The potential role of GM cost reducing technology in helping the Slovak arable cropping sector remain competitive

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Executive summary and conclusions

This paper outlines the key factors affecting competitiveness in the European maize and sugar markets up to 2012/13. It also explores the possible role and impact of using genetic modification (GM) technology in the maize and sugar beet sectors to maintain/enhance Slovak competitiveness.

Key market features
The key market features of the EU maize and sugar markets are summarised in Table 1.

Table 1: key market features

	Maize	Sugar beet
EU production (million tonnes)	49.2	131 (beet), 20 (raw sugar)
EU consumption (million tonnes)	48.7	16 (raw sugar)
Imports	2.5	2.3 (raw sugar)
Prices	Farm level about 20% higher than in the US and Argentina Slovak prices a little below French levels	Higher than world prices by a factor x 3 Farm level prices largely influenced by support regime: Slovakia fully acceded to sugar support prices
Non GM market	23% to 27% of total consumption required to be certified non GM	Not relevant: no GM sugar grown commercially anywhere in the world

Future market developments
Within the EU 25, maize production in 2012/13 is forecast to be about 55.1 million tonnes compared to current levels of 49.2 million tonnes. EU maize consumption is also forecast to rise to 55.5 million tonnes (from 48.6 million tonnes). The EU market will, however probably become more 'open' and subject to the influences of world markets largely because of commitments likely to be agreed at the World Trade Organisation (WTO) relating to reduced levels of import protection and domestic agricultural support, and elimination of export subsidies.

The EU 25 sugar market in 2012/13 is forecast to see consumption at roughly the same level as 2006 (about 16 million tonnes) but with EU production falling to 12.2 million tonnes (16.7 million tonnes at present) post reform of the sugar regime. Imports are expected to rise from 2.3 million tonnes (2005) to 3.9 million tonnes and exports to fall from 3.1 million tonnes in 2005 to 0.4 million tonnes in 2012/13.

In relation to the GM versus non GM markets:

Maize
The majority of EU maize production is likely to remain non GM in the next 1-3 years, although a slow expansion in the area planted to GM cultivars can be expected.

Those requiring certified non GM will have little difficulty in procuring supplies, with little or no price differentials between the two origins (at best a marginal differential of 1% to 2% in favour of non GM and this post farm gate rather than a farm level differential).

Sugar
Although most sugar beet processors have indicated that they would not wish to currently buy in GM sugar beet for use in food products if it was available, a change in attitude post 2008/09 may occur as duty free sugar from least developed countries enters EU and domestic growers & processors seek to compete with imports. This is likely to focus initially on servicing new non food market opportunities that may well develop (notably bio-ethanol)) where the GM versus non GM origin of raw materials will probably be of limited relevance.

Beyond 2008, the levels of EU consumer opposition to GM technology will probably recede slowly as a result of greater levels of awareness and understanding of the technology (in particular recognition, from empirical studies of the environmental benefits, associated with reduced pesticide use and reduced greenhouse gas emissions). In addition, crops containing GM quality traits are likely to become commercially available by 2010 – these latter innovations being ones consumers can more readily associate with direct benefits.

Farmers choosing to plant GM cultivars will find plenty of buyers for their production, both currently and in the future (mainly in the feed sector which dominates consumption).

Competitiveness issues
Maize and sugar beet are currently two of the most profitable arable crops grown in the EU 25. They are equally two of the most profitable crops in new member states like Slovakia. Average profitability levels in the new member states are, however significantly lower than in the leading maize and sugar beet producing countries of the EU 15. This derives from a combination of lower levels of (current) support payments (maize) and lower levels of productivity (ie, lower average yields).

Looking forward to 2012/13, this will be a period of implementation of the 2003 Mid Term Policy (MTR) and the 2005 sugar policy reforms, transition to the full CAP in the new member states and implementation of the next WTO trade agreement. The key points of relevance for profitability and competitiveness arising from these changes, coupled with the expected changes in global markets are:

- Levels of support for agriculture will be lower than at present in the EU 15 (significantly so in the sugar sector). However, in the new member states these will be higher than prior to accession. The receipt of direct aids will provide additional income and should lead to higher investment in agriculture, both in terms of fixed assets (eg, machinery, crop storage) and more efficient use of variable inputs (eg, new varieties and pesticides). As a result, levels of technical performance should improve and an element of 'closing the productivity gap' with longer standing EU member states should occur over a number of years;
- The EU market will be open to increasing levels of competition from world markets. This will apply to all sectors;
- The EU agricultural market will probably be subject to greater variability in prices (reduced role of policy support mechanisms and increased openness of markets);
- Demand for crops in non food sectors (notably bio-fuels) can be expected to increase across the EU. Agri-environmental schemes may become more attractive to some producers, especially if national governments choose to channel addition rural development funding from modulation into such schemes. Nevertheless, the majority of agricultural policy support will continue to be delivered via market measures and direct payments;
- In order to remain competitive in the EU marketplace, many producers will increasingly explore all forms of new technology that can assist them (eg, through yield enhancement and cost reduction[1]) or ways of reducing production and price risk. Others may focus on higher value, niche product production, such as organics, where cost is less of a market driver or 'care' goods (eg, environmental set-aside, membership of agri-environmental schemes that target the delivery of environment and landscape goods for the wider public). Lastly, some may choose to exit from the sector.

[1] Including in the new member states, where despite the increases in levels of agricultural support, accession is likely to result in the real increases in the costs of land and labour inputs

Possible role of using GM cost reducing technology in maize and sugar beet in Slovakia
In the next few years, some GM traits may become available to Slovak maize and sugar beet growers. Those most likely to become available first are herbicide tolerant (GM HT) and insect resistant (GM IR) maize and GM HT sugar beet. Maize resistant to the European corn borer already has EU-wide approval for planting.

Drawing on a review of literature (see references), Table 2 summarises the likely impact of using GM HT, GM IR maize, and GM HT sugar beet in Slovakia.

The analysis assumes that GM technology is made available in leading varieties adapted to Slovak agronomic conditions and Slovak farmers are able to make choices about whether to plant GM crops according to technical and agronomic performance criteria and market requirements. As such, this assumes that co-existence conditions for the planting of GM crops in Slovakia are practical, proportionate and based on science.

The key points to note are as follows (see section 5):

- yield gains are likely from using GM IR technology where currently farmers experience economic losses from the European corn borer and corn rootworm pests. Significant yield gains are also likely from the use of GM HT sugar beet;
- The impact on the costs of production varies by trait used. Users of GM HT maize and sugar beet are likely to experience reduced levels of costs even after paying for the technology. With regard to GM IR technology, some users may find that average variable costs decrease whilst for others costs increase (this will depend upon whether insecticides or seed treatments have traditionally been used to combat pest attacks or not);
- An increase in average gross margin profitability is likely to arise for users of GM HT maize of +€6/ha to +€33/ha (+1.7% to +9.5%). For users of GM IR technology (which currently suffer economic losses from the corn borer and rootworm pests) the gross margin gains are likely to be in the range of +€31/ha to +€61/ha (+8.9% to +17.5%) where the target pest is the ECB and +€56/ha to +€89/ha (+16.1% to +25.6%) where the target pest is the corn rootworm[2]. An increase in average gross margin profitability of between +€344/ha to +€368/ha is likely to arise for users of GM HT sugar beet;
- At the national level the positive farm income impact is likely to be between 8.12 and 10.6 million euros;
- The technology offers additional intangible benefits such as increased management flexibility and simplicity;

Overall, important benefits are likely to be derived from using the technology, if it is made available in leading varieties adapted to Slovak agronomic conditions. Against a background of an increasingly open and competitive marketplace, both domestically and in export markets, application of this technology has the potential to make an important contribution to maintaining and enhancing Slovak competitiveness.

It is, however important to note that as weed and pest infestation levels and farm performance vary by farm and year, so will the impact of using GM technology. Some farmers may not derive benefits from using the technology, in some years. The analysis of impact on farm performance does, however suggest that <u>most</u> farmers stand to benefit financially from using the traits examined.

[2] These impacts on profitability assume average yields. For above average performing growers who may achieve yields of in excess of 10 tonnes/ha the profitability gains (and hence incentive to use this technology) are likely to be more significant. For example, the adoption of Bt maize resistant to the European corn borer would potentially lead to gross margin profitability increases of between €59/ha and €103/ha for a producer with a baseline yield of 10 tonnes/ha (compared to €31/ha to €61/ha for the average performer)

Table 2: Potential commercial farm level impact of using GM technology (per hectare) on grain maize and sugar beet in Slovakia (2012 and beyond)

	Herbicide tolerant (grain) maize	Insect resistant (grain) maize	Herbicide tolerant sugar beet
Yield	No expected impact: possibly small improvement up to +2.5%	+10% to +14.7% where economic losses currently incurred	+18%
Variable costs of production	A decrease of between 1.9% and 5.5% from lower costs of herbicides	An increase in variable costs of 11% (the seed premium for the technology being greater than any costs savings from reduced insecticide use)	A decrease of between 17.6% and 21% from lower costs of herbicides
Gross margin profitability	+1.7% to +9.5%	+8.9% to +17.5% GM IR targeting the corn borer and +16.1% to +25.6% GM IR targeting corn rootworm	+56% to +60% relative to expected post reform levels of profitability
Other impacts	Increased management flexibility and better weed control	Increased management flexibility, reduced production risk, lower levels of mycotoxins	Increased management flexibility and better weed control
Possible adoption % (in terms of total grain maize crop)	45%	33% for GM IR targeting the European corn borer, 5,000 ha for GM IR targeting corn rootworm	65%
National level impact on farm income (baseline 2006)	+0.94 to +1.687 million euros	+1.51to +3.03 million euros: GM IR targeting corn borer +0.27 to +0.44 million euros: GM IR targeting corn rootworm	+5.4 million (+9.5 million if based on 2004-05 prices)

