Impact of Unapproved Genetically Modified Soybean on the EU Feed Industry

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Abstract

The EU is a major importer of protein rich feedstuffs as soy, which is increasingly produced with GM varieties. Only GM varieties approved in a lengthy approval procedure can be imported to the EU. The EU zero tolerance policy for unapproved GM means that only soy batches without traces of EU-unapproved GM varieties can be imported. Relaxing the zero tolerance policy for unapproved GM-soy varieties to an alternative tolerance threshold might prevent the import decline and consequential problems. This study evaluates alternative tolerance thresholds for EU-unapproved GM soy in combination with alternative delay periods of EU approval for use in feed compared to approval for production in soy exporting countries by using a stochastic computer based model of a three segment supply chain of soy producers in the USA, Brazil and Argentina, EU importers and feed producers. Results show that a two year delay period can lead to problems for the supply of soy to EU. This conclusion is not influenced by the chosen tolerance threshold level within the range 0.0-0.9%. When both Brazil and the EU have the same approval policy, supply problems are not expected.

Introduction

Over the last years there have been increasing difficulties with the EU import of soy from major exporting countries. This is among other things caused by the lengthy procedure in the EU for the approval of new genetically modified organisms (GMOs) in combination with a zero tolerance for traces of unapproved varieties. However, the EU livestock industry is highly dependent on the import of soy as the main source of proteins. With the more widespread cultivation of GM varieties that are approved in the exporting countries but not, or not yet, in the EU, potential trade disruptions could become more severe, more frequent, and affect more products. Impurities or contaminations in commodities are difficult to avoid, and it is common practice in food safety legislation that minute presence is allowed of certain unwanted materials. According to law products in the EU may contain up to 0.5% of unapproved GM material that has received positive risk assessment from the European Food Safety Authorities. Conventional unlabeled products may contain up to 0.9% of approved GM material and 0% of GM material that has not undergone a safety review. If the presence of unapproved GM soy in imported soy exceeds this threshold, the product has to be destroyed, which involves enormous costs. Relaxing

the zero tolerance policy for unapproved GM-soy varieties to an alternative tolerance threshold might prevent the import decline and consequential problems. The goal of this research is to investigate the impact of alternative tolerance thresholds for EU-unapproved GM soy in combination with alternative delay periods of EU approval of EU-unapproved GM for use in feed compared to approval for production in soy exporting countries on EU feed industry.

Methodology

The analyses are based on a supply chain with soy producers in the USA, Brazil and Argentina, EU importers, and feed producer. Different scenarios were analyzed using a stochastic computer based model. The model is applied for the Netherlands. The model distinguishes 2 types of soy: 1) EU-tolerant soy (non-GM and GM-approved soy in EU), 2) GM-unapproved soy- approved outside EU.

One of the major concerns regarding the importing of GM soy is the risk of the presence of EU-unapproved GM soy in a batch of non-GM or EU-approved GM soy. In this study such presence is called contamination. Sources of contamination are: 1) out crossing of EU-unapproved GM soy into neighboring fields with non-GM soy or EU-approved GM soy, 2) mixing of EU-approved GM soy and EU-unapproved GM soy during transport and storage, 3) cross contamination of a batch of non-GM or of EU-approved GM soy with traces of EU-unapproved GM varieties during transportation and storage. According to experts the risk of contamination is high during transportation and storage in the exporting countries and low at the primary producers and at the importers. We assume that contamination of batches of non-GM and EU-approved GM soy with EU-unapproved GM soy happens prior to shipment to the EU. The model has three modules and several in-between steps

Module I

The first module calculates total available soy for the EU (EU-tolerant soy). Expert estimation of the probability of contamination with EU-unapproved GM soy determines the available amount of EU-tolerant soy for each tolerance threshold. To obtain insight into the distribution of the impact of the contamination levels of EU-tolerant soy with EU-unapproved GM soy, a Monte Carlo simulation model was applied. In a Monte Carlo simulation, selected variables or relationships incorporate random or stochastic components by specifying probability distributions, to reflect important parts of uncertainty in the real system (Hardaker et al., 2004)

