rationale for using this method is to assess whether voting decisions can be explained by factors associated with a MS's characteristics (i.e. endogenous factors), or whether MS-specific effects prevail if explanatory variables based on qualitative information (e.g. crop type, or the crop's intended use) are added to the model. Theoretically, what appears to be a MS-specific effect may in fact reflect a MS-specific concern or opportunity leading respectively to a negative or positive vote. For example, Scandinavian MSs tend to accept (vote 'for') GE crops, but it is unknown whether these MSs' voting behaviour is related to liberal and open-minded societies, or whether their positive votes are associated with, for example, factors favouring their bio-economies (agricultural and biotech sectors). We use a set of logistic regression models for disentangling these factors and for testing if they can be used for explaining the variation in voting behaviour.

Figure 2. The relative frequency of votes cast by MSs at the SCFCAH from December 2003 to December 2014 (MS abbreviations are listed in Table 1)*



*On the vertical axis, the numbers in parentheses are the number of voting opportunities per MS.
Note: "Absent" included no position taken due to parliamentary reserve.
Source: AgraFacts and AgrFocus
(see http://www.agrafacts.com/home.html)

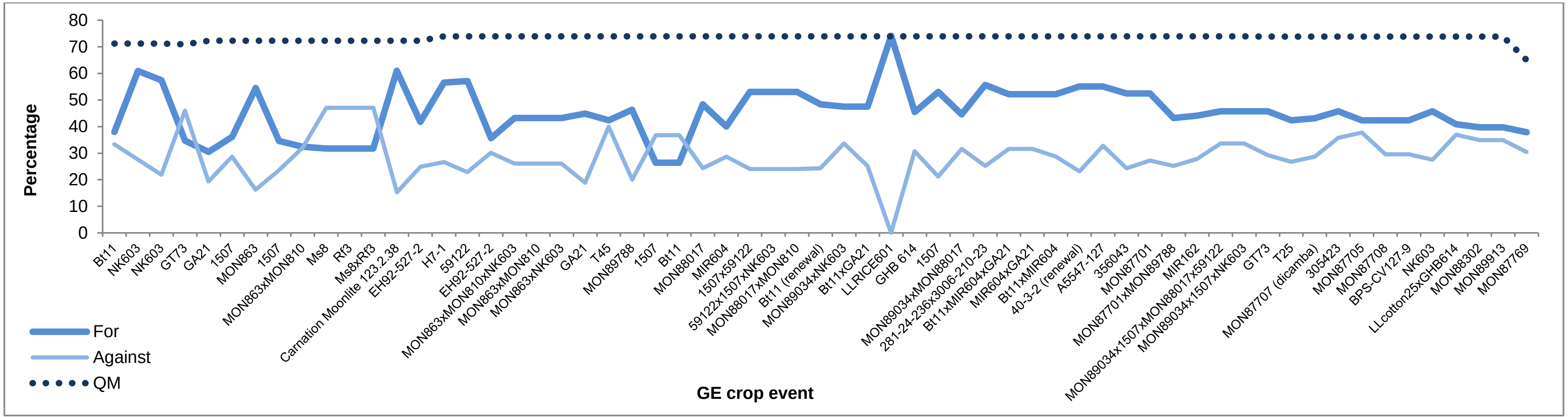
Figure 3. The relative frequency of votes cast by MSs at the C/AC from May 2004 to February 2015 (MS abbreviations are listed in see Table 1)*



*On the vertical axis, the numbers in parentheses are the number of voting opportunities per MS.
Note: "Absent" included no position taken due to parliamentary reserve. Because voting on the same GE crop takes place at the C/AC after the SCFCAH, our start and end date of 2004 and 2015, respectively, are each a year later than that for SCFCAH in Figure 2.
Source: AgraFacts and AgrFocus
(see http://www.agrafacts.com/home.html)

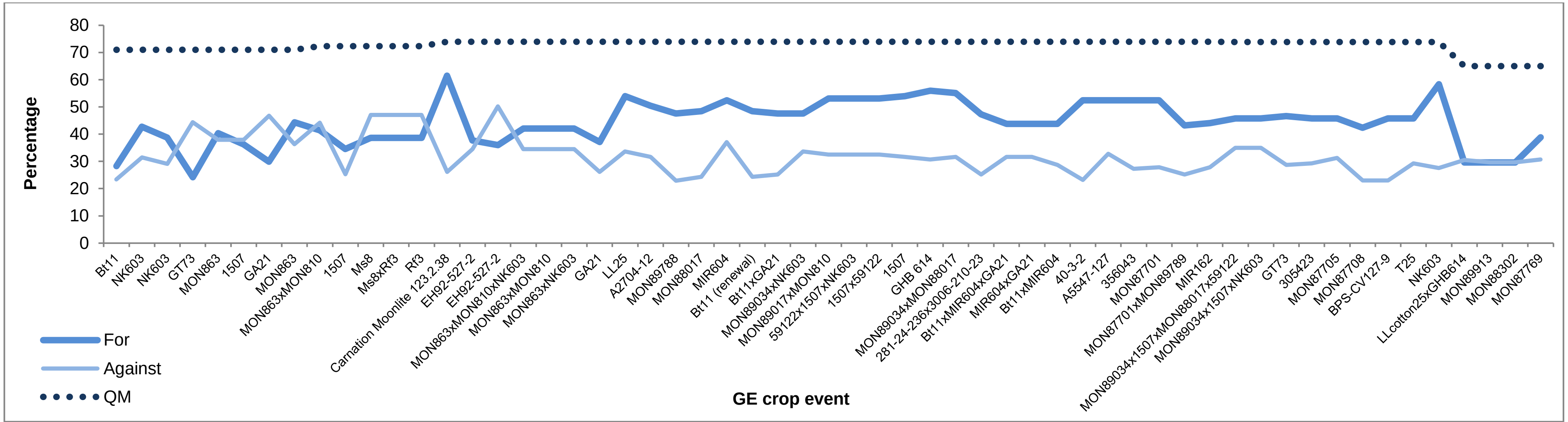
The equation below illustrates our estimation strategy for testing the relationship between a positive vote and a set of explanatory factors, where μ represents a binary variable that is one for a positive vote of MS i, at time t, for crop j, and zero otherwise. The dependent variable is assumed to be a function of MS-fixed-effects (C) that are included to reflect MS-specific voting patterns. The vector X includes controls for plant-related features such as type of trait, plant type, intended crop use, and the developer's (applicant) domicile. We aim at capturing a time trend (T) to observe any temporal changes in voting pattern; α and ε represent a constant and the error term, respectively.