Sources: Based on data used in Demont et al (2006), Brookes (2002 & 2005b), NCFAP (2003), Bonis et al (2005), Szell et al (2005) and drawing on conventional farm income data in Brookes (2007), which itself draws on data from the Slovak Institute of Agricultural Economics (VUEPP)

Notes:

1. GM maize traits: GM HT (to glyphosate) and GM IR to the European Corn Borer and Corn Rootworm
2. Yield gains for GM IR crops based on Demont (2006), commercial crop monitoring in Slovakia in 2006, trials and commercial crop reporting in the Czech Republic in 2005/2006 and Rice (2004)
3. Cost of the technology (charged as a seed premium) based on Demont et al (2005) and/or cost currently charged in Slovakia (for GM IR maize targeting the ECB) and Brookes and Barfoot (2005). For further details see Appendix 3
4. Impact on costs of insecticides and herbicides, based on Demont et al (2005 and 2006), Brookes (2002 & 2005b), NCFAP (2005) and Rice (2004): see Appendix 3
5. Adoption levels GM IR maize targeting the corn borer 33%, GM IR maize targeting corn rootworm 5,000 ha by 2012 (currently 1,000 ha affected), GM HT maize 45% and GM HT sugar beet 65%

Implication of not using GM technology: servicing non GM markets

A constraint often cited to the adoption of GM technology in Europe relates to whether a sufficiently large market exists for GM maize and sugar beet and what might be foregone in terms of possible loss of sales into markets that require certified non GM crops?. Whilst there is a current market segment that requires certified non GM maize, it is important to recognise the following points:

- finding outlets for GM derived maize crops is likely to be fairly straightforward, especially in the feed sector. This sector accounts for 78% of total grain maize usage in the EU 25, and 85%-90% of this usage has no requirement for non GM maize;
- current non GM markets account for a minority of uses and are found mostly in the human food sector. In these markets, quality is an important criteria influencing sources of supply and usually requires supplies to be fully traceable. Servicing this market requires investment in quality assurance and traceability systems, an aspect of competition that the Slovak maize sector probably lags behind most of its EU counterparts;

- over the next few years, the distinct market for non GM maize and derivatives is expected to decrease in size;
- marketing to the non GM maize market should be approached in the same way as looking to supply any market segment. To be successful, suppliers need to be competitive;
- currently maize from the central and eastern European new member states struggles to compete in the EU 25 maize market regardless of whether its maize is GM or not. The most important export markets in Europe are within the feed sector where price is the most important factor influencing buying decisions and where GM derived ingredients are widely used. In the Spanish market, central and eastern European maize has to compete on price with both EU origin maize and imports, including GM maize from Argentina. This highlights the importance of price competitiveness with both non GM and GM derived maize. It also re-enforces the current poor competitive position of central and eastern European maize relative to other sources of supply in that transport subsidies have had to be provided by the EU Commission in order to facilitate the sale of Hungarian maize stocks held in intervention stores onto the Spanish market in 2005;
- there have been no price differentials between GM and non GM ‘equivalent’ crops at the farm level in most GM growing countries. For example, in Spain the farm level price of GM and non GM maize has been the same each year since 1998 when GM maize was first planted. Sometimes small price differentials in favour of non GM maize have developed (eg, 1% to 2% in favour of non GM) but these have been post farm level and largely reflect any additional costs associated with segregation, testing and certifying the non GM status of supplies to buyers. Consequently, farmers are unlikely to realise any price premia for producing non GM maize.

In relation to any non GM sugar market developments, this market will largely be determined by the attitude of EU sugar beet processors. Post 2008/09 when duty free sugar from least developed countries can enter the EU, and the sugar policy reforms begin to impact on the EU production base, processors are likely to look to the EU production base to be as price competitive as possible. It is therefore possible that a GM share of domestic EU sugar beet production will develop (as farmers take advantage of the productivity enhancing impacts of the technology), most likely focus initially on servicing new non food market opportunities (notably bio-ethanol)) where the GM versus non GM origin of raw materials will probably be of limited relevance.

1 Introduction

Currently, a limited area of commercial genetically modified (GM) crops is planted in Slovakia[3]. In the next few years, this GM trait plus some others may become available to Slovak arable farmers, if products are brought through for regulatory approval, the approvals are received and seed companies develop varieties containing these products suitable for Slovakia. The traits most likely to become available first are herbicide tolerant sugar beet and maize and insect resistant (Bt) maize (resistant to the European corn borer and the corn rootworm).

This paper examines the key drivers for maintaining competitiveness in the global and European maize and sugar markets up to 2013 and the possible role and impact of using genetic modification (GM) technology in the maize and sugar beet sectors to maintain/enhance Slovak competitiveness.

The work is based on desk research/analysis of relevant current/recent global and European markets, and economic data, including published forecasts of likely market developments from bodies such as the United States Department of Agriculture (USDA) and the European Commission.

The paper[4] is structured, after this introduction, as follows:

- Section 2: current features of the global and European markets for maize and sugar, including an overview of the nature of market differentiation between products derived from GM and non GM maize (and sugar)
- Section 3: likely future direction of relevant world and EU markets to 2012/13
- Section 4: issues affecting current and future competitiveness for EU producers
- Section 5: the possible role and impact of using GM cost reducing technology and the implications of not using GM technology.

2 Current global and EU market features

2.1 Maize

2.1.1 Production and consumption

Global maize production and consumption in 2005/06 were about 684 and 685 million tonnes respectively (Table 3). The main usage is as animal feed (68%), with the equivalent of about 11% of global production exported/traded onto world markets[5].

Table 3: World maize supply and usage 2005-06

Area (million hectares)	144.2
Average yield (tonnes/ha)	4.74
Production (million tonnes)	684
World trade (million tonnes)	74.3
Total consumption (million tonnes)	685
Consumption as feed (million tonnes)	*463.5*
End stocks (million tonnes)	130.9

Source: USDA 2006

[3] 30 hectares of insect (European corn borer) resistant (Bt) maize planted in 2006

[4] The authors acknowledge funding for the research came from Monsanto Europe SA. The contents of the paper are, however the independent and objective views of the authors and have not been influenced by Monsanto – this was a condition of undertaking the work

[5] Maize is an important subsistence crop in many parts of the world and hence the majority of production is consumed within the country of production

2.1.2 EU production and usage

In 2005, the EU 25 planted about 10.74 million hectares to maize of which 6 million hectares (56%) were grain maize and the balance forage maize. Total production of grain maize was about 50 million tonnes. Within this the leading producers were France, Italy, Hungary, Spain and Germany with 13.2, 10.5, 9.1, 3.7 and 4 million tonnes respectively in 2005[6].

In terms of usage, the EU 25 consumed 48.7 million tonnes of grain maize (Table 4), of which the majority (77%) is used as an animal feed source. Starch and sweetener production accounts for about 14% of total usage and other food uses for about 5%. The vast majority of maize is derived from domestic EU production with imports (mostly into Spain and Portugal) amounting to only 2.6 million tonnes, equal to about 5% of total consumption. The main source of imported maize is South America, with Argentina being the primary supplier. The limited share of imports in the EU market partly reflects the level of protection imposed on maize imports into the EU (currently equal to about €55-€60/tonne) which effectively makes imported maize uncompetitive with domestically produced maize (see Appendix 1 for further details about the import regime). The primary usage sector of imported maize is the animal feed sector, for which (low) price is the key factor of influence for determining sources of supply.

Table 4: European Union (25): key grain maize supply and usage features 2005-06 (million tonnes)

Opening stocks	5.0
EU production 2005	49.2
Imports	2.6
Supply availability	56.80
Usage	48.7
Animal feed	37.4
Starch & sweeteners	7.0
Other food uses	2.6
Seed & waste	1.6
Exports	0.15
Closing stocks[7]	8.05 (including in intervention)

Sources: Strategie Grains, EU Commission, Coceral

In Slovakia, domestic production of grain maize was about 1 million tonnes in 2005 and total usage was 0.83 million tonnes. The main usage sector was animal feed which accounted for about 0.32 million tonnes usage. Human food and starch usage was around 0.23 million tonnes and exports were also approximately 0.23 million tonnes. In the 2005-06 marketing year about 0.42 million tonnes of maize were sold into public intervention storage. Imports were very low at less than 50,000 tonnes in 2005/06 (4,000 tonnes in 2004/05).

2.2 Sugar beet

2.2.1 Production and consumption

World sugar production in 2005-06 is forecast to be about 144.2 million tonnes (raw value) compared to 140.9 million tonnes in 2004/05. About a third of this production is annually traded on world markets.

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[6] Sources: European Commission, Strategie Grains and Coceral

[7] Includes about 2 million tonnes in intervention

2.2.2 EU production and usage

In 2004-05 the EU 25 produced about 20 million tonnes of raw sugar. This was produced by about 325,000 farms on 2.2 million hectares (1.8 million in the EU 15). 95,000 of these farmers were located in the ten new member states. In the global context, the EU 25 accounts for 14% of total production, 12% of consumption, 12% of exports and 5% of imports. In recent years the EU's share of global production, consumption and trade has declined, mainly because of increasing levels of production in southern hemisphere countries (notably Brazil) and a general increase in the level of global consumption.

France, Germany and Poland are the largest producers accounting for about half of total EU 25 sugar production (23%, 21% and 10% respectively of total production), followed by Italy and the UK (6.5% and 6% respectively).

In Slovakia, 2004-05 sugar production was 233,000 tonnes (raw) of which about 207,000 tonnes was produced under A and B quota[8].

Sugar support policies play a significant role in influencing the production and trade in sugar in the EU. The EU's sugar regime is highly protectionist and has controlled production largely through the use of production quotas operated at both a national and farm level. The domestic EU sugar market has traditionally been protected from competition from third country imports through the use of import duties, and hence almost all of the sugar imports into the EU derive from African, Caribbean and Pacific countries which have annual duty-free access to the EU market for 1.6 million tonnes of raw sugar.