Module II

The second module is a partial equilibrium model that uses EU-demand and the available EU-tolerant soy to calculate market costs. Market costs are the price premium if soy availability is restricted. The primary production, processing, transport, and market costs are added to calculate the expected price of EU-tolerant soy. Relating soy price to feed composition determines EU demand for EU-tolerant soy. The relationship between world wide soy production, soy demand from the EU, and the world soy price was based on data about non-GM soy because insufficient data was available about EU-approved GM soy varieties. The price premium was estimated with the excess supply above the EU demand, because outside the EU no specific demand for EU-approved GM soy varieties is to be expected. The relationship between price premium and excess supply is presented as simple constant elasticity form based on work of (Breukers et al., 2008)

$$\text{EU-demand} = \alpha \cdot (\text{excess supply})^{\varepsilon} \quad (1)$$

Excess supply was calculated as the difference between the global supply of EU approved varieties and the demand from the EU:

$$\text{Excess supply} = \text{world production} - \text{EU-demand} \quad (2)$$

The demand from the EU depends on the price of soy and was calculated based on data provided by the feed industry. The relationship between EU-demand and soy price was estimated with a simple constant elasticity form: $\text{EU-demand} = \alpha \cdot (\text{soy price})^{\varepsilon}$.

Module III

The third module calculates feed prices for various threshold levels. Scenario analyses with different tolerance thresholds and share percentages of EU-unapproved GM soy in total production provide insight on the impact of alternative tolerance thresholds for EU-unapproved GM soy on soy supply, soy prices and feed prices. Scenarios are based on different threshold values of unapproved GM soy present in EU tolerant GM soy batch and growth % GM soy in the 3 countries. Four scenarios were developed. For all scenarios the production of a new variety of GM soy starts in year t in the USA. In scenario 1 it is assumed that the production of the new variety in Brazil and Argentina takes place in year t+1 and that the EU approves a new GM variety in year t+1. This scenario thus provides the impact of a one year delay of approval of a new variety on the supply volumes to EU and on the prices of EU-approved GM soy. In scenario 2 we assume that again the production of the new variety in the USA starts in year t and in Brazil, Argentina in year t+1, but EU approval of a new GM variety is in year t+2. This scenario thus provides the impact of a 2 years delay of approval of a new variety. The other two scenarios are designed similarly for three and four years delay of approval in the EU.

Taking into account the fact that in Brazil the GM soy production grows less rapid than in the USA and Argentina, four additional scenarios were developed, in which the approval for production of new GM soy varieties in Brazil follows the approval of these varieties in the EU

Input Data

Input Data for Module I

The first step of this module starts with calculation of total GM and non-GM soy production for the years t,…,t+3 in the USA, Brazil and Argentina. The minimum, most likely and maximum values of adoption percentage of GM soy production in these three countries (Table 2) were elicited, based on historical data presented at Table 1 and experts judgments presented.

Table 1 Adoption percentage of GM soy production in exporting countries

	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
USA	13	35	50	55	71	77	81	85	87	89	91
Brazil	2	8	15	24	30	32	34	34	49	56	66
Argentina	23	61	90	94	97	99	99	99	99	99	95

Source: www.soystats.com

Table 2	Expected adoption of GM soy in exporting countries based on expert judgment (% of total production)			
	t	t+1	t+2	t+3
USA				
Min	91	91	91	91
Most Likely	95	95	95	95
Max	99	99	99	99
Brazil				
Min	66	66	66	66
Most Likely	85	85	85	85
Max	99	99	99	99
Argentina				
Min	95	95	95	95
Most Likely	97	97	97	97
Max	99	99	99	99

Data from Table 2 were used in the second step to calculate the total GM and non-GM soy production in three exporting countries using a triangular distribution function (Table 3). The triangular distribution can, if no sample data are available, be fully specified from the minimum, most likely and maximum values provided by experts (Hardaker et al., 2004).

Table 3	Most likely total soy production in three exporting countries (1000 ton)			
	t	**t+1**	**t+2**	**t+3**
USA				
Estimated Non-GM	4,194	4,091	4,243	4,211
Estimated GM	79,694	77,731	80,615	80,016
Estimated total production	83,889	81,822	84,858	84,228
Brazil				
Estimated Non-GM	11,605	12,174	12,639	13,081
Estimated GM	58,024	60,872	63,196	65,404
Estimated total production	69,628	73,046	75,835	78,485
Argentina				
Estimated Non-GM	1,536	1,572	1,600	1,628
Estimated GM	50,832	52,012	52,945	53,871
Estimated total production	52,369	53,584	54,545	55,499
USA, Brazil, Argentina				
Estimated Non-GM	17,335	17,837	18,482	18,920
Estimated GM	188,550	190,615	196,756	199,291
Estimated total production	205,886	208,452	215,238	218,211
Source: www.fapri.org for total soy production data				

The third step in module I was to calculate the number of EU-tolerant soy batches contaminated with EU-unapproved GM soy based on different scenarios and % share of EU-unapproved GM soy in total soy production. Each batch was assumed to consist of 6,000 ton.