Figure 4. The total number of 'for' and 'against' votes cast at the SCFCAH expressed as a percentage of the maximum possible number of votes, according to each EU MS's weight for ballots authorizing GE crops from December 2003 to December 2014 versus the QM threshold



Source: AgraFacts and AgrFocus (see http://www.agrafacts.com/home.html)

Figure 5. The total number of 'for' and 'against' votes cast at the C/AC expressed as a percentage of the maximum possible number of votes, according to each EU MS's weight for ballots authorizing GE crops from 2004 to 2015 versus the QM threshold



Source: AgraFacts and AgrFocus (see http://www.agrafacts.com/home.html)

$$\mu_{ijt} = \alpha + \beta_1 * \mathrm{C} + \beta_2 * \mathrm{X} + \beta_3 * \mathrm{T} + \varepsilon$$

Regression models 1 to 8 in Table 3 analyse MSs' voting at the C/AC, which is politically more important than the SCFCAH (Table 4) (EUROPEAN COMMISSION, 2015b). Model 1 only controls for MS-fixed-effects, reflecting general voting behaviour. For example, the coefficient for the voting behaviour of Finland and Sweden reflects an accepting (positive) attitude towards GE crops contrasted by Cyprus' voting indicating the opposite sentiment. Italy was chosen as a reference category because its voting behaviour was the most dynamic (i.e. changed its position the most) of the 'heavy-weight' MSs. In subsequent models we added explanatory variables, which may: (1) help explain results represented in model 1, (2) add more statistical explanatory power, and (3) test the robustness of initial results. For example, in model 2, we added a metric variable capturing a time trend; results indicate that with time EU MSs have become more likely to vote in favour of approving GE crops. In model 3 we added controls for a GE crop's intended use (import; or food or feed; or cultivation), which turned out to be statistically unimportant. However, this finding needs to be contextualized: the number of applications for cultivation is very low. Similarly, we found no robust evidence for differences between multiple- and single trait crops, or crops engineered for herbicide tolerance or insect resistance, respectively (models 4 and 5). In models 7 and 8 we tested the influence of plant type on voting behaviour. Our results suggest that MSs were most in favour of GE flowers (the petal colour as a carnation was altered) and least in favour of GE oilseed rape.

Most importantly, however, we observed no substantial changes in the coefficients reflecting MS-fixed-effects. MSs' voting decisions can neither be explained by crop type nor a developers' domicile. Foreign-based developers were involved with 62 and 65% of the votes at SCFCAH and the C/AC, respectively. It seems that the factors influencing voting decisions are related to a MS's endogenous characteristics, which is supported by the explanatory power of our models: controlling for MS-fixed-effects only, gave a pseudo-R^2 of 0.44. By adding the full set of explanatory variables available increases this metric marginally to 0.47, an unimportant difference (Table 2). MÜHLBÖCK and TOSUN (2015) found that voting patterns on GE crops at Council are influenced by (1) national interests: expressed via a combination of public opinion (public fear of genetically modified organisms); "issue salience" (agriculture's share of total employment); and lobbying against genetically modified organisms (share of organic farming); and (2) ideology (i.e. the political party family that the responsible minister voting, belonged to).

We repeated the above analysis for votes cast at the SCFCAH. Our results (Table 3) confirmed earlier findings regarding the importance of a MS's identity for explaining vote polarity. Coefficients reflecting MS-fixed-effects are similar in magnitude to the corresponding models in Table 2, and they are very robust (including additional explanatory variables had a negligible effect in terms of effect size and pseudo-R^2 values). MS-fixed-effects alone account for 45% of the explanatory power of the basic model; all additional qualitative models add a mere four percentage points (pseudo-R^2 of 0.49 in model 16, Table 3). We found a positive and statistically significant time trend in the likelihood for positive votes. GE crops intended for cultivation appear to have gained less support for authorization at the SCFCAH than at the C/AC. This is supported by the fact that only one GE crop has been approved for cultivation, but very few applications have been submitted for this use category (i.e. statistically a low number of observations).

There is marginal evidence for supporting imported GE crops, but this observation is neither robust nor consistently statistically significant. We also found evidence that at the SCFCAH caution was exercised for authorizing the following crops: oilseed rape, cotton, maize, and soybean.

We ran a set of robustness tests addressing the changes in the EU's growing membership over time. During the period under observation (2003 to 2015), the EU's membership grew by 13, potentially giving rise to a systematic change in voting outcomes. We addressed this issue by using a set of regressions that were identical to the aforementioned ones using 15 'core' MSs instead of the full panel of 28[1]. The results confirmed earlier findings: MS-fixed-effects are virtually identical and pseudo-R^2 computations indicate that these MS-fixed-effects explain 29% of votes alone. Additional explanatory variables increase this metric by nine percentage points. For the 15 'core' members, we found a positive time trend for the C/AC and the SCFCAH, as well as negative sentiments towards approvals for the cultivation of GE crops (SCFCAH only) and generally weaker support for GE oilseed rape.

[1] These results are not reported, but available on request from the authors.