2.3 Prices

2.3.1 Maize

Recent trends in the price of maize on global markets and within the EU are shown in Figure 1. This highlights:

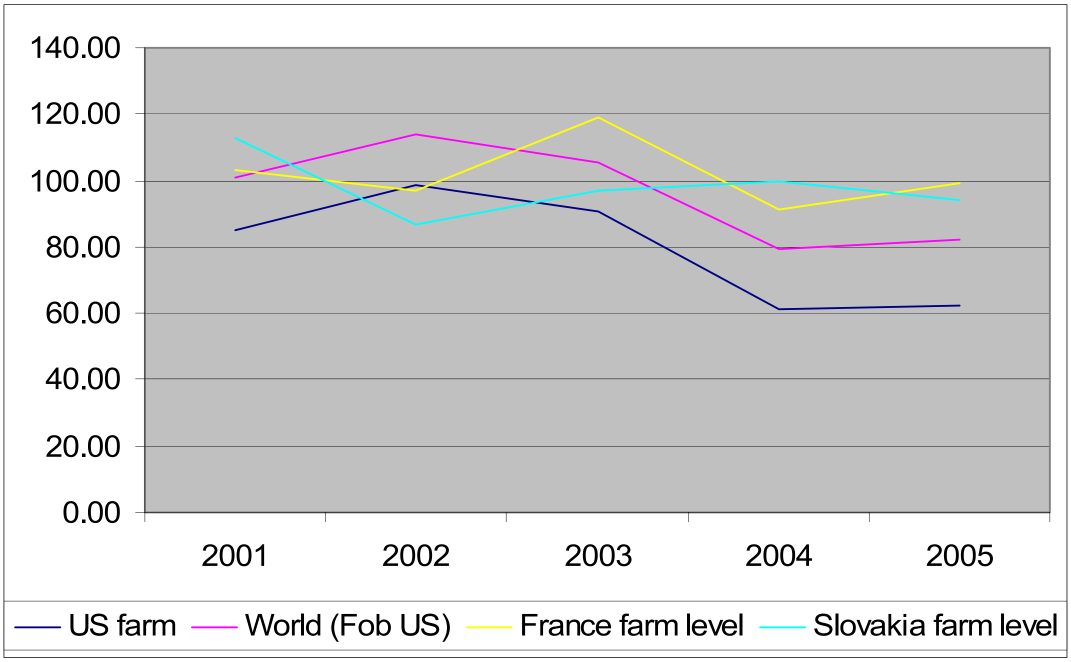
- the fluctuating nature of both global and EU maize prices;
- EU farm level prices have been about 20% higher than US and Argentine farm level equivalents in the last five years and about 3% to 5% higher than world market levels[9]. This fairly close relationship of EU prices with world market prices largely reflects the increasing 'openness' of the EU grain market and the need for EU prices to reflect global price levels, if exports of grains are to be facilitated without the need for export subsidies[10];
- Average Slovak farm prices having been a little below average farm price levels in France (the leading EU producer) since 2001 (by about 3% to 4%).

[8] In other words, 207,000 tonnes was produced within the direct support mechanisms of the EU sugar regime and the balance of about 26,000 tonnes was classified as C sugar that does not receive direct support payments

[9] Export basis (USA), which is the benchmark price for world maize market prices

[10] Which are limited by WTO commitments, both in value and volume terms

Figure 1: A comparison of world and EU maize prices 2001-2005 (Euros/tonne)



Sources: USDA, ONIC, Slovak Agricultural Economics Institute (VUEPP)

2.3.2 Sugar

The price of sugar beet in the EU is largely set by the operation of the EU's sugar regime. The minimum price payable to farmers for A quota sugar beet was been set (unchanged) for many years at about €47/tonne (for B quota it has been €32.42/tonne). At the processor level, the support price has been about €632/tonne of raw sugar. Relative to world market price levels the support price for sugar in the EU has been about three times higher than world market prices for traded raw sugar.

For new member states such as Slovakia, joining the EU has resulted in a significant increase in the (support) price received by farmers for growing sugar beet. For example, in 2003/04 the average price paid to sugar beet farmers was about €24/tonne compared to €47/tonne in 2005 (post EU accession).

2.4 GM versus non GM markets

2.4.1 The market for GM versus non GM maize

A distinct non-GM market began to develop in the EU in 1998 (for ingredients used in human food) and was extended to the animal feed sector from about 2000. It focused largely on soybeans/soy derivatives and, to a lesser extent, maize because these were the first two crops to receive import and use authorisations in the EU (before the introduction of the *de facto* moratorium).

Key features of the market development have been (Table 5):

- *In the human food sector, a switch to using alternative non-GM derived ingredients (e.g. the replacement of soy oil with sunflower or rapeseed oil*). This was relatively easy for a number of food products like confectionery and ready meals where possible GM derived ingredient incorporation levels were low (e.g. 0.5 - 1%). This course of action has been more difficult to take in the animal feed sector because of higher incorporation levels (eg, broiler feeds, where typical incorporation rates for soymeal are 20%-25%). This market development has, however mainly been associated with soy usage rather than maize usage;

- *If the GM crop or derivative could not be readily replaced, non-GM derived sources of supply were sought*. For maize, this was relatively easy and focused on domestic EU origin sourcing. The need to initiate identity preserved (IP) supply lines has been limited because of the absence of GM maize material in the vast majority of EU supplies. Only in Spain (where over 50,000 hectares of GM IR maize have been grown annually in the last two years) has a (potential) need for greater attention to segregation/IP been relevant. However, the majority of GM IR maize grown in Spain is concentrated in a few regions and is supplied to the local animal feed compounding sector, where there is little demand for non-GM ingredients. Nevertheless, where some buyers (eg, the starch industry) located in the main GM growing regions have requirements for certified non GM maize (sometimes with a maximum threshold for GM adventitious presence of 0.1%), no difficulties in sourcing this non GM material from local supplies have arisen;
- *GM derived crop ingredients have largely been removed from most products directly consumed (by humans)*. The user sectors requiring certified non GM maize represent a minority, with the feed sector being the primary user of maize (79% of total use[11]). Overall, about 23%-27% of total current demand for maize in the EU-25 (10.81-12.68 million tonnes is probably required to be certified as non-GM;
- *as non-GM maize accounts for 97%-98% of EU maize supplies[12], the development of a clear GM and non-GM derived maize market has been less marked than in the market for soybeans and derivatives*. Where users of maize (notably in the food and starch sectors) have specifically required guaranteed non-GM maize (to a threshold of 0.9% or sometimes to 0.1%), price differentials have tended to be in the range of 0% to 2% (ie, non GM maize prices have been the same or marginally higher than GM maize prices). These price differentials have been post farm-gate with no price differential at the farm level;
- *any additional cost burden of supplying non-GM ingredients has largely been absorbed by the supply chain up to the point of retailers* (ie, the cost burden has fallen on feed compounders, livestock producers and food manufacturers and has not been passed on to retailers and end consumers);
- *any price differential that has arisen has been mainly post farm gate*. At the farm level in countries where GM crops are widely grown, there has been and is currently very little development of a price differential. In respect of soybeans in Brazil (the focus of non-GM supplies of soybeans), there has, to 2005 been no evidence of a non-GM price differential having developed. In the US and Canada, the farm level price for non-GM supplies has tended to be within the range of 1%-3% higher than GM supplies, and this level of differential in favour of non-GM crops has had little positive effect on the supply of non-GM crops (ie, GM plantings have continued to increase, with the price differential being widely perceived to be an inadequate incentive for most farmers to grow non-GM crops like soybeans). In the EU maize market, there has been no noticeable farm level price differential between GM and non GM origin maize.

Table 5: Estimated GM versus non-GM maize use 2005 in the EU 25 (*million tonnes*)

Product	Market size	Non GM share	Non GM share (%)
Maize			
Food & starch	9.6	6.72	70
Feed	37.4	3.74-5.61	10-15
Seed	0.5	0.35	70
Total	***47.5***	***10.81-12.68***	***23-27***

Source: derived from PG Economics and Strategie Grains

[11] The balance is accounted for by seed

[12] The GM share comes from Spanish production of about 0.6 million tonnes (2005) and annual imports of between 0.6 and 1.4 million tonnes from Argentina

Note: The non GM share refer to the proportion of usage required to be certified as non GM. A much higher proportion of actual usage is non GM, although for many buyers (especially in the animal feed sector) there is no requirement for the maize supplied to be certified as coming from a non GM origin.
The range for the estimated share of non GM demand in the animal feed sector reflects the broad range of views and limited research in the sector

Overall, current EU requirements for non-GM ingredients of maize (ie, where buyers actively request that supplies are certified as being non-GM) accounts for about 23% to 27% of total maize use.

At the global level, it should be noted that the leading exporting nations of maize are countries which grow GM maize (the US, Argentina, South Africa and Canada), with these GM growing countries accounting for over 80% of global trade. Assuming that the proportion of production in these countries that was GM in 2005 is also exported, then 45% of globally traded maize was GM, although if it is assumed that there is no active segregation of exported maize from these countries into GM versus non GM product (ie, exported maize is likely to comprise a mix of both GM and non GM maize) then the GM share of global exports can reasonably be expected to have been over 80% in 2005. As there has been limited development of a GM versus non GM maize market (mostly in the EU, and to a lesser extent in Japan), which has necessitated some segregation of exports into GM versus non GM supplies, the likely share of global trade accounted for by GM maize exports is within the range of 45% to 80% plus, but closer to the higher end of this range.

2.4.2 The market for GM versus non GM sugar
As no GM sugar beet (or cane) has been commercially grown anywhere in the world to date, there has not been any distinct GM versus non GM sugar market developments. In the EU, most sugar beet processors have indicated that they would not wish to buy in GM sugar beet for use in food products if it was available.

3. Markets in 5-7 years time (2011-2013)

This section examines the likely future developments in the global and European maize and sugar markets to the period 2011 to 2013.

3.1 Maize

3.1.1 General maize market developments to 2011-2013
This sub-section draws on annual forecasts made by organisations such as the USDA, the EU Commission, OECD and FAPRI – the latter two of which are summarised in the latest EU Commission analysis of 2005 (see references). The material presented gives a perspective of possible future developments based on specific sets of assumptions and circumstances[13]. The forecasts therefore represent one possible long term outcome to 2011-2013 that presumes a continuation of current support and trade policies and no major weather or political shocks.