Scenario analyses were carried out to provide insight on the impact of alternative tolerance thresholds for EU-unapproved GM soy on soy supply to EU. The scenarios are based on alternative tolerance thresholds of EU-unapproved GM soy and different shares of EU-unapproved GM soy in total soy production in the USA, Brazil and Argentina. The analyzed tolerance threshold values are 0.0%, 0.1%, 0.2%, 0.5%, 0.9% and 100.0% (no threshold) of EU-unapproved GM soy in a batch of EU-tolerant soy. Expert judgment was used to elicit the probability of contamination of EU-tolerant soy batches with EU-unapproved GM soy for each tolerance threshold value for each country (Table 4).

The 0% in the first column with contamination level 0.0% means that if the share of EU-unapproved GM soy in the USA/Argentina is 5% of total GM production, the probability is 0% that the contamination level in a batch of EU-tolerant soy is 0.0%. The 10% in the same column for Brazil with the contamination level of 0.2%-0.5% means that if the share of EU-unapproved GM soy in the Brazil is 5% of total GM production, the probability is 10% that a batch of EU-tolerant soy contains between 0.2%-0.5% EU-unapproved GM soy.

Table 4 Assumed probability % of EU-tolerant soy batches being contaminated with EU-unapproved GM soy depending on share levels of EU-unapproved GM soy in total soy production

	Share of EU-unapproved GM soy in total soy production (% of total GM soy production)			
Contamination level	5	25	50	75
USA, Argentina				
0.0%	0	0	0	0
>0.0% – 0.1%	0	0	0	0
>0.1% - 0.2%	1	0	0	0
>0.2% - 0.5%	9	0	0	0
>0.5% - 0.9%	10	0	0	0
>0.9%	80	100	100	100
Brazil				
0.0%	5	0	0	0
>0.0% - 0.1%	5	0	0	0
>0.1% - 0.2%	20	5	0	0
>0.2% - 0.5%	10	5	0	0
>0.5% - 0.9%	20	10	0	0
>0.9%	40	80	100	100

The following step in this module is the calculation of the impact of delays in EU approval for new GM varieties not yet approved in the EU on the supply levels of EU-tolerant soy to EU from the three countries based on growth percentage of the not yet in the EU approved GM soy, different tolerance thresholds of EU-unapproved GM soy, and contamination levels.

Because historical data were not available, expert judgment was used to determine the minimum, most likely and maximum values of the growth percentages of new GM soy varieties (Table 5). Production of a new GM variety starts in the USA and only in the following year production can be expected in Brazil and Argentina. The production of a new variety in Brazil and Argentina progresses less rapid than in the USA.

Table 5	Assumed production of new GM soy varieties (% of total production in the country)			
Production year	t	t+1	t+2	t+3
USA				
Min	5	10	15	20
Most Likely	10	15	20	25
Max	15	20	25	30
Brazil, Argentina				
Min	0	5	10	15
Most Likely	0	10	15	20
Max	0	15	20	25

To evaluate the expected impact of a delay of EU approval of new GM soy varieties for use in feed compared to the approval for the production in the USA, Brazil and Argentina, four scenarios were developed (Table 6). These scenarios are discussed in the previous section.

Table 6	Scenarios "Delay in EU approval of new varieties"			
	t	t+1	t+2	t+3
Scenario 1: EU approval in t+1				
Approved for production in				
USA	X	X	X	X
Brazil		X	X	X
Argentina		X	X	X
Approved in EU		X	X	X
Scenario 2: EU approval in t+2				
Approved for production in				
USA	X	X	X	X
Brazil		X	X	X
Argentina		X	X	X
Approved in EU		-	X	X
Scenario 3: EU approval in t+3				
Approved for production in				
USA	X	X	X	X
Brazil		X	X	X
Argentina		X	X	X
Approved in EU		-	-	X
Scenario 4: EU approval in t+4				
Approved for production in				
USA	X	X	X	X
Brazil		X	X	X
Argentina		X	X	X
Approved in EU		-	-	-

There is a high level of uncertainty around the duration of the approval process in the EU. Therefore sensitivity analyses are carried out for scenario 4 using different share percentages

higher growth % of unapproved varieties of 5%, 25%, 50% and 75% in total soy production for the years t, t+1, t+2, t+3 in all three countries.