Table 3. Correlates of positive ('for') votes at the EU's C/AC for authorizing GE crops from 2004 to 2015

Parameter		Model							
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Dependent variable: likelihood of 'for' vote at C\AC							
Member State	AT	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted
	BE	3.51***	3.60***	3.60***	3.61***	3.61***	3.62***	3.74***	3.75***
		(5.35)	(5.46)	(5.46)	(5.47)	(5.47)	(5.48)	(5.57)	(5.57)
	BG	1.79***	1.67**	1.67**	1.67**	1.67**	1.68**	1.70**	1.69**
		(2.61)	(2.42)	(2.42)	(2.41)	(2.42)	(2.43)	(2.42)	(2.41)
	CP	-1.12	-1.13	-1.13	-1.13	-1.13	-1.13	-1.15	-1.15
		(-0.95)	(-0.97)	(-0.97)	(-0.96)	(-0.96)	(-0.97)	(-0.97)	(-0.98)
	CZ	5.01***	5.14***	5.14***	5.15***	5.16***	5.17***	5.35***	5.37***
		(6.83)	(6.94)	(6.95)	(6.96)	(6.96)	(6.97)	(7.10)	(7.10)
	DE	2.79***	2.85***	2.85***	2.86***	2.86***	2.87***	2.96***	2.96***
		(4.29)	(4.36)	(4.36)	(4.36)	(4.37)	(4.37)	(4.44)	(4.44)
	DK	3.28***	3.37***	3.37***	3.38***	3.38***	3.39***	3.50***	3.50***
		(5.03)	(5.13)	(5.13)	(5.14)	(5.14)	(5.15)	(5.23)	(5.23)
	ES	3.43***	3.52***	3.53***	3.53***	3.53***	3.54***	3.66***	3.66***
		(5.25)	(5.35)	(5.35)	(5.36)	(5.36)	(5.37)	(5.46)	(5.46)
	EE	5.21***	5.34***	5.34***	5.36***	5.36***	5.37***	5.57***	5.58***
		(6.90)	(7.01)	(7.01)	(7.03)	(7.03)	(7.04)	(7.17)	(7.17)
	FI	5.78***	5.93***	5.93***	5.95***	5.95***	5.96***	6.16***	6.19***
		(6.89)	(7.02)	(7.02)	(7.04)	(7.04)	(7.05)	(7.18)	(7.19)
	FR	1.67**	1.70**	1.70**	1.70**	1.70**	1.71**	1.76**	1.76**
		(2.49)	(2.51)	(2.51)	(2.51)	(2.52)	(2.52)	(2.56)	(2.56)
	EL	-0.00	-0.00	0.00	0.00	-0.00	0.00	0.00	-0.00
		(-0.00)	(-0.00)	(0.00)	(0.00)	(-0.00)	(0.00)	(0.00)	(-0.00)
	HU	-1.12	-1.13	-1.13	-1.13	-1.13	-1.13	-1.15	-1.15
		(-0.95)	(-0.97)	(-0.97)	(-0.96)	(-0.96)	(-0.97)	(-0.97)	(-0.98)
	IE	3.07***	3.15***	3.15***	3.15***	3.15***	3.16***	3.27***	3.27***
		(4.72)	(4.80)	(4.80)	(4.81)	(4.81)	(4.82)	(4.90)	(4.90)
	IT	reference	reference	reference	reference	reference	reference	reference	reference
	LV	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted
	LT	-0.41	-0.42	-0.42	-0.42	-0.42	-0.42	-0.43	-0.43
		(-0.43)	(-0.45)	(-0.45)	(-0.45)	(-0.45)	(-0.45)	(-0.45)	(-0.45)
	LU	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted
	MT	1.48**	1.49**	1.49**	1.50**	1.50**	1.50**	1.55**	1.54**
		(2.17)	(2.18)	(2.18)	(2.18)	(2.18)	(2.18)	(2.22)	(2.22)
	NL	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted
	PL	-0.41	-0.42	-0.42	-0.42	-0.42	-0.42	-0.43	-0.43
		(-0.43)	(-0.45)	(-0.45)	(-0.45)	(-0.45)	(-0.45)	(-0.45)	(-0.45)
	PT	4.11***	4.23***	4.23***	4.24***	4.24***	4.25***	4.40***	4.41***
		(6.12)	(6.24)	(6.24)	(6.25)	(6.25)	(6.26)	(6.37)	(6.37)
	RO	5.93***	5.87***	5.88***	5.89***	5.89***	5.91***	5.99***	5.97***
		(6.34)	(6.26)	(6.26)	(6.27)	(6.28)	(6.29)	(6.32)	(6.31)
	SI	-1.12	-1.13	-1.13	-1.13	-1.13	-1.13	-1.15	-1.15
		(-0.95)	(-0.97)	(-0.97)	(-0.96)	(-0.96)	(-0.97)	(-0.97)	(-0.98)
	SK	3.81***	3.90***	3.90***	3.91***	3.92***	3.92***	4.06***	4.07***
		(5.74)	(5.84)	(5.84)	(5.85)	(5.85)	(5.86)	(5.97)	(5.97)
	SE	4.86***	4.99***	5.00***	5.01***	5.01***	5.02***	5.20***	5.21***
		(6.77)	(6.90)	(6.90)	(6.92)	(6.92)	(6.93)	(7.05)	(7.05)
	UK	4.70***	4.84***	4.84***	4.85***	4.85***	4.86***	5.04***	5.05***
		(6.67)	(6.80)	(6.80)	(6.81)	(6.82)	(6.83)	(6.94)	(6.95)
	HR	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted
Time trend	Year		0.13***	0.13***	0.13***	0.13***	0.13***	0.12***	0.12***
			(4.90)	(4.66)	(4.70)	(4.72)	(4.57)	(4.00)	(3.94)
GE crop's use	Import			-0.05	0.02	0.01	0.07	0.16	0.15
				(-0.22)	(0.10)	(0.06)	(0.29)	(0.65)	(0.61)
	Food, feed			reference	reference	reference	reference	reference	reference
	Cultivation			-0.32	0.00	-0.02	0.15	0.64	0.63
				(-0.51)	(0.00)	(-0.04)	(0.23)	(0.73)	(0.71)
Trait multiple	multiple					-0.10	-0.10	-0.22	-0.20
						(-0.53)	(-0.56)	(-1.11)	(-0.91)
	single					reference	reference	reference	reference
Type of GE trait	Herbicide tolerance				-0.16	-0.13	-0.13		0.10
					(-0.84)	(-0.64)	(-0.61)		(0.45)
	Insect resistance				reference	reference	reference		reference
	Other				-0.42	-0.41	-0.39		-0.49
					(-1.56)	(-1.51)	(-1.45)		(-1.31)
Developer's domicile	Foreign (ex-Europe)						0.24	0.06	0.05
							(1.37)	(0.34)	(0.27)
	Domestic (European)						reference	reference	reference
Plant type	Cotton							-0.17	-0.30
								(-0.50)	(-0.86)
	Flower							2.37***	2.81***
								(3.22)	(3.59)
	Maize							0.08	-0.05
								(0.31)	(-0.17)
	Oilseed rape							-1.10***	-1.09***
								(-3.29)	(-3.20)
	Potato							-0.91	-0.49
								(-1.40)	(-0.70)
	Rice								omitted
	Soybean								omitted
	Sugarbeet								omitted
	Constant	-2.89***	-254.57***	-255.52***	-262.33***	-264.35***	-257.60***	-252.48***	-250.19***
		(-4.87)	(-4.95)	(-4.72)	(-4.76)	(-4.78)	(-4.63)	(-4.05)	(-3.99)
	Pseudo R²	0.44	0.45	0.45	0.45	0.45	0.46	0.47	0.47
	Observations	1,276	1,276	1,276	1,276	1,276	1,276	1,276	1,276