Demand
Population growth, continued urbanisation, rising real incomes and associated increases in levels of meat consumption (of between 1% and 1.3% annually), particularly in developing countries (notably China, Latin America, North Africa and the Middle East) are expected to be important drivers of higher levels of demand for feed grains on a global basis over the next 7 years (eg, global demand for coarse grains is forecast to increase by between 8.5% and 10.2% to 2011: source EU Commission 2005).

[13] It is not possible to provide a comprehensive view of all macroeconomic and policy assumptions adopted by each of the forecasting organisations. These can be found in the documents highlighted in the references

As maize is the most important feed grain traded in international markets (78% of the total), global trade in maize is therefore expected to increase by between 15% and 30% (+11 and +22 million tonnes) by 2011.

Supply
The additional demand for coarse grains is expected to be met by between a 9.3% to 10.5% increase in global production by 2011 (source: EU Commission). The supply is expected to be provided through a combination of additional domestic production in most maize growing countries and increased export-oriented production in the US and Argentina. For example, the 2006 USDA forecasts put US maize production rising from about 280 million tonnes in 2005/06 to 313 million tonnes in 2012/13 and US maize exports increasing from 51 to 58 million tonnes (+14%) over the same period. The USDA also forecasts maize exports from Argentina increasing from 11 million tonnes in 2004/05 to 15 million tonnes by 2012/13.

Prices and stocks
Global cereal stocks fell significantly in the period 2001-2003 (for coarse grains from about 190 to 120 million tonnes) and are expected to remain at this level for the next few years. Combined with the projected global increase in cereal demand referred to above, the stock to use ratio is expected to remain fairly low, maintaining an upward pressure on world cereal prices over the period to 2012/13. Thus world maize prices (basis US export prices from the Gulf of Mexico) are projected to rise from current levels of about €79/tonne to between €87/tonne and €93/tonne[14].

3.1.2 EU maize market developments to 2011-2013

General
Drawing on the EU Commission's maize market projections to 2012[15] that take into account the 2003 CAP reforms and the impact of enlargement, EU 25 production is forecast to be about 55.1 million tonnes in 2012, compared to current production levels of 49.2 million tonnes. Consumption is forecast to be 55.5 million tonnes in 2012 relative to current levels of 48.76 million tonnes. This increase in consumption is predicted to largely come from additional demand in the animal feed sector.

Within the new member states, the Commission forecasts that production will stabilise around the 12-13 million tonnes level, similar to 2004/05 levels (production is forecast to decline to about 49 million tonnes between 2006 and 2008 before recovering to 12-13 million tonnes by 2012). In the short to medium term high transport costs and the lack of important storage facilities are expected to continue to be significant limiting factors in the development of the competitiveness of new member states and their access to EU domestic and/or world markets. This should constrain any additional expansion in production (in excess of the increase forecast), mainly because relatively low price levels and price volatility are expected to remain key factors of influence. With increased investment in transport and storage infrastructure, improved competitiveness and greater price stability are expected in the medium to long term.

Consumption of maize in the new member states is predicted to increase from about 8.6 million tonnes in 2004 to between 9 and 9.5 million tonnes by 2012, with feed maize benefiting from increased substitution of barley in total feed demand. Accession is forecast to lead to a general expansion of markets, with production, consumption, imports and exports all increasing. The additional trade is expected both within the EU 25 and to third countries.

[14] Sources: FAPRI & OECD – based on US dollar forecasts of $107-$114/tonne converted to euros at the average 2004 exchange rate of 1 euro = 1.225 dollars
[15] Source: EU Commission (DG Agriculture: 2005) Prospects for agricultural markets in the EU. See appendix 2 for details of key assumptions underpinning this analysis

Slovakia, although a relatively minor producer and consumer (compared to countries such as France and Hungary) is likely to continue to be an exporter. Maize production is expected to increase modestly in line with the expected increase in production across the new member states (about 5%-10% to 2012).

The main factor not taken into account in the forecasts presented above relates to possible commitments negotiated as part of the next WTO trade round of agreements. Whilst it is not possible to ascertain the details, the nature of principles so far agreed and the general thrust of the negotiations point to:

- Elimination of export subsidies;
- Additional reductions in the level of import protection;
- Additional reductions in the overall level of agricultural support.

In the context of the EU maize market, this suggests an even more ‘open’ domestic EU market in which EU maize producers will find additional import competition and influence of world market price changes. The phasing out of export subsidies will also contribute to ensuring that EU cereal prices are in line with world market prices.

3.1.3 The future GM versus non GM maize market

How these market segments for maize will develop will be determined by how the balance of supply and demand for each category of product changes.

Summary of the current market

As indicated above, the development of distinct markets for GM versus non-GM maize has been much less marked in the EU than the market for soybeans, due largely to the virtual self sufficient nature of the EU market for maize (as distinct from soybeans/derivatives, which are much more dependent on imports):

- Consumption is mostly derived from EU origin maize, of which 98% was non-GM in 2005. As such, sourcing non-GM maize has not been difficult and possible concern about GM adventitious presence being found in non-GM maize supplies has largely been confined to some parts of Spain, where GM maize has been grown. Here, the GM maize has mainly been sold for use into the animal feed sector. Those users requiring certified non-GM maize (mostly the food using sector, including the starch sector) have not experienced difficulties in sourcing non-GM material even in the regions where GM IR maize production is concentrated. Price differentials, where they have arisen, have only been between 0% and 2% (ie, the same or marginally in favour of non-GM maize);
- Regarding maize imports, of the 2.6 million tonnes of maize that the EU annually imports, the majority of this has been for use in the feed industry (mostly in Spain and Portugal) where there has been no requirement for certified non-GM material. As such, a significant proportion (eg, about 60%) of these imports has consisted of GM maize from Argentina. The primary category of maize imports with a certified non-GM requirement has been flint maize (mostly imported from Argentina) used in the manufacture of breakfast cereals. As GM traits have not been available in this specialist maize, accessing non-GM flint maize has not been a problem;
- Lastly, the EU animal feed sector annually uses 5-7 million tonnes of imported maize gluten (a by-product of starch manufacturing). These imports are almost all sourced from the US and hence likely to be derived from GM maize (or from non-GM maize that has been mixed with GM maize prior to processing). To date, the use of this GM-derived ingredient in animal feed has not led to any significant development of a GM versus non-GM maize gluten market because the main livestock product sectors in which a demand

for non-GM derived protein feed ingredients has developed (fresh poultry and eggs) do not traditionally use maize gluten in rations[16].

The future market

Our analysis of current non-GM supply availability, trends in plantings to GM versus non-GM maize (globally and separately in the EU) and the approvals process for growing GM maize in the EU, suggests the following:

- Currently, the EU allows the importation and use of several types of GM maize and its derivatives. In the next 2-3 years, it is expected that additional import approvals will be forthcoming. In addition, there is likely to be continued expansion of the global area planted to GM maize, further increasing the share of globally traded maize (and derivatives) accounted for by GM cultivars. The net effect will be increased availability of GM maize/derivatives and decreased availability of non-GM maize/derivatives. Those wishing to procure and use non-GM maize and derivatives are likely to find limited, additional difficulty in accessing certified non-GM sources of supply. As a consequence, the differential between GM and non-GM maize prices traded on global markets may increase but will probably continue to remain fairly small (0% to 2%).
- Domestically, the EU has already approved the planting of GM IR maize. Over the next 2-3 years, plantings of this maize are likely to see modest increases from the current baseline of 50-60,000 ha, as additional plantings occur in Spain, and some small scale plantings occur in other EU member states, as national/regional level co-existence arrangements are finalised. However, by 2008, the vast majority of EU maize is still likely to be non-GM, and therefore accessing supplies of certified non-GM maize and derivatives from within the EU is not likely to be problematic. Price differentials between GM and non-GM maize/derivatives may increase marginally (reflecting an increased need to check the non-GM status and to ensure segregation) but can be expected to remain no higher than 1% to 2%;
- Beyond 2008, we expect the levels of EU consumer opposition to GM technology to recede slowly compared to current levels. In effect it is likely that there will be a 'trickle effect' relating to GM acceptance, with opposition levels declining slowly as each year passes. This may occur as a result of greater levels of awareness and understanding of the technology and in particular recognition, from empirical studies of the environmental benefits, associated with reduced pesticide use and reduced greenhouse gas emissions. In addition, crops containing GM quality traits are likely to become commercially available by 2010 – these latter innovations being ones that consumers can much more readily associate with direct benefits. As a result of decreasing opposition to GM technology *per se,* we perceive that the market segment based on demand for non GM maize and derivatives will decline to a fairly small, niche element, akin to the current organic market segment[17].

3.2 Sugar beet

3.2.1 General sugar market developments to 2010

There is limited availability of annual forecasts made by any organisations about the likely future in world sugar markets. Forecasts by LMC International for 2009/2010 put world production of raw sugar at 161 million tonnes (a 7.8% increase relative to 2005). Over the same period, world consumption of sugar is forecast to increase by 7.6% to 159.6 million tonnes.

[16] The main feed user sector of maize gluten is the dairy sector. Demand for use non-GM derived protein ingredients in the dairy feed sector has been very small and hence any move away from the use of maize gluten as a feed ingredient because of its probable GM origins has also been minimal

[17] It may well, by 2012 become a part of the organic market niche

3.2.2 EU sugar beet markets 2011 to 2013

The future nature and direction of the EU market for sugar is likely to be significantly influenced by the recently agreed reforms to the EU sugar regime.

The reform of the EU sugar regime sees a 36% cut in the support price for sugar (and the minimum price paid to farmers) over four years beginning in 2006/07. This will effectively result in the price received by farmers falling from about €47/tonne for A quota sugar to €30/tonne. For sugar processors the support price will fall from €632/tonne of raw sugar to €404/tonne. Farmers also receive compensation equal to 64.2% of the price cut in the form of additional aid in the single farm payment[18].