Input Data for Module II

The second module of the model involves a Partial Equilibrium Model. The partial equilibrium model is used to calculate the increase in soy price if the available amount of EU-tolerant soy decreases. The relationship between world wide soy production, soy demand from the EU, and the world soy price was based on data about non-GM soy (Table 7), because insufficient data was available about EU-approved GM soy varieties.

Table 7 World non-GM soy production (mln ton), EU non-GM demand (mln ton), excess supply above EU demand (mln ton), total EU demand for non-GM and GM soy (mln ton), and additional non-GM soy price (€/ton) for 1999-2008

	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
World non-GM soy production[a]	67.5	65.3	54.1	53.0	46.7	48.0	40.1	35.7	29.2	26.8
EU non-GM demand[b]	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Excess supply above EU demand	58.5	56.3	45.1	44.0	37.7	39.0	31.1	26.8	20.2	17.8
Total EU Soy Demand[c]	29	31	35	34	33	33	34	34	36	33
Price premium[d]	0.00	0.00	0.00	2.65	4.43	4.02	8.05	7.97	43.86	54.65

Source: [a] Own calculations based on Table 1; [b] Based on 27% non-GM soy in 2004 (Brookes, 2004); [c] EU Import of soy meal and soy meal equivalents (Eurostat) [d] Cardy Brown (2008).

Excess supply was calculated as the difference between the global supply of EU approved varieties and the demand from the EU

The demand from the EU depends on the price of soy and was calculated based on data provided by the feed industry (Table 8).

Table 8 Soy price and % of soy in animal feed in the Netherlands

Soy price (€/ton)	**290**[a]	**340**	**390**	**490**	**690**
Soy in feed in the Netherlands (%)[b]	11.0%	10.55%	10.3%	9.85%	9.15%
Estimated soy use in feed in EU[c]	24.3%	23.9%	23.6%	23.2%	22.5%

a) Base price of soy meal determined as the average price of 1997-2006. In 2008 RR2 was produced in the USA increasing soy prices; b) Source: results from a commercial feed optimization ; c) The average soy percentage in EU in 2007 of 24.3% (Van Gelder et al., 2008) was used as the percentage at the base price. The percentages at the other prices are lowered with the difference as observed in the Netherlands

In equilibrium the EU demand as determined by the soy price equals the world production of soy minus the excess demand above the EU demand, which determines the soy price. The partial equilibrium model was numerically solved.

Input Data for Module III

The last module of the model calculated the impact of various threshold levels and share % of unapproved GM soy on prices of feed for layer hens, broilers, sows, finishing pigs and cattle. This module relates soy prices to feed composition for each animal type. The base feed prices in 2008/2009 (Table 9) were used when calculating the impact of assumed soy price increases on the feed price. A commercial optimization model with the current available raw materials was used to calculate the effects of a soy price increase from €50 to €400 per ton. All feed quality and environmental restrictions to the feed as valid for current feeds with the base soy price were met in the optimization for all soy prices.

Table 9 Feed prices per animal category depending on soy price 2008/2009

	Price and additional price [a] (%) above base price at soy price (€/ton)				
Soy price	**290**	**340**	**390**	**490**	**690**
Feed price layer hens	198[b]	+6.5	+13.5	+39.0	+60.0
Feed price broilers	236[b]	+5.0	+13.0	+28.5	+51.0
Feed price sows	180[b]	+6.5	+12.5	+26.5	+48.0
Feed price finishing pigs	190[b]	+5.0	+10.0	+20.0	+35.0
Feed price cattle	185[b]	+4.0	+10.0	+20.0	+40.0

Source: a) results from a commercial feed optimization; b) KWIN 2008/2009

Results

Results of Module I

The combined results for scenarios 1 to 4 are presented in Table 10 taking into account the production in three countries combined (USA, Brazil and Argentina). The values presented in the table are mean values. In the event of an introduction of a new GM variety in the US in production year t, a one year delay in EU approval for new varieties results in a sufficient supply of EU-tolerant soy to meet the EU soy demand level of 33 million ton in 2008 for any threshold level from 0.0% to 100.0%. For all later production years, a delay in EU approval for new varieties of already 1 year results in insufficient supply of EU-tolerant soy to meet the EU soy demand level of 33 million ton in 2008 for any threshold up to the level of 0.9%. However, EU soy demand does also depend on soy prices. The impact of price on EU soy demand is presented in next subsection..