Note: Robust z-values in parentheses. ***, **, * indicate statistical significance at 1, 5, and 10% levels. Dependent variable is the likelihood of "for" vote at C/AC. Some MSs' voting behaviour cannot be assessed in the chosen framework since there is no "variation" in their votes, i.e. they consistently voted either 'for' or 'against'.

Source: AgraFacts and AgrFocus (see http://www.agrafacts.com/home.html)

Table 4. Correlates of positive ('for') votes at SCFCAH for authorizing GE crops in the EU from 2003 to 2014

Parameter		Model (9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
		Dependent variable: Likelihood of 'for' vote at SCFCAH							
Member State	AT	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted
	BE	2.85***	2.88***	2.91***	2.92***	2.92***	2.92***	3.16***	3.17***
		(5.32)	(5.36)	(5.40)	(5.40)	(5.41)	(5.41)	(5.57)	(5.58)
	BG	1.23**	1.15**	1.15**	1.15**	1.16**	1.16**	1.29**	1.29**
		(2.12)	(1.97)	(1.97)	(1.97)	(1.99)	(1.99)	(2.11)	(2.11)
	CY	-0.92	-0.94	-0.94	-0.94	-0.94	-0.94	-1.03	-1.02
		(-1.07)	(-1.09)	(-1.09)	(-1.09)	(-1.09)	(-1.09)	(-1.15)	(-1.14)
	CZ	4.58***	4.60***	4.69***	4.69***	4.70***	4.70***	5.06***	5.08***
		(7.20)	(7.22)	(7.30)	(7.30)	(7.31)	(7.31)	(7.53)	(7.54)
	DE	2.05***	2.07***	2.09***	2.09***	2.09***	2.09***	2.28***	2.29***
		(3.84)	(3.86)	(3.88)	(3.88)	(3.89)	(3.89)	(4.03)	(4.04)
	DK	2.92***	2.95***	2.99***	2.99***	2.99***	2.99***	3.24***	3.25***
		(5.44)	(5.48)	(5.52)	(5.52)	(5.53)	(5.53)	(5.69)	(5.70)
	ES	3.54***	3.57***	3.63***	3.63***	3.64***	3.64***	3.93***	3.94***
		(6.39)	(6.43)	(6.49)	(6.50)	(6.50)	(6.50)	(6.68)	(6.69)
	EE	3.98***	4.00***	4.08***	4.08***	4.09***	4.09***	4.42***	4.43***
		(6.85)	(6.86)	(6.93)	(6.93)	(6.95)	(6.95)	(7.14)	(7.16)
	FI	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted
	FR	0.79	0.79	0.79	0.80	0.80	0.80	0.88	0.88
		(1.35)	(1.36)	(1.36)	(1.36)	(1.36)	(1.36)	(1.43)	(1.43)
	EL	-1.68	-1.68	-1.68	-1.68	-1.69	-1.69	-1.81	-1.81
		(-1.51)	(-1.51)	(-1.51)	(-1.51)	(-1.51)	(-1.51)	(-1.58)	(-1.58)
	HU	-1.63	-1.65	-1.65	-1.65	-1.65	-1.65	-1.78	-1.78
		(-1.46)	(-1.48)	(-1.48)	(-1.48)	(-1.48)	(-1.48)	(-1.55)	(-1.55)
	IE	2.51***	2.54***	2.57***	2.57***	2.57***	2.57***	2.79***	2.80***
		(4.72)	(4.75)	(4.78)	(4.79)	(4.79)	(4.79)	(4.95)	(4.96)
	IT	reference	reference	reference	reference	reference	reference	reference	reference
	LV	0.96*	0.95*	0.96*	0.96*	0.96*	0.96*	1.06*	1.06*
		(1.68)	(1.65)	(1.66)	(1.66)	(1.66)	(1.66)	(1.74)	(1.74)
	LT	-0.49	-0.51	-0.51	-0.51	-0.51	-0.51	-0.57	-0.57
		(-0.65)	(-0.68)	(-0.68)	(-0.68)	(-0.68)	(-0.68)	(-0.72)	(-0.71)
	LU	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted
	MT	0.96*	0.95*	0.96*	0.96*	0.96*	0.96*	1.06*	1.06*
		(1.68)	(1.65)	(1.66)	(1.66)	(1.66)	(1.66)	(1.74)	(1.74)
	NL	5.38***	5.43***	5.52***	5.53***	5.53***	5.53***	5.91***	5.93***
		(7.13)	(7.18)	(7.26)	(7.26)	(7.27)	(7.27)	(7.51)	(7.52)
	PL	-0.92	-0.94	-0.94	-0.94	-0.94	-0.94	-1.03	-1.02
		(-1.07)	(-1.09)	(-1.09)	(-1.09)	(-1.09)	(-1.09)	(-1.15)	(-1.14)
	PT	3.45***	3.49***	3.54***	3.54***	3.55***	3.55***	3.83***	3.84***
		(6.27)	(6.31)	(6.37)	(6.38)	(6.38)	(6.38)	(6.56)	(6.57)
	RO	6.24***	6.18***	6.27***	6.28***	6.30***	6.30***	6.60***	6.62***
		(5.61)	(5.55)	(5.61)	(5.62)	(5.63)	(5.63)	(5.80)	(5.81)
	SI	-0.19	-0.21	-0.20	-0.21	-0.20	-0.20	-0.23	-0.23
		(-0.27)	(-0.30)	(-0.29)	(-0.29)	(-0.29)	(-0.29)	(-0.31)	(-0.31)
	SK	3.30***	3.31***	3.36***	3.36***	3.37***	3.37***	3.65***	3.66***
		(6.01)	(6.01)	(6.07)	(6.07)	(6.08)	(6.09)	(6.26)	(6.28)
	SE	4.46***	4.51***	4.58***	4.59***	4.59***	4.60***	4.94***	4.95***
		(7.24)	(7.29)	(7.36)	(7.37)	(7.37)	(7.38)	(7.57)	(7.59)
	UK	5.07***	5.12***	5.21***	5.22***	5.22***	5.22***	5.59***	5.61***
		(7.28)	(7.33)	(7.41)	(7.41)	(7.42)	(7.42)	(7.64)	(7.66)
	HR	4.81***	4.50***	4.59***	4.57***	4.54***	4.53***	4.89***	4.90***
		(4.21)	(3.92)	(3.99)	(3.97)	(3.94)	(3.94)	(4.18)	(4.19)
Time trend	Year		0.07***	0.06**	0.06**	0.06**	0.06**	0.07**	0.07**
			(3.03)	(2.33)	(2.25)	(2.25)	(2.22)	(2.24)	(2.13)
GE crop's use	Import			-0.28	-0.30*	-0.35*	-0.34*	-0.05	-0.05
				(-1.54)	(-1.65)	(-1.87)	(-1.81)	(-0.27)	(-0.26)
	Food, feed			reference	reference	reference	reference	reference	reference
	Cultivation			-1.31***	-1.33***	-1.41***	-1.39***	-1.93***	-1.85***
				(-4.15)	(-3.94)	(-4.11)	(-4.02)	(-4.50)	(-4.30)
Trait multiple	multiple					-0.22	-0.23	-0.12	-0.19
						(-1.27)	(-1.28)	(-0.63)	(-0.90)
	single					reference	reference	reference	reference
Type of GE trait	Herbicide tolerance				0.09	0.15	0.15		0.29
					(0.47)	(0.78)	(0.78)		(1.31)
	Insect resistance				reference	reference	reference		reference
	Other				0.16	0.18	0.18		-0.15
					(0.65)	(0.74)	(0.73)		(-0.44)
Developer's domicile	Foreign (ex-Europe)						0.05	0.22	0.20
							(0.34)	(1.18)	(1.10)
	Domestic (European)						reference	reference	reference
Plant type	Cotton							-1.98***	-1.87**
								(-2.71)	(-2.54)
	Flower							0.96	1.42
								(1.03)	(1.43)
	Maize							-1.73***	-1.60**
								(-2.59)	(-2.37)
	Oilseed rape							-2.71***	-2.60***
								(-3.96)	(-3.73)
	Potato							0.02	0.38
								(0.02)	(0.41)
	Rice							0.94	0.95
								(1.01)	(1.02)
	Soybean							-1.79**	-1.64**
								(-2.56)	(-2.34)
	Sugarbeet							omitted	omitted
	Constant	-2.42***	-148.34***	-119.00**	-115.72**	-116.11**	-114.99**	-139.27**	-135.02**
		(-5.18)	(-3.07)	(-2.38)	(-2.29)	(-2.30)	(-2.27)	(-2.26)	(-2.16)
	Pseudo R^2	0.45	0.45	0.45	0.45	0.45	0.45	0.48	0.49
	Observations	1,418	1,418	1,418	1,418	1,418	1,418	1,418	1,418