The EU Commission has undertaken analysis of the possible impact of these reforms. The key findings are:

- The average price likely to be received by farmers for sugar beet post reforms will be €25-€28/tonne. At this level of price, the Commission estimate that sugar beet production will no longer be viable for farmers in some regions (notably Finland, Greece, Italy and Spain ie, the estimated average break-even price at which level sugar beet becomes less profitable than competing crops such as cereals and oilseeds is higher than €25-€28/tonne). In new member states such as Slovakia, this price level is broadly similar to the prices received by farmers prior to EU entry and suggests that for Slovak farmers, sugar beet would continue to be an attractive crop relative to alternative cereal or oilseed crops;
- The Commission's analysis of the combining profitability for farmers and processors (comparing average sugar processing costs and field production costs), estimates that sugar production in Slovakia post reforms falls into a 'border zone' categorisation. In other words, the analysis estimates that the breakeven level for sugar production is likely to be close to the forecast post reform price of just over €400/tonne for raw sugar. This implies that sugar production is likely to be maintained in Slovakia in the long term but possibly at a reduced level relative to 2006. These issues are examined further in section 4.

Overall, at the EU 25 level, the post reform 2012/13 sugar supply balance is forecast to be consumption at roughly the same level as 2006 (about 16 million tonnes), EU production will be 12.2 million tonnes (16.7 million tonnes at present) and imports forecast to rise from 2.3 million tonnes (2005) to 3.9 million tonnes. Exports are forecast to fall from 3.1 million tonnes in 2005 to 0.4 million tonnes in 2012/13.

3.2.3 The future GM versus non GM sugar beet

As indicated above, there has not been any distinct GM versus non GM sugar market developments. In the EU, most sugar beet processors have indicated that they would not wish to currently buy in GM sugar beet for use in food products if it was available. The oligopolistic nature of the EU sugar processing sector and its influence over sugar cropping is likely to continue to stall any GM crop planting on a significant basis in the near future, although a change in attitude post 2008/09 may occur as duty free sugar from least developed countries enters EU and domestic growers & processors seek to compete with imports. It is therefore possible that a GM share of domestic EU sugar beet production will develop post 2008/09. This is most likely to focus initially on servicing new non food market opportunities that may well develop (notably bio-ethanol)) where the GM versus non GM origin of raw materials will probably be of limited relevance.

[18] This may be payable directly to sugar producers or distributed to all farmers in each member state according to how each member state has chosen to implement the single farm payment mechanism

4 Competitiveness issues

4.1 Recent trends in production

a) Maize
The area planted to grain maize in the EU 25 has increased by 17% since 1995. This represents an increase in plantings of 0.9 million hectares and compares with a 5% increase in wheat plantings (+1.1 million hectares) and an 8% decrease in the area planted to barley (-1.1 million hectares: see sub-section 4.2 for a discussion of reasons for these changes). Within the current area, about 0.8% (63,000 hectares in 2006) was planted to GM IR varieties.

The increase in maize plantings across the EU 25 has occurred both within the EU 15 (+5%) and the maize growing new member states, where the largest increases in plantings have occurred in Poland, Hungary and the Czech Republic. In Slovakia, the maize area has increased by 23% since 1995 (+28,000 ha).

b) Sugar beet
The area planted to sugar beet in the EU 25 has fallen by 22% since 1995. This represents a decrease in plantings of 0.6 million hectares and compares with increases in wheat and maize plantings and a decrease in the area planted to barley.

The decrease in sugar beet plantings across the EU 25 has occurred both within the EU 15 (-20%) and the sugar beet growing new member states (-29%). The largest planted sugar beet areas in the new member states are found in Poland (nearly 300,000 ha or 60% of the total new member state plantings in 2005). In Slovakia, the sugar beet area has fluctuated over the last 10 years between 30,000 and 40,000 ha.

The declining overall area planted to sugar beet in the EU largely reflects the influence over plantings of the EU sugar regime, which largely controls production through production quotas. As production levels have been broadly similar over the last ten years, with increasing levels of productivity, production levels have been maintained through decreased plantings.

4.2 Margins

This sub-section examines the profitability of growing grain maize and sugar beet in the main EU producing countries.

There are several key factors that influence farm-level profitability for a particular cropping system:

- Short term profit factors (eg, crop yield, output prices, input costs);
- Dynamic factors (short to medium term): these include impacts on subsequent crop yields due to current fertiliser use, weed control, tillage method, crop disease incidence;
- Sustainability factors (eg, pesticide resistance, soil degradation);
- Risk factors (eg, yield and price variability, system flexibility, farmer attitude to risk);
- Whole farm factors (eg, machinery capacity, finance availability and cost, labour, farmer objectives, knowledge and experience).

How these factors impinge on individual farmers ultimately determines the way in which farms and farming systems are used. Not surprisingly, due to variation in the above five factors, the economic performance of farms can vary widely, both between and within regions. Also, it is important to recognise that when considering different possible rates of application of farming inputs to a crop, there may be a reasonably wide range of input levels either side of the 'economic optimum' that delivers profit levels that are only marginally different from that attained at the optimum. In other words, there can be a reasonable margin for error, and scope for flexibility in choosing input levels, without substantially reducing profits.

Against this background, Table 6 summarises and compares the average gross margins for grain maize, sugar beet and the other main cereal and oilseed crops in the leading EU producing countries of France, Italy, Spain, Germany, Poland, Czech Republic and Hungary plus Slovakia and Austria. This highlights the following key points:

- In France, maize has tended to be the second most profitable cereal crop after soft wheat. It also has had a lower level of average return than oilseed crops over the last four years. Sugar beet has consistently been the most profitable arable crop;
- In Italy, maize has been consistently the most profitable cereal or oilseed crop. The margins derived from maize, for most farmers, have been significantly higher than the returns derived from other cereal and oilseed crops. Profitability from maize growing has also been higher than for sugar beet;
- In Germany, soft wheat and maize have been the most profitable cereal crops. However, oilseed rape has been the most profitable of both cereal and oilseed crops. The returns from maize have been, on average, similar to returns from wheat, although the above average maize growers derive returns that are higher than above average wheat performers. Sugar beet has been the most consistently profitable arable crop;
- In Spain and Austria, maize and sugar beet have been the most profitable arable crops over the last four years;
- In Hungary, Poland, Slovakia and the Czech Republic, sugar beet has become the most profitable arable crop, followed by maize;
- The trend of increased plantings to wheat and maize in most parts of the EU (see section 4.1) is closely related to the level of (higher) returns derived from these crops compared to most alternatives, especially in the three new member states;
- The level of gross margins earned in the leading EU 15 countries is significantly higher than the average margins earned in the new member states. This derives from a combination of higher levels of support payments and higher levels of productivity (ie, higher average yields).

Table 6: Arable crop gross margins 2004/2005: in key maize & sugar beet growing member states (euros/hectare)

	Grain maize	Sugar beet	Soft wheat	Barley	Oilseed rape	Sunflower	Soybeans
Slovakia	393	1,171	341	399	245	255	N/a
Hungary	762-786	1,785-1,828	471-485	414-426	507-565	491-518	570-604
France	585	2,255	661	518	647	609	716
Italy	751	689	468	N/a	N/a	219	85
Germany	554	1,355	486	467	646	N/a	N/a
Spain	315 (dry), 788 (irrigated)	2,157	291 (dry), 513 (irrigated)	283	N/a	156 (dry), 359 (irrigated)	N/a
Poland	306	1,081	11	-17	254	N/a	N/a
Czech Republic	372	1,442	312	295	431	206	N/a
Austria	477	1,013	137	129	274	213	310

Sources: European Arable Crop Profit Margins 4th edition
Note: Gross margins include provision for variable costs of production and area payments for maize (and sugar beet in the new member states)

4.3 Future margins

4.3.1 The 2003 Mid Term Review (MTR) policy reforms and sugar reforms of 2005

The 2003 policy reforms provide the current base for EU support to the arable cropping sectors[19]. The 2005 sugar policy reforms are also of importance – this reform is also to be integrated into the broader arable sector policy changes initiated through the MTR.

The main policy changes implemented by the MTR reforms relate to decoupling and cross compliance. Since the reforms introduced in 2000, area payment rates have been largely set at a uniform level for most arable crops (supplements for durum wheat, rice and protein crops excepted). The MTR changes have largely decoupled these direct payments and made as a condition for receipt of payment, compliance with mandatory environmental standards (related to keeping all land in good agricultural and environmental condition and abiding by the specific requirements of 18 existing EU Directives and Regulations covering environmental protection, public, animal and plant health and animal welfare). De-coupling effectively means that farmers no longer have to plant crops in order to receive the direct payments, except for ensuring that the land on which the payments are made is kept in good agricultural practice.

All area payments are in the process of being replaced by a single decoupled payment (known as the single farm payment (SFP)), based on aids received in the 2000-02 reference period, with the exception of direct payments related to:

- Seeds;
- Up to 25% of arable crops (ie, member states can, if they wish, continue to production link 25% of arable crop direct payments), except durum wheat and rice where 40% (the supplement) and 75 euros/ha are respectively production linked;
- Decoupling does not apply to the energy crop aid, the protein crop supplement and support for flax and hemp.

Land on which decoupled direct payments are made is also not allowed to be used for growing fruit, vegetables or potatoes.