Table10	Impact of delay in EU approval of a new variety on production availability of EU-tolerant soy from the USA, Brazil, and Argentina depending on threshold level for years t-t+3.			
Production year				
Approval year	**t**	**t+1**	**t+2**	**t+3**
t+1	↓[a]	a.a.[b]	a.a.[b]	a.a.[b]
t+2		↓	a.a.[b]	a.a.[b]
t+3			↓	a.a.[b]
t+4				↓
Threshold (%)	**Mean values of total available production of EU-tolerant soy (1,000 ton)**			
0.0%	121,997	0	-	-
0.1%	121,997	4,535	3,201	1,263
0.2%	123,201	7,939	6,019	2,879
0.5%	127,636	24,351	16,354	6,838
0.9%	132,910	31,275	21,114	9,007
100.0%	197,915	185,508	181,692	165,126

a) ↓: see lower part of the table for the total available production of EU-tolerant soy depending on the threshold
b) all available: the GM variety is also approved in the EU, so no availability restrictions exist

Table 11 presents the combined results over the three countries of the sensitivity analyses for scenario 4 with the shares of unapproved varieties of 5%, 25%, 50% and 75% in total soy production for the years t, t+1, t+2, t+3 respectively. If the share of EU-unapproved GM varieties in all three countries is only 5%, sufficient EU-tolerant soy is available to meet the 2008 EU soy demand level of 33 million ton for a tolerance threshold of 0.5% or higher in the first year after approval in the three countries. In the following years for all threshold levels up to 0.9% insufficient EU-tolerant soy is available to meet the EU soy demand level for 2008.

Table 11	Sensitivity analyses for scenario 4 for total available production of EU-tolerant soy from the USA, Brazil, and Argentina by threshold level			
	t	**t+1**	**t+2**	**t+3**
Share of unapproved GM in total soy production	**5%**	**25%**	**50%**	**75%**
Threshold (%)	**mean values of total available production of EU-tolerant soy (1,000 ton)**			
0.0	0	0	0	0
0.1	7,038	0	0	0
0.2	20,496	2,946	0	0
0.5	40,218	7,080	0	0
0.9	67,380	12,486	0	0
100.0	196,452	160,800	116,862	68,742

The results of the scenarios in which the approval for production of new GM soy varieties in Brazil follows the approval of these varieties in the EU are presented in Figure 1. If production of a new variety of GM soy in Brazil closely follows EU approval for this variety, for all

tolerance thresholds for unapproved GM soy total supply of EU-tolerant soy exceeds EU soy demand of 33 million ton in 2008.