Note: Robust values in parentheses. ***, **, * indicate statistical significance at 1, 5, and 10% levels. Dependent variable is the likelihood of "for" vote at SCFCAH.
Source: AgraFacts and AgrFocus (see http://www.agrafacts.com/home.html)

Therefore, the current voting mechanism, despite the voting gridlock, allows for the importation of certain GE crops as food and or feed. Its slowness contributes to approval asynchrony. Developers avoid applying for authorization to cultivate GE crops in the EU. Unity in the EU concerning the approval of GE crops for their various uses, is lacking. Research is required for finding possible mechanisms for breaking the gridlock so that those MSs wishing to gain from using these innovations earlier, can do so.

3 Voting Gridlock on GE Crops

A decision by QM vote for the authorization of GE crops in the EU has been reached once; for all other ballots there was a consistent 'no opinion' i.e. a QM was not reached (Figures 4 and 5). This relentless deadlock has contributed to the slowness of the authorization process, and hence approval asynchronicity. We are interested to know if there are any MSs who have persistently contributed to this trend. Is a there a way out of this regulatory gridlock?

We assume that each MS cast its ballot independently - uninfluenced by exogenous factors[1]. The only positive contribution towards achieving a QM is a 'for' vote. We, therefore, scrutinized each ballot for all MSs that prevented a QM, namely those who voted: 'against', abstained, or who were absentees. From this subset of voters, we found (1) the minimum number of MSs needed to achieve a QM, and (2) who they were. Continuing with our previous mathematical notation: without loss of generality, we ordered members of set *N* according to their vote weights, i.e.,

$$w_i \geq w_j \ \forall \ (i,j) \in N$$

The minimum number required for a QM, *M*, is calculated as follows:

$$M = t - Q$$

MSs who voted anything but 'for' (i.e. all forms of 'against' as previously explained) comprise *A*, which is a subset of *N* such that:

$$A\colon \{i \in N | V_i = 0\}$$

Now find the minimum subset *R* of *A* that satisfies the following condition:

$$\sum_{i \epsilon R} w_i \geq M,$$

for finding the voters who prevented a QM.

In practise, we sequentially added these MSs' votes until a QM could theoretically have been achieved. When counting the number of MSs in this subset for ballots where more than one MS of equal rank (vote weight) could have contributed to the total, we counted them all (consistent with our assumption of independence). For example, consider the SCFCAH ballot for Monsanto's oilseed rape MON88302 on 24.10.2014.

Total number of 'for' votes, *Q* = 140; with *t* = 260. Thus *M* = 120.