Modulation (reductions) of the above area payments can, however occur and the amount of SFP receivable by farmers will be subject to reductions from several quarters:

- Compulsory modulation: 3% in 2005 rising to 5% in 2007 (farms claiming less than about €5,000 annually will be exempt from this). This modulation money is to be used to fund additional rural development measures;
- Financial discipline: this is related to the EU budget limits for the period 2007-2013. Due to the costs of the latest EU enlargement (which increases as the new member states accede gradually to full support payments by 2013/2014: see below) and likely funding requirements for reforms in sectors like sugar (now completed), olive oil and wine, it is expected that additional cuts in the level of SFPs will be required each year from 2007. Drawing on EU Commission forecasts of developments in the main agricultural sectors over the period to 2013 and expected budgetary requirements, it is likely that an additional 5% minimum will be deducted in 2007 and this could increase further (towards 10%) by 2013. In addition, the requirements to fund the accession of Romania and Bulgaria, possibly from 2007, and their transition to adoption of the SFP mechanism will require to be funded. The adoption of the SFP system in these countries is estimated to require an additional €8 billion from the EU budget (after transition) and therefore it is possible that by the period 2010-2014, a further 5% modulation may be required from the EU 25 agricultural support payment budget;

[19] For the purposes of the legislation, arable crops include cereals, oilseeds, pulses and flax. It does not include potatoes and sugar beet

- Member State discretion to impose additional cuts in modulation (national envelopes) of up to 10% for the purposes of encouraging specific types of farming that are important for the protection of the environment or improving the quality and marketing of agricultural products. For example, these funds could be channelled into supporting specific types of farming (eg, organic), agri-environmental schemes or the production and marketing of higher quality products.
- Establishment of a national reserve of 3% (for dealing with cases of farmers which have undergone changes to ownership and size of farms during or after the base reference period of 2000-2002).

In total, this means that the level of reduction applicable to SFPs could be within a range of 5% to 33%. Given the almost inevitability that there will be cuts for financial discipline reasons, a likely level of compulsory cut across all member states by 2013 is 20%, with the scope for an additional 13% on a voluntary basis.

As indicated in section 3.2.2, the EU sugar regime is about to implement changes over the four year period 2006-07 to 2010-2011. This will result in the support price payable to farmers falling by 36%. Partial compensation for this price cut (equivalent to 64.2% of the price cut) is to provided via an addition to the single farm payment.

4.3.2 New member states accession to the full CAP

All of the new member states are in transition to adoption of the full payment levels of the SFP. This transition is scheduled for completion in 2013/14, when the level of SFP received should be based on the same (full) rates applicable in the EU 15 (Table 7). This implies that the level of support payments made available to farmers in the new member states is set to increase each year until 2013/2014 and points to increasing levels of farm income (in the absence of decreases in market prices or lower than average yields being obtained).

However, the expected levels of SFP receivable by farmers in the new member states during the latter years of transition are subject to some uncertainty and are likely to be fall relative to the full (expected) rates from 2010/2011 onwards. This reflects the complex nature of the rules relating to modulation and the new member states accession. More specifically, until the completion of the transition, the modulation rules applicable in the EU15 are not applicable in the new member states. However, the maximum amount of SFP payable in the new member states cannot, during transition, be greater than the levels of SFP payable in the EU 15, net of compulsory modulation and financial discipline cut backs.

From 2007, EU 15 member states are likely to be subject to at least a 10% compulsory modulation rate of their SFPs and this could rise to 20% by 2013. This suggests that by 2012 (and possibly by 2011), the level of SFP received in the new member states will have peaked and may subsequently fall as the costs of paying for the accession of Bulgaria and Romania increase during their ten year transition period.

Table 7: Transition payments to full SFP in most of the new Member States

Year	% of direct payments receivable
2004/05	25
2005/06	30
2006/07	35
2007/08	40
2008/09	50
2009/2010	60
2010/2011	70
2011/2012	80
2012/2013	90

2013/2014	100

Note: During the transition period, the new member states can top up the level of single farm payment from national resources, equal to a maximum of 30% of the full amount receivable in 2013/14. For example if the full single farm payment payable is €300/ha, then in 200/05 the transition payment payable from EU resources is €75/ha, with scope for new member states adding another €90/ha as a top up (ie, paying a total SFP in 2004-05 of €165/ha)

4.3.3 Impact of the MTR and sugar policy changes on maize, sugar beet and other arable crop margins

The key points to note relating to the impact of the MTR policy changes and EU enlargement on arable crop profit margins are that the levels of direct support payments (SFP) will probably decrease from 2007 resulting in decreased levels of gross margins in EU 15 countries (Table 8). Thus gross margins could fall by between 10% and 18% by 2013. However, in the new member states, margins are likely to increase during the early years of transition, before the financial pressures on the EU budget in the post 2011 period, lead to possible reductions in the level of support and crop margins. Despite this 'peaking' of support payments and gross margins in the period 2010-2012, the level of gross margin earned in 2013 (when modulation will fully apply) for maize will still be higher than 2004 levels by about 11% to 18% (Table 8: +17% in Slovakia).

Table 8: Impact on maize gross margins of the MTR policy changes: 2004 and 2013: €/ha (bracket figures = 2013)

	Area payment/Single Farm Payment	Gross margin
France	488 (390)	505 (407)
Germany	474 (379)	554 (459)
Hungary	155 (234)	786 (865)
Italy	544 (436)	735 (642)
Poland	114 (154)	306 (346)
Czech Republic	107 (176)	381 (451)
Spain	383 (306)	785 (708)
Slovakia	88 (192)	392 (458)
Austria	332 (266)	477 (411)

Source: derived from Brookes (2005) European arable crop profit margins 2004-05
Notes: 2004 prices, yields and costs are assumed for 2013, 2013 SFP based on 20% modulation. In 2004/05 direct payments to new member states equal to 25% of full post transition entitlement plus any national top-up

As the MTR policy changes primarily impact on the provision of direct support payments (the SFP), the increasing levels of modulation that are likely to occur will impact equally (in absolute terms) on all arable crop profit margins. Thus the underlying profitability levels of all cereals, oilseeds and pulses in the EU 15 can be expected to decrease by 2013 and the underlying profitability in the new member states to increase (until about 2010/2011).

In relation to sugar beet, the impact of the 2005 policy changes are summarised in Table 9. This highlights the significant negative impact on sugar beet profitability that will arise when the reforms have been completed by 2011. All of the leading producers of sugar beet are likely to experience decreases in gross margins of at least 50% to 60% compared to levels earned in 2004/05. For the producers in the new member states profitability levels will be broadly similar to those earned prior to EU accession. Relative to other arable crops, post reform sugar beet is still likely to be the most profitable arable crop in France and the Czech Republic. It is also likely to be one of the most profitable arable crops alongside maize in Slovakia and Hungary. In countries such as Poland and Austria maize is likely to be a more profitable crop.

Table 9: Impact on sugar beet gross margins of the 2005 policy changes: 2004 and 2013: €/ha (bracket figures = 2013)

	2004	2013
France	2,255	1,123
Germany	1,355	460

Hungary	1,828	955
Poland	1,082	339
Czech Republic	1,486	617
Slovakia	1,171	456
Austria	1,003	54

Source: derived from Brookes (2005) European arable crop profit margins 2004-05
Notes: 2004 prices, yields and costs are assumed for 2013, 2013 based on 36% price cut. Compensation for price cut, payable via SFP has been excluded

4.3.4 Other key factors of influence on future margins
With the policy changes referred to above (decoupling and reduction of support payments in the EU 15 and increase in level of support payments in the new member states), the primary factor of influence on farmers' planting choices will be the underlying profitability of different crops (excluding support payments). Thus the economics of production (costs of production relative to prices and yields) will become the most important driver of planting decisions.

This mix of factors of influence have been taken into account in the analysis of the likely direction of maize plantings and production in both the EU 25 and globally presented in section 3. This forecasts that EU 25 maize production is likely to be broadly similar in 2012/13 to current levels mainly because:

- Maize will continue to be one the most profitable cereal crops, especially in southern EU countries. Farm level response to declining general profitability levels in the EU 15 will be to focus more on the most profitable crops (like maize) and diverting additional (marginally profitable) land into voluntary set-aside. In the new member states focus is also likely to be more on the more profitable crops like maize, although compulsory set-aside requirements will constrain plantings from about 2009;
- The increasingly 'open' nature of the EU grain market will re-enforce the influence of world markets on the EU market, contributing to possible increased volatility of prices. This increase in the level of uncertainty and competitiveness may constrain the expansion of plantings, hence counter balancing the positive influence referred to above and therefore contributing to no significant change in the overall EU maize area forecast for 2011/2012.

In relation to sugar beet, the 2006-2011 reforms will result in the relative attractiveness of sugar beet as an arable crop declining in all countries, although it will continue to be one of the most profitable crops in a number of countries, including Slovakia. The limit on the production volume eligible to receive support will, however continue to constrain plantings and as has occurred in the last ten years, the area planted to sugar beet is likely to decline in future, partly as a result of the deteriorating relative levels of profitability and partly due to productivity enhancements being used by farmers which mean that production volumes can be maintained using a decreasing area planted.

4.3.5 Summary of influences on future margins
Overall, the key points of relevance for EU maize and sugar beet crop profitability over the period to 2012 are:

- The agricultural sector will be operating within a larger and more competitive internal EU marketplace;
- Levels of support for agriculture will be lower than at present in the EU 15. However, in the new member states levels of support will be higher than existed prior to accession. The receipt of direct aids will provide additional income and should lead to higher investment in agriculture, both in terms of fixed assets (eg, machinery, crop storage) and more efficient use of variable inputs (eg, new varieties and pesticides). As a result, levels

of technical performance should improve and an element of 'closing the productivity gap' with longer standing EU member states should occur over a number of years;
- The EU market will be open to increasing levels of competition from world markets. This will apply to all sectors;
- The EU agricultural market environment will probably be subject to greater variability in prices (reduced role of policy support mechanisms and increased openness of markets);
- New demand for crops in non food uses (notably bio-fuels) can be expected to increase across the EU. Agri-environmental schemes may become more attractive to some producers, especially if national governments choose to channel addition rural development funding from modulation into such schemes. Nevertheless, the main share of agricultural policy support will continue to be delivered via market measures and direct payments;
- In order to remain competitive in the EU marketplace, many producers are likely to increasingly explore all forms of new technology that can assist them (eg, through yield enhancement, cost reductions[20]) and ways of reducing production and price risk. Others may focus on higher value, niche product production, like organics, where cost is less of a market driver or on the production of 'care' goods (eg, environmental set-aside, membership of agri-environmental schemes that target the delivery of environment and landscape goods for the wider public). Lastly, some others may choose to exit from the sector.