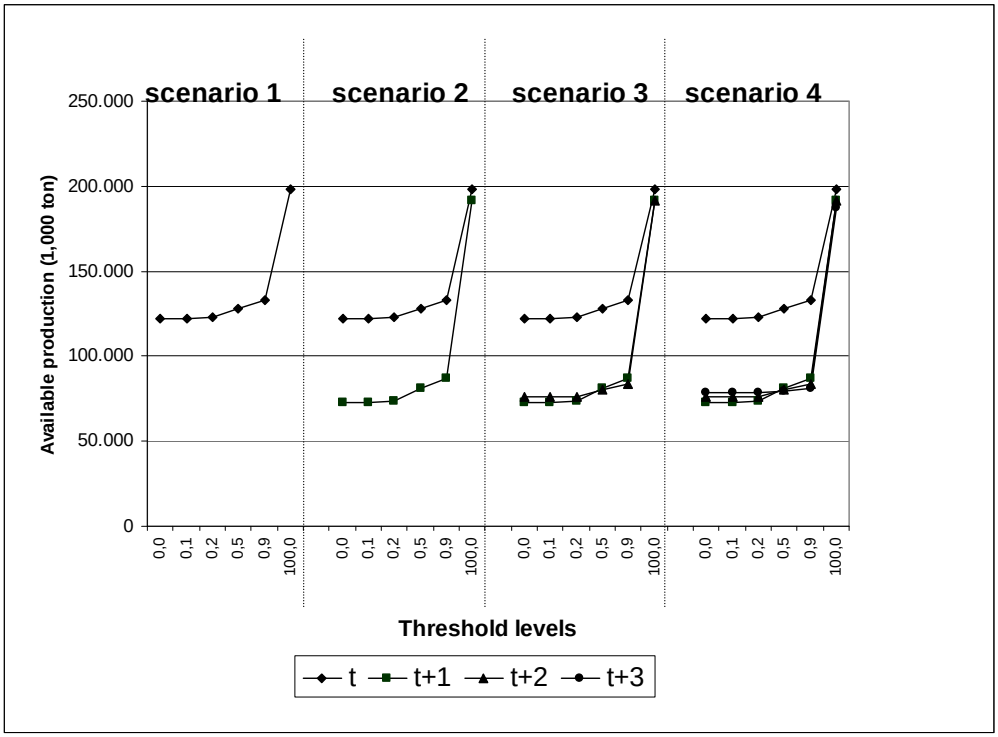

Figure 1. Total available EU-tolerant soy production if the approval policy of Brazil follows the approval policy of the EU.

Results of Module II

A delay in EU approval for new varieties for only 1 year does only affect estimated GM soy prices marginally, with an increase in mean values of prices from 290.0 to 292.2 €/ton. However, a delay for 2 or more years increases estimated soy prices to over €7.747 per ton or higher for all thresholds up to 0.9%.

Figure 2 presents the results for estimated EU-demand for GM soy if EU-demand is an endogenous variable based on the estimated soy price. The EU demand for soy remains constant in year t, when soy prices are constant, and it decreases considerably in years t+1-t+3, due to increased in soy prices.

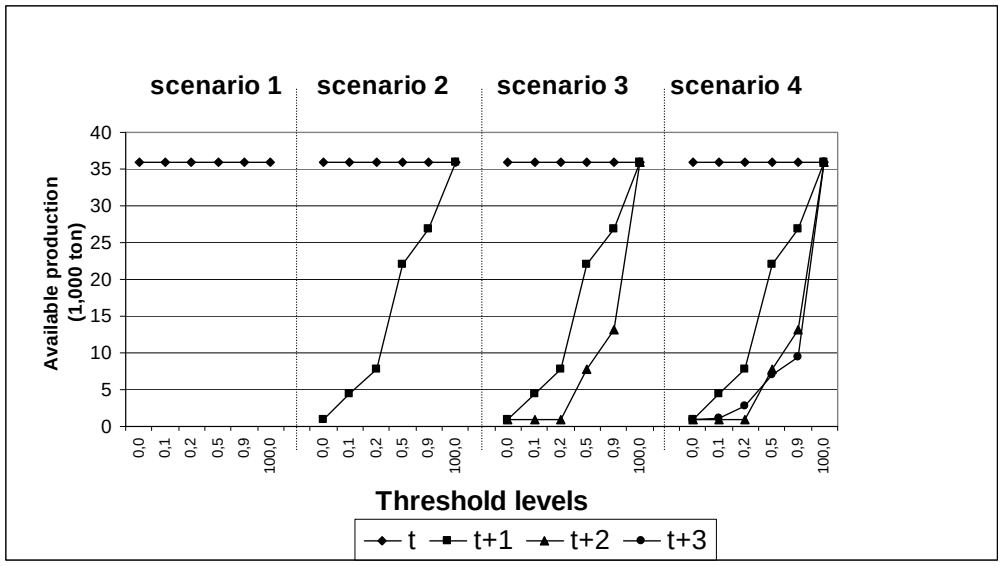

Figure 2. EU-demand for soy if EU-demand is an endogenous variable based on the soy price.