The following MSs comprised subset *A* (i.e. all MSs who did not vote 'for'), in descending order (vote weight in parenthesis): France (29); Germany (29); Italy (29); Poland (27); Greece (12); Hungary (12); Austria (10); Bulgaria (10); Sweden (10); Croatia (7); Cyprus (7); Denmark (7); Lithuania (7); Slovakia (7); Latvia (4); Slovenia (4); Luxembourg (4); and Malta (3) (AF, 2014:2). The sum of the votes for the first four voters is 114. A minimum of six more votes is needed for a QM, i.e. for *t* to be reached. The next candidate in alphabetical order is Greece with 12 votes, but Hungary has the same weight, therefore both MSs are chosen as potential contributors for reaching a QM. We computed the frequency with which MSs' negative votes could have contributed to achieving a QM for the six periods shown in Table 4. The results reported includes a bias towards larger EU MSs, but can be justified as coalitions are easier to achieve with a lower number of participants.

Table 5 shows six voting periods according to the number of EU MSs and EU voting rules. Columns 3 to 6 show the relation between the number of 'against' votes in relation to the total number of votes. The MSs listed are those that would be needed for a QM. Germany for example, had a weight of 11.49% (10 votes) in the first period, voted three times at the SCFCAH and always 'against'. Germany was needed each time for achieving a QM. France voted once 'against' in the same period and would have also been needed in that specific case for getting a QM. The other two times France voted 'for'.

Three of the four 'heavy-weight' MSs, namely, France, Germany, and Italy (UK is the fourth) feature prominently in preventing a QM. Since its accession to the EU in May 2004, Poland has become an important and consistent opponent (contributor to the 'against' vote) due to its sizable vote weight, while Spain (Poland's equal in vote weight (see Table 1))

[1] Note: the formation of coalitions and other tactics influencing a ballot's outcome do not form part of this study and are investigated in on-going research on the topic.

switched to being a consistent supporter from 2007 onwards. Although the number of ballots with the latest double majority voting rule is low, early evidence reveals that the influence of Germany, France, and Italy – in this order – on achieving a QM has strengthened due to their new, larger vote weights (Table 4).

Table 5. The absolute and relative frequency (%) with which MSs opposed (voted 'against', 'abstain', or were absent) the authorization of a GE crop at the SCFCAH and the C/AC from 2003 to 2014

Period	MS (relative vote weight (%))	Voting Body			
		SCFCAH (2003-2014)		C/AC (2004-2015)	
		MS's Vote/No. of Ballots	Frequency (%)	MS's Vote/No. of Ballots	Frequency (%)
1. EU15: 01.01.1995 - 30.04. 2004	Germany (11.49)	3/3	100.0	No voting took place	
	France (11.49)	1/3	33.3		
	Italy (11.49)	2/3	66.7		
	Spain (9.20)	1/3	33.3		
2. EU25: 01.05.2004 - 31.10.2004	Germany (8.06)	1/1	100.0	6/8	75.0
	France (8.06)			2/8	25.0
	Italy (8.06)	1/1	100.0	7/8	87.5
	UK (8.06)	1/1	100.0	1/8	12.5
	Poland (6.45)			4/8	50.0
	Spain (6.45)	1/1	100.0	8/8	100.0
	Belgium (4.03)			4/8	50.0
	Czech Rep. (4.03)			2/8	25.0
	Greece (4.03)	1/1	100.0	8/8	100.0
	Hungary (4.03)	1/1	100.0	4/8	50.0
	Portugal (4.03)	1/1	100.0	6/8	75.0
	Austria (3.23)			2/8	25.0
	Denmark (2.42)			1/8	12.5
	Luxemburg (1.61)			1/8	12.5
3. EU25: 01.11.2004 - 31.12.2006	Germany (9.03)	5/10	50.0	1/5	20.0
	France (9.03)	2/10	20.0		
	Italy (9.03)	10/10	100.0	5/5	100.0
	UK (9.03)			3/5	60.0
	Poland (8.41)	8/10	80.0	5/5	100.0
	Spain (8.41)	9/10	90.0	5/5	100.0
	Belgium (3.74)	1/10	10.0	1/5	20.0
	Czech Rep. (3.74)	4/10	40.0	1/5	20.0
	Greece (3.74)	7/10	70.0	2/5	40.0
	Hungary (3.74)	7/10	70.0	2/5	40.0
	Portugal (3.74)	4/10	40.0	2/5	40.0
	Austria (3.12)	3/10	30.0		
	Sweden (3.12)	3/10	30.0		
4. EU27: 01.01.2007 - 30.06.2013	Germany (8.41)	17/36	47.2	10/31	32.3
	France (8.41)	35/36	97.2	29/31	93.5
	Italy (8.41)	32/36	88.9	29/31	93.5
	UK (8.41)	3/36	8.3	3/31	9.7
	Poland (7.83)	35/36	97.2	30/31	96.8
	Spain (7.83)			5/31	16.1
	Romania (4.06)	1/36	2.8	2/31	6.5
	Netherlands (3.77)	2/36	5.6		
	Belgium (3.48)	4/36	11.1		
	Czech Rep. (3.48)	2/36	5.6		
	Greece (3.48)	6/36	16.7	5/31	16.1
	Hungary (3.48)	6/36	16.7	5/31	16.1
	Portugal (3.48)	5/36	13.9	5/31	16.1
5. EU28: 01.07.2013 – 31.10.2013	Germany (8.24)	9/9	100.0	9/9	100.0
	France (8.24)	9/9	100.0	9/9	100.0
	Italy (8.24)	9/9	100.0	9/9	100.0
	Poland (7.67)	9/9	100.0	9/9	100.0
	Greece (3.41)	3/9	33.3		
	Hungary (3.41)	3/9	33.3		
6. EU28[1]: From 01.11.2013	Germany (15.93)	1/1	100.0	4/4	100.0
	France (12.98)	1/1	100.0	4/4	100.0
	Italy (11.81)			3/4	75.0

[1] Vote weights in this category are percentages.
Source: AgraFacts and AgrFocus (see http://www.agrafacts.com/home.html)

4 Discussion and Conclusion

Our statistical analysis shows that a MS's identity (i.e. endogenous factors) is statistically the most significant factor driving voting behaviour. Other factors like a GE crop's characteristics play an unimportant role (i.e., do not influence the voting outcome - all GE crops are seen in the same light) in explaining MS voting behaviour in the context of our study and assumptions. The country fixed-effects are, in most cases, statistically significantly the most important factors explaining voting behaviour. This empirical finding supports the gridlock hypothesis. We also found an overall positive time trend suggesting a persistent, but slightly weakening, gridlock. We maintain that it is unlikely in the foreseeable future for this trend to persist to the point where a QM is reached.