5 The possible role of using GM cost reducing technology in maize and sugar beet, in Slovakia

Currently, only a small area of commercial genetically modified (GM) crops is planted in Slovakia. In the next few years, additional GM traits may become available to Slovak growers, if products are brought through for regulatory approval, the approvals are received and seed companies develop varieties containing these products suitable for Slovakia. Those most likely to become available first are, GM herbicide tolerant (HT) and insect resistant (IR) maize and GM herbicide tolerant (HT) sugar beet. Maize resistant to the European corn borer (ECB) already has EU-wide approval for planting and, seed containing this trait was planted on 30 hectares in Slovakia in 2006.

5.1 Potential impact of using GM technology at the farm level

Drawing on a review of literature (see references), including analysis which specifically examined the potential impact of GM technology in the Czech Republic (Demont et al (2006), recent analysis looking at the impact of the technology in Hungary and Poland[21], together with trial results in both Slovakia and the Czech Republic (of GM IR maize targeted at the ECB), Table 10 summarises the likely impact of using GM HT, GM IR maize, and GM HT sugar beet in Slovakia. The analysis assumes that GM technology is made available in leading varieties adapted to Slovak agronomic conditions and Slovak farmers are able to make choices about whether to plant GM crops according to technical and agronomic performance criteria and market requirements. As such, this assumes that co-existence conditions for the planting of GM crops in Slovakia are practical, proportionate and based on science.

The key points to note are as follows[22]:

[20] Including in the new member states, where despite the increases in levels of agricultural support, accession is likely to result in the real increases in the costs of land and labour inputs
[21] Brookes (2005b) and Demont et al (2005)
[22] For details of all assumptions used, refer to Appendix 3

- yield gains are likely from using GM IR technology where currently farmers experience economic losses from the European corn borer (ECB) and corn rootworm pests. Clearly the extent to which yield gains may arise will depend upon the level of pest infestation, which varies by locality and year. ECB is currently a problem for many farmers in Slovakia, whilst corn rootworm is a less prevalent pest (first detected in 2000 and by 2005 was causing economic damage to about 1,000 ha). Small yield gains may also arise from using GM HT maize. Important yield gains are likely from using GM HT sugar beet;
- The impact on the costs of production varies by trait used. Users of GM HT maize and sugar beet are likely to experience reduced levels of costs even after paying for the new technology. With regard to GM IR technology, some users may find that average variable costs decrease whilst for others costs increase (this will depend upon whether insecticides or seed treatments have traditionally been used to combat pest attacks or not);
- An increase in average gross margin profitability is likely to arise for users of GM HT maize of +€6/ha to +€33/ha (+1.7% to +9.5%). For users of GM IR technology (which currently suffer economic losses from the corn borer and rootworm pests) the gross margin gains are likely to be in the range of +€31/ha to +€61/ha (+8.9% to +17.5%) where the target pest is the ECB and +€56/ha to +€89/ha (+16.1% to +25.6%) where the target pest is the corn rootworm[23]. For users of GM HT sugar beet average gross margin profitability is likely to rise by between €344/ha and €368/ha (+56% to +60%). Clearly, the impact on profitability of using GM technology will vary according to the level of pest and weed pressure and the assumed price of the technology (in terms of a seed price premia). For some farmers the gains may be higher than these average values, whilst for others the gains could be lower (including a possible negative impact for some, if for example, the yield gains are less than the seed premia charged for the GM traits);
- At the national level the positive impact on farm income is likely to be between 8.12 and 10.6 million euros per year;
- The technology offers benefits to farms of all sizes. Small farms have been some of the most enthusiastic adopters of GM traits (eg, in Spain) due to their simplicity and very low capital costs. This is important in the Slovak context where there is a wide range of farm sizes;
- The technology offers additional intangible benefits such as increased management flexibility and simplicity.

Overall, the analysis of possible impact at the commercial farm level shows that important benefits are likely to be derived from using the technology, if it is made available in leading varieties adapted to Slovak agronomic conditions. Against a background of an increasingly open and competitive marketplace, both domestically and in export markets, and the recently agreed reforms to the EU sugar regime (which will significantly reduce sugar beet profitability levels), application of this technology has the potential to make an important contribution to maintaining and enhancing Slovak competitiveness.

Average performing Slovak maize and sugar beet growers that adopt the technology have the potential to gain more from adoption than their average performing EU 15 counterparts because they are starting from a lower average level of technical efficiency (eg, in terms of average levels of weed and pest control). Therefore they will potentially derive greater productivity (notably yield) gains. As such, the technology offers scope for accelerating the process of 'productivity catch up' post EU accession, enabling average performing Slovak producers to compete more

[23] These impacts on profitability assume average yields. For above average performing growers who may achieve yields of in excess of 10 tonnes/ha the profitability gains (and hence incentive to use this technology) are likely to be more significant. For example, the adoption of Bt maize resistant to the European corn borer would potentially lead to gross margin profitability increases of between €59/ha and €103/ha for a producer with a baseline yield of 10 tonnes/ha (compared to €31/ha to €61/ha for the average performer).

effectively, and earlier than they might otherwise have been capable of, if they did not use GM technology[24].

It is, however important to note that as weed and pest infestation levels and farm performance vary by farm and year, so will the impact of using GM technology. Some farmers may not derive benefits from using the technology, in some years. The analysis of impact on farm performance does, however suggest that most farmers stand to benefit financially from using the traits examined.

Table 10: Potential commercial farm level impact of using GM technology (per hectare) on grain maize crops and sugar beet in Slovakia (2012 and beyond)

	Herbicide tolerant (grain) maize	Insect resistant (grain) maize	Herbicide tolerant sugar beet
Yield	No expected impact: possibly small improvement up to +2.5%	+10% to +14.7% where economic losses currently incurred	+18%
Variable costs of production	A decrease of between 1.9% and 5.5% from lower costs of herbicides	An increase in variable costs of 11% (the seed premium for the technology being greater than any costs savings from reduced insecticide use)	A decrease of between 17.6% and 21% from lower costs of herbicides
Gross margin profitability	+1.7% to +9.5%	+8.9% to +17.5% GM IR targeting the corn borer and +16.1% to +25.6% GM IR targeting corn rootworm	+56% to +60% relative to expected post reform levels of profitability
Other impacts	Increased management flexibility and better weed control	Increased management flexibility, reduced production risk, lower levels of mycotoxins	Increased management flexibility and better weed control
Possible adoption % (in terms of total grain maize crop)	45%	33% for GM IR targeting the European corn borer, 5,000 ha for GM IR targeting corn rootworm	65%
National level impact on farm income (baseline 2006)	+0.94 to +1.687 million euros	+1.51 to +3.03 million euros: GM IR targeting corn borer +0.27 to +0.44 million euros: GM IR targeting corn rootworm	+5.4 million (+9.5 million if based on 2004-05 prices)

Sources: Based on data used in Demont et al (2006), Brookes (2002 & 2005b), NCFAP (2003), Bonis et al (2005), Szell et al (2005) and drawing on conventional farm income data in Brookes (2007), which itself draws on data from the Slovak Institute of Agricultural Economics (VUEPP)

Notes:

1. GM maize traits: GM HT (to glyphosate) and GM IR to the European Corn Borer and Corn Rootworm
2. Yield gains for GM IR crops based on Demont (2006), commercial crop monitoring in Slovakia (2006), trials and commercial crop reporting in the Czech Republic (2005/06) and Rice (2004)
3. Cost of the technology (charged as a seed premium) based on Demont et al (2005) and/or cost currently charged in Slovakia (for GM IR maize targeting the ECB) and Brookes and Barfoot (2005). For further details see Appendix 3
4. Impact on costs of insecticides and herbicides, based on Demont et al (2005 and 2006), Brookes (2002 & 2005b), NCFAP (2005) and Rice (2004): see Appendix 3
5. Adoption levels GM IR maize targeting the corn borer 33%, GM IR maize targeting corn rootworm 5,000 ha by 2012 (currently 1,000 ha affected), GM HT maize 45% and GM HT sugar beet 65%

[24] There are above average performing producers in Slovakia, many of which are found on larger than average sized farms that are as technically and economically efficient as leading EU 15 maize and sugar beet producers. For this category of Slovak producer, the 'productivity catch up' argument does not apply and the main benefit from adopting GM maize and sugar beet comes from the yield gains and cost savings that contribute to maintaining competitiveness

5.2 Implication of not using GM technology: servicing non GM markets

Whilst the analysis presented in section 5.1 above shows that technical and economic benefits are likely to arise for most Slovak maize and sugar beet farmers who adopt GM technology, an additional constraint often cited relates to whether a sufficiently large market exists for GM maize and sugar beet and what might be foregone in terms of possible loss of sales into markets that require certified non GM crops?. Whilst there is a current market segment that requires certified non GM maize, it is important to recognise the following points:

- finding outlets for GM derived maize crops is likely to be fairly straightforward, especially in the feed sector. This sector accounts for 78% of total grain maize usage in the EU 25, and 85%-90% of this usage has no requirement for non GM maize. The EU feed sector also currently makes widespread use of other GM derived ingredients, notably soymeal and the majority of animal feed sold in the EU is positively labelled as containing GM derived ingredients;
- whilst markets currently exist in which there are non GM requirements, these account for a minority of uses and are found mostly in the human food sector. In these markets, quality is an important criteria influencing sources of supply and usually requires supplies to be fully traceable. Servicing this market therefore requires investment in quality assurance and traceability systems, which is an aspect of competition that the Slovak maize sector probably lags behind most of its EU counterparts;
- over the next few years, the distinct market for non GM maize and derivatives is expected to decrease in size (see section 3.2.2);
- marketing to the non GM maize market should be approached in the same way as looking to supply any market segment. To be successful, suppliers need to be competitive;
- currently maize from the central and eastern European new member states struggles to compete in the EU 25 maize market regardless of whether its maize is GM or not. The most important export markets in Europe are within the feed sector in countries such as Germany, Greece, Slovenia, Austria and Spain, where price is the most important factor influencing buying decisions and where GM derived ingredients are widely used. In the Spanish market, central and eastern European maize has to compete on price with both EU origin maize and imports, including GM maize from Argentina. This highlights the importance of price competitiveness with both non GM and GM derived maize. It also re-enforces the current poor competitive position of central and eastern European maize relative to other sources of supply in that transport subsidies have had to be provided by the EU Commission in order to facilitate the sale of Hungarian maize stocks held in intervention stores onto the Spanish market in 2005;
- there have been no price differentials between GM and non GM ‘equivalent’ crops at the farm level in most GM growing countries. For example, in Spain the farm level price of GM and non GM maize has been the same each year since 1998 when GM maize was first planted. Sometimes small price differentials in favour of non GM maize have developed (eg, 1% to 2% in favour of non GM) but these have been post farm level and largely reflect any additional costs associated with segregation, testing and certifying the non GM status of supplies to buyers. Consequently, farmers are unlikely to realise any price premia for producing non GM maize.