Table 12	**Sensitivity analyses for estimated soy prices** (€/ton) **for scenario 4**			
Year	**t**	**t+1**	**t+2**	**t+3**
Share of unapproved GM soy	5%	25%	50%	75%
Threshold (%)				
0.0	xxx	xxx	xxx	xxx
0.1	xxx	xxx	xxx	xxx
0.2	xxx	xxx	xxx	xxx
0.5	1.112	xxx	xxx	xxx
0.9	297	xxx	xxx	xxx
100.0	290	290	290	290

Table 13	**Sensitivity analyses for estimated EU demand for soy (million ton) for scenario 4**			
Year	**t**	**t+1**	**t+2**	**t+3**
Share of unapproved GM soy	5%	25%	50%	75%
Threshold (%)	EU demand (million ton)			
0.0	0,91	0,91	0,91	0,91
0.1	6,98	0,91	0,91	0,91
0.2	18,99	2,94	0,91	0,91
0.5	31,80	7,02	0,91	0,91
0.9	35,76	12,12	0,91	0,91
100.0	35,85	35,85	35,84	35,78

Sensitivity analysis results for an increased share of unapproved GM soy in total soy production for scenario 4 are presented in Tables 12 and 13. An increase in the share of unapproved GM varieties up to 5% of total soy production in all exporting countries, and a delay in EU approval for new GM varieties for several years (t+4), already requires adjustments in the

tolerance threshold levels to at least <0.5% in order to be able to maintain reasonable soy prices and the EU demand level for soy.

Figure 3 presents the results of estimated GM soy prices when the production of a new GM variety in Brazil follows the approval of EU this variety. In line with the results from Figure 3, if production of a new variety of GM soy in Brazil follows EU-approval for this variety, the GM soy prices remains unaffected with the current tolerance threshold levels.

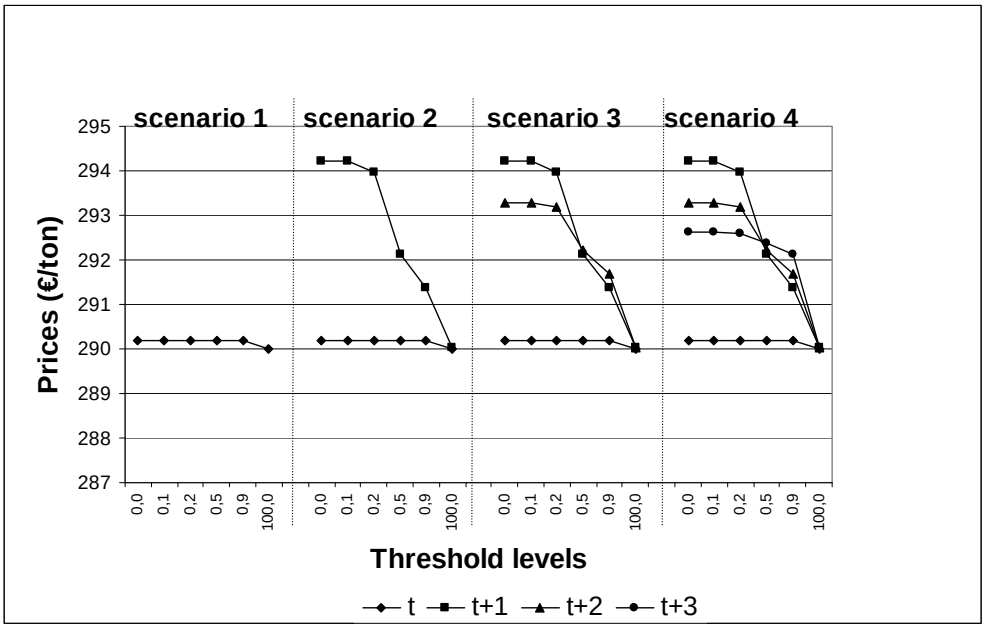

Figure 3. Estimated GM soy prices if the production of a new GM variety in Brazil follows the EU-approval policy for this variety

Calculations of EU demand for soy when the production of a new GM variety in Brazil follows the approval of EU this variety reveal a constant demand of 35 million ton for all scenarios in years t –t+4.

Results of Module III

Based on the results of the impact of a delay in EU approval of a new variety on estimated GM soy prices, a delay of 1 year will not impact on feed prices, since soy prices remain the same. A delay of 2 years or more will have a significant impact on feed prices. The tolerance of GM unapproved soy should be adjusted to over 0.9% to maintain a soy price at €290 and current feed price. The tolerance thresholds below 0.9% result in very high soy prices (€7.747 per ton or higher). Table 14 shows that if soy price increases from €290 to €7.747, the model calculates an increase in production costs with factor 8 for cattle and factor 18 for layer hens and broilers. At these price levels there will be no EU demand for soy as a raw material for feed, and the EU livestock industry will face a severe loss of competitiveness within short term.