Results indicate that reaching a QM vote is unlikely due to the strong blocking effect of a few 'heavy weight' voters like France, Germany, Italy (LEECH, 2002), and more recently, Poland. The latest changes to the voting rules (double majority) mean that Germany has the strongest blocking power in the EU conferring it with significant leverage for concessions with other voters (MOBERG, 2007).

The status quo of not reaching a QM is likely to persist unless Germany, France, and Italy collectively change their positions to a 'for' vote in favour of GE crops. The 2015 proposal by the EC for MSs to 'opt-out' from approvals for cultivation is designed, in part, to "improve the process of authorizations" (OJEU, 2015), i.e. facilitate an increase the number of GE crops authorized for cultivation in the Union. According to our results, this outcome is unlikely as it would require more MSs to vote in favour of approval. This would require at least two of the three 'heavy weights' in France, Germany, or Italy to change their latest voting behaviour. Importantly, it would require them to vote in favour of the most sensitive use category, namely cultivation. The strong policy signals from Germany and France against the cultivation of GE crops further supports our doubt that their voting behaviour will change in the foreseeable future. Italy might be the only 'heavy weight' most likely to change - this is based on its historical voting behaviour and the demand by some of its "pro-biotech" farmers to access the technology (FLAK et al., 2013). Even if the 'opt-out' proposal fails to yield in a QM for approval, the time the EC takes after the voting at the AC might shorten as the EC might be under less pressure from MSs to delay a final decision, and can therefore justify accepting EFSA's favourable opinions by indicating that MSs who had voted against cultivating GE crops in their countries had in fact 'opted-out' anyway.

The voting behaviour of the EU MSs for GE plants is well established and therefore unlikely to change much because green biotechnology is such a "controversial and value-loaded" issue (MÜHLBOCK and TOSUN, 2015). Why is it so controversial and value-loaded? More in-depth research is required to understand the MS endogenous factors driving voting behaviour such as: (1) the core reasons for each MS's stance on GE plants, (2) the factors driving politicians' voting behaviour, and (3) at MS-level, the link between the public's stance on genetic engineering and the voting behaviour of its representatives at the Union. A reductionist approach is one future avenue to follow to reveal the underlying reasons for this voting gridlock. An improved understanding of the root causes of the gridlock has the potential for finding ways of alleviating the gridlock so that the costs caused by the current approval system can be reduced.

Finally, political-economy factors of each MS that may play a role in their voting behaviour need to be investigated more deeply for providing an improved understanding of their voting behaviour. We suggest that further research test the hypothesis that in the EU the political-economic benefit-cost ratio is too low for politicians to vote in favour of approving GE crops.

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Annex

Table A1. SCFCAH's voting results ('for', 'against') according to each MS's weight, and the minimum additional number of votes required for reaching a qualified majority for authorizing GE crops for votes from December 2003 to September 2014 in the EU

Plant	Event	Votes 'For'			Votes 'Against'	Additional votes required for a QM
		Number	Per cent of maximum possible	Per cent of QM		
Results for EU-15 until April 2004, maximum possible votes = 87						
Maize	Bt11	33	37.9	53.2	25	29
Maize	NK603	53	60.9	85.5	20	9
Maize	NK603	50	57.5	80.6	15	12
Results for EU-25 from May - November 2004, maximum possible votes = 124						
Rapeseed	GT73	43	34.7	48.9	57	45
Results for EU-25 from November 2004 – December 2006, maximum possible votes = 321						
Maize	GA21	98	30.5	42.2	62	134
Maize	1507	116	36.1	50.0	92	116
Maize	MON863	175	54.5	75.4	52	57
Maize	1507	111	34.6	47.8	76	121
Maize	MON863xMON810	94	29.3	40.5	45	138
Rapeseed	Ms8	102	31.8	44.0	151	130
Rapeseed	Rf3	102	31.8	44.0	151	130
Rapeseed	Ms8xRf3	102	31.8	44.0	151	130
Flowers	Carnation Moonlite 123.2.38	196	61.1	84.5	49	36
Potato	EH92-527-2	134	41.7	57.8	80	98
Results for EU-27 from January 2007 – June 2013, maximum possible votes = 345						
Sugarbeet	H7-1	195	56.5	76.5	92	60
Maize	59122	197	57.1	77.3	79	58
Potato	EH92-527-2	123	35.7	48.2	104	132
Maize	MON863xMON810xNK603	149	43.2	58.4	90	106
Maize	MON863xMON810	149	43.2	58.4	90	106
Maize	MON863xNK603	149	43.2	58.4	90	106
Maize	GA21	155	44.9	60.8	65	100
Rapeseed	T45	146	42.3	57.3	138	109
Soybean	MON89788	160	46.4	62.7	69	95
Maize	1507	91	26.4	35.7	127	164
Maize	Bt11	91	26.4	35.7	127	164
Maize	MON88017	167	48.4	65.5	84	88
Maize	MIR604	138	40.0	54.1	99	117
Maize	1507x59122	183	53.0	71.8	83	72
Maize	59122x1507xNK603	183	53.0	71.8	83	72
Maize	MON88017xMON810	183	53.0	71.8	83	72
Maize	Bt11 (renewal)	167	48.4	65.5	84	88
Maize	MON89034xNK603	164	47.5	64.3	116	91
Maize	Bt11xGA21	164	47.5	64.3	87	91
Rice	LLRICE601	256	74.2	100.4	0	-1
Cotton	GHB 614	157	45.5	61.6	106	98
Maize	1507	183	53.0	71.8	73	72
Maize	MON89034xMON88017	154	44.6	60.4	109	101
Cotton	281-24-236x3006-210-23	192	55.7	75.3	87	63
Maize	Bt11xMIR604xGA21	180	52.2	70.6	109	75
Maize	MIR604xGA21	180	52.2	70.6	109	75
Maize	Bt11xMIR604	180	52.2	70.6	99	75
Soybean	40-3-2 (renewal)	190	55.1	74.5	80	65
Soybean	A5547-127	190	55.1	74.5	113	65
Soybean	356043	181	52.5	71.0	84	74
Soybean	MON87701	181	52.5	71.0	94	74
Soybean	MON87701xMON89788	149	43.2	58.4	87	106
Maize	MIR162	152	44.1	59.6	96	103
Maize	MON89034x1507xMON88017x59122	158	45.8	62.0	116	97
Maize	MON89034x1507xNK603	158	45.8	62.0	116	97
Results for EU-28 from July 2013 - October 2014, maximum possible votes = 352						
Oilseed rape	GT73	161	45.7	61.9	103	99
Maize	T25	149	42.3	57.3	94	111
Soybean	MON87707 (dicamba)	152	43.2	58.5	101	108
Soybean	305423	161	45.7	61.9	126	99
Soybean	MON87705	149	42.3	57.3	133	111
Soybean	MON87708	149	42.3	57.3	104	111
Soybean	BPS-CV127-9	149	42.3	57.3	104	111
Maize	NK603	161	45.7	61.9	97	99
Cotton	LLcotton25xGHB614	144	40.9	55.4	130	116
Oilseed rape	MON88302	140	39.8	53.8	123	120
Cotton	MON89913	140	39.8	53.8	123	120
Results for EU-28 from November 2014, double majority voting; maximum possible votes = 100						
Soybean	MON87769	37.9	37.8	58.2	30.5	27.15