Table 14	Effect of increase of soy price on livestock production costs				
	Feed costs at soy price of	**Feed costs at soy price of**	**Feed cost as % of**	**Production costs at**	**Production costs at soy**

	€290/ton	€7,747/ton	total farm production costs	€290/ton	price of €7,747/ton
Animal type	€/ton	€/ton	%	€/animal [b]	Factor increase
Layer hens	198	1290	65[a]	1247	18
Broilers	236	1166	66 [a]	750	18
Sows	180	803	36 [a]	152	10
Finishing pigs	190	601	51 [a]	92	14
Cattle	185	663	28 [a]	962	8

a) Source: KWIN 2008-2009, b) production costs for hens and broilers are given per100 animal

Conclusions and Discussion

This study evaluates alternative tolerance thresholds for EU-unapproved GM soy in combination with alternative delay periods of EU approval for GM unapproved soy for use in feed, compared to approval for production in soy exporting countries. Different scenarios were analysed.

Our results show how the EU approval process affects the import of soy into the EU. In fact the duration of the EU approval process for new GM varieties has more impact on availability and price of EU-tolerant soy than adjustments of tolerance thresholds. Importing soy into the EU is going to become more difficult. The maximum delay in the EU approval process for new GM soy varieties compared to the introduction of this GM-soy variety in the USA is one year. A two year delay period leads to soy supply problems, and to a loss of competitiveness for the EU livestock industry. This conclusion is not influenced by the chosen tolerance threshold level for acceptance as not containing unapproved GM soy varieties within the range 0.0-0.9%. When both Brazil and the EU have the same approval policy, supply problems are not expected. Based on the results of this study it can be suggested that the policy makers should rather focus on adjustments of the duration of the approval policy for new GM soy varieties than adjustment of tolerance thresholds, because the EU livestock industry is highly dependent on the import of soy and delay in approval procedure may cause serious trade disruptions. Even if the share of EU-unapproved GM varieties in total soy production in all three countries will be only 5%, a tolerance threshold needs to be adjusted to 0.5% or higher in the first year in order to meet 2008 EU soy demand level of 33 million ton. However in the following years for all threshold levels up to 0.9% insufficient EU-tolerant soy is available to meet the EU soy demand level, unless the EU approval procedure will be synchronised.

Overlooking this issue may lead to very high feed costs, which will force feed producers and livestock industry to search alternative solutions, such as e.g. substitution of soy with other protein rich materials (e.g. peas or grains). However, technical feasibility and social-economic impact of such alternative solutions need further research. An alternative solution for this problem could be the strengthening of institutional arrangements in the exporting countries, in order to prevent the contamination risks of GM approved soy with GM unapproved soy. Namely, to enforce stricter control and monitoring of the exported product to EU at the exporting harbour as well as during the transportation. Yet such arrangements still entail higher costs, due to monitoring and control costs, which will eventually affect feed prices and secondly, the EU still risks to fall in shortage of EU tolerant soy supply.

The need to simplify the analysis has resulted in at least three limitations. First, in determining soy supply to the EU data were lacking on the probabilities of EU-tolerant soy

batches being contaminated with EU-unapproved GM soy depending on the growth levels of EU-unapproved GM soy. Expert judgment was used to elicit the probability of contamination of EU-tolerant soy batches with EU-unapproved GM soy for each tolerance threshold value for each country.

Second, historical data for the growth percentage of new GM soy varieties and the price premium of approved GM soy varieties are lacking. A probability distribution with assumed minimum, most likely and maximum values of the growth percentages of new GM soy varieties reflects this uncertainty. The price premium for non-GM soy over the last few years was used to estimate the price premium of approved-GM soy varieties. The world demand for non-GM soy mainly originated from the EU, as is the world demand for EU-approved GM soy varieties. It is therefore assumed that the price premium of non-GM soy represents the price premium of EU-approved soy.

Third, a partial equilibrium model was used with only endogenous EU demand and exogenous supply from three major exporting countries. Expanding this analysis to include endogenous world supply, where the decision to produce a GM soy variety depends on the world price, could yield useful insights on price quantity relationships for soy and feed.

References

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