Source: AgraFacts and AgrFocus (see http://www.agrafacts.com/home.html)

Table A2. C/AC's voting results ('for', 'against') according to each EU MS's weight, and the minimum additional number of votes required for reaching a qualified majority for authorizing GE crops for votes from 2004 to 2015

Plant	Event	Votes 'For'			Votes 'Against'	Votes required for a qualified majority
		Number	Per cent of maximum possible	Per cent of QM		
Results for EU-25 from May - November 2004, maximum possible votes = 124						
Maize	Bt11	35	28.2	39.8	29	53
Maize	NK603	53	42.7	60.2	39	35
Maize	NK603	48	38.7	54.5	36	40
Oilseed rape	GT73	30	24.2	34.1	55	58
Maize	MON863	50	40.3	56.8	47	38
Maize	1507	45	36.3	51.1	47	43
Maize	GA21	37	29.8	42.0	58	51
Maize	MON863	55	44.4	62.5	45	33
Results for EU-25 from November 2004 – December 2006, maximum possible votes = 321						
Maize	MON863xMON810	133	41.4	57.3	142	99
Maize	1507	111	34.6	47.8	81	121
Oilseed rape	Ms8	124	38.6	53.4	151	108
Oilseed rape	Ms8xRf3	124	38.6	53.4	151	108
Oilseed rape	Rf3	124	38.6	53.4	151	108
Results for EU-27 from January 2007 – June 2013, maximum possible votes = 345						
Flower	Carnation Moonlite 123.2.38	212	61.4	83.1	90	43
Potato	EH92-527-2	130	37.7	51.0	119	125
Potato	EH92-527-2	114	33.0	44.7	173	141
Maize	MON863xMON810xNK603	145	42.0	56.9	119	110
Maize	MON863xMON810	145	42.0	56.9	119	110
Maize	MON863xNK603	145	42.0	56.9	119	110
Maize	GA21	128	37.1	50.2	90	127
Cotton	LL25	186	53.9	72.9	109	69
Soybean	A2704-12	174	50.4	68.2	109	81
Soybean	MON89788	164	47.5	64.3	79	91
Maize	MON88017	167	48.4	65.5	84	88
Maize	MIR604	181	52.5	71.0	128	74
Maize	Bt11 (renewal)	167	48.4	65.5	84	88
Maize	Bt11xGA21	164	47.5	64.3	87	91
Maize	MON89034xNK603	164	47.5	64.3	116	91
Maize	MON89017xMON810	183	53.0	71.8	112	72
Maize	59122x1507xNK603	183	53.0	71.8	112	72
Maize	1507x59122	183	53.0	71.8	112	72
Maize	1507	186	53.9	72.9	109	69
Cotton	GHB 614	193	55.9	75.7	106	62
Maize	MON89034xMON88017	190	55.1	74.5	109	65
Cotton	281-24-236x3006-210-23	163	47.2	63.9	87	92
Maize	Bt11xMIR604xGA21	151	43.8	59.2	109	104
Maize	MIR604xGA21	151	43.8	59.2	109	104
Maize	Bt11xMIR604	151	43.8	59.2	99	104
Soybean	40-3-2	181	52.5	71.0	80	74
Soybean	A5547-127	181	52.5	71.0	113	74
Soybean	356043	181	52.5	71.0	94	74
Soybean	MON87701	181	52.5	71.0	96	74
Soybean	MON87701xMON89789	149	43.2	58.4	87	106
Maize	MIR162	152	44.1	59.6	96	103
Results for EU-28 from July 2013 - October 2014, maximum possible votes = 352						
Maize	MON89034x1507xMON88017x59122	161	45.7	61.9	123	99
Maize	MON89034x1507xNK603	161	45.7	61.9	123	99
Oilseed rape	GT73	164	46.6	63.1	101	96
Soybean	305423	161	45.7	61.9	103	99
Soybean	MON87705	161	45.7	61.9	110	99
Soybean	MON87708	149	42.3	57.3	81	111
Soybean	BPS-CV127-9	161	45.7	61.9	81	99
Maize	T25	161	45.7	61.9	103	99
Maize	NK603	161	45.7	61.9	97	99
Results for EU-28 from November 2014, double majority voting; maximum possible votes = 100						
Cotton	LLcotton25xGHB614	29,6	29.6	45.5	61.2	35,4
Cotton	MON89913	29,6	29.6	45.5	61.2	35,4
Oilseed rape	MON88302	29,6	29.6	45.5	61.2	35,4
Soybean	MON87769	38,9	38.9	59.8	61.2	26,1

Source: AgraFacts and AgrFocus (see http://www.agrafacts.com/home.html)