In relation to any non GM sugar market developments, this market will largely be determined by the attitude of EU sugar beet processors. Post 2008/09 when duty free sugar from least developed countries can enter the EU, and the sugar policy reforms begin to impact on the EU production base, processors are likely to look to the EU production base to be as price competitive as possible. It is therefore possible that a GM share of domestic EU sugar beet production will develop (as farmers take advantage of the important productivity enhancing and cost reducing impacts of the technology), most likely focus initially on servicing new non food market opportunities (notably bio-ethanol)) where the GM versus non GM origin of raw materials will probably be of limited relevance.

Appendix 1: EU import arrangements

Due to the operation of the Common Agricultural Policy (CAP), EU imports of maize are subject to the imposition of import duties. These are set according to rules agreed as part of the 1995 Uruguay Round Agreement. Import duties are set on a variable basis that reflects differences between reference world prices for maize and what is known as a maximum duty paid import price – the maximum duty paid import price is set at a level equal to the intervention support price for maize in the EU plus 55% (set at the level of €157.03/tonne). The world reference price for maize is US yellow corn number 3, quoted on the Chicago Board of Trade plus an allowance for transport to Rotterdam.

On the basis of this mechanism the current/recent level of import duty applicable on maize imports into the EU is/has recently been about €55-€60/tonne.

Although the above mechanism applies to 'general' imports of maize into the EU, the majority (80% plus) of EU imports benefit from the existence of an import duty concession for up to 2.5 million tonnes of maize that can enter Spain and Portugal[25]. This import duty concession was originally granted as compensation to third country suppliers for the loss of export competitiveness in Spain and Portugal when both countries joined the EU in 1986 and adopted the protective import regime of the EU's Common Agricultural Policy. The main features of the import duty concession are:

- The 2 million tonnes for Spain and 0.5 million tonnes for Portugal are the maximum volumes that can benefit from an import duty concession;
- The volumes allowed for import are reduced according to the volume of maize gluten (that enters the EU duty-free) that is imported into these two countries;
- The maximum duty that can be charged within the concession is €50/tonne in Portugal (in practice it is lower) – there is no maximum duty applicable to imports into Spain;
- The concession only applies to dent maize – flint maize is excluded;
- Imports must be into Spain and Portugal – the concession does not apply to imports into other EU countries. This is facilitated by the requirement for importers to pay a security deposit on application for an import licence that is only re-paid when they (the importers) can show documentary evidence that the maize has been processed or used in Spain/Portugal (within 18 months of import);
- The import duty concession is administered on a tender basis. Each importer wishing to benefit from the concession bids a maximum duty concession it wishes to receive and the EU Commission then decides periodically (eg, every week when a tender has been opened) which tenders to accept. In practice, the Commission sets a maximum duty level at which all bids at, or lower than this level are accepted, with bids for higher levels rejected. For example, tenders into Spain for the period 8-14 July 2005 set the maximum duty concession accepted at €20.96/tonne and the volume that this concession applied to was 2,800 tonnes.

[25] The concession is for 2 million tonnes entering Spain and 0.5 million tonnes entering Portugal

Appendix 2: Underlying assumptions to the EU Commission's analysis presented in 'Prospects for agricultural markets in the EU'

1. Annual inflation rate of 1.9% from 2005/06 to 2011/12
2. Euro to $ exchange rate: €1 = $1.15 for the period 2005/06 to 2011/2012
3. The introduction of the 2003 CAP reform – the introduction of the single farm payment and reduction in the level of support in the cereal sector (mainly affecting rye and durum wheat) are expected to lead to a slight decline in the cereal area and to a rise in voluntary set aside as land with low profitability moves out of production
4. A compulsory set aside rate of 10% is assumed to apply in all years from 2005
5. The slowdown in cereal yield growth observed in the EU over the last few years is expected to persist to 2011/12
6. Contrary to the past decade which was characterised by a steady development of the white meat sector (and subsequent gains in cereal feed usage), the period to 2011/12 is projected to exhibit a marked slowdown in the production growth in the pig meat, poultry meat and egg sectors. This should then translate into more moderate demand prospects
7. World market (price) conditions for cereals are forecast by most international organisations to be moderately favourable, with notably an expanding world (import) demand in South East Asia
8. The lack of important storage facilities is a significant limiting factor in the development of the competitiveness of some new member states and their access to EU domestic and/or world markets. Increased investment in transport and storage infrastructure will become a crucial factor for the competitiveness of the crop sector in new member states like Hungary. As these investments will take time to effectively influence production and trade patterns, the economic perspectives for crop production as expressed in levels and volatility of producer prices are likely to improve only slowly.

Appendix 3: Farm level impact of using GM technology in Slovakia

Impact of using GM grain maize on farm profitability in Slovakia (€/ha)

Baseline 2004/05 margin	**Conventional: average performance**	**GM IR targeted at the European corn borer**	**GM IR targeted at the corn rootworm**	**GM HT maize**
Price (€/tonne)	94	94	94	94
Yield (tonnes/ha)	6.97	7.667-7.99	7.67-8.02	6.97-7.14
Sales revenue	655	721-751	721-754	655-671
Variable costs				
Seed	90	125	100	102
Fertiliser	79	79	79	79
Crop Protection	60	60	60	31-42
Other variable costs	79	79	79	79
Total variable costs	308	343	318	291-302
Gross margin	**347**	**378-408**	**403-436**	**353-380**
% change in gross margin relative to baseline		**+8.9% to +17.5% (+€31/ha to +€61/ha)**	**+16.1% to +25.6% (+€56/ha to +€89/ha)**	**+1.7% to +9.5% (+€6/ha to +€33/ha)**

Source: Conventional performance data derived from Brookes (2005a), which itself draws on data supplied from the Slovak Agricultural Economics Institute (VUEPP)

Notes:

1. Baseline yield = 2006. Assumed yield impact is for GM IR maize targeting the ECB +10% to +14.7% (range based on findings in the Czech Republic (farm reporting & trials in the Czech Republic 2005/06 and commercial crop monitoring in Slovakia (2006)) and Demont (2006), for corn rootworm +10% to +15% based on Bonis et al (2005), Szell et al (2005) and Demont (2006)
2. Price of maize based on average farm level prices in October 2006
3. Cost of technology (seed premium) assumed to be: for Bt maize targeting the European Corn Borer +€35 (based on typical current premia paid by Slovak farmers using the technology; for Bt maize targeting the corn rootworm see note 4 below. For GM HT maize: €12/ha based on typical average price paid by farmers using the technology in North America
4. Cost of insecticides: for GM IR targeting the ECB, it is assumed that no insecticides are currently used: this therefore gives a conservative estimate of the overall impact of the technology. For GM IR maize targeting the corn rootworm, although insecticides and/or seed treatments have, historically rarely been used (because of the recent introduction of this pest to Slovakia), saving in 'hypothetical' future costs of €50/ha are assumed, although this is counterbalanced by a technology cost of €40/ha, hence a net additional cost to the seed cost presented of +€10/ha. This data/assumptions are based on Demont et al (2005) & Rice (2004). Hence, all crop protection costs shown relate to herbicides.
5. Cost of herbicides. Given the assumption that no insecticides are used by the average maize grower in Slovakia, all of the crop protection costs incurred for the conventional baseline crop are assumed to be herbicides. Cost of herbicides for the GM HT crop based on the assumption that the GM HT crop uses 3 litres of glyphosate at €5.3/litre and €2.5 litres of Guardian (at €7.3/litre: source Monsanto) for the high end of the cost range and €23/ha as the lower end of range (source: Brookes 2005 (b))
6. Policy change impact. The main policy change impact expected between 2006 and 2012 is the increase in the level of single farm payment as Slovakia accedes to full adoption of the CAP. This will result in the SFP increasing from about €88/ha to €154/ha. This policy change would have no impact on the revenue or variable cost of production basis associated with adoption of GM technology, or affect the absolute level of impact in €/ha terms

Impact of using GM HT sugar beet on average Slovak sugar beet gross margins (€/ha)

	Conventional: average performance 2004-05	**Conventional performance 2012 estimated**	**GM HT 2004-05 baseline**	**GM HT 2012 baseline**
Price (€/tonne)	45	28.8	45	28.8
Yield (tonnes/ha)	41.4	41.4	48.85	48.85
Sales revenue	1,863	1,192	2,198	1,407

Single farm payment	44	154	44	154
Total revenue	1,907	1,346	2,242	1,561
Variable costs				
Seed	162	162	192-202	192-202
Fertiliser	113	113	113	113
Crop protection	271	271	86.75-101.75	86.75-101.75
Other variable costs	190	190	190	190
Total variable costs	736	736	581.75-606.75	581.75-606.75
Gross margin	**1,171**	**610**	**1,636-1,661**	**953.79-978.19**
% change in gross margin relative to baseline			**+40% to +42% (+€465/ha to +€490/ha)**	**+56% to +60% (+€344/ha to +€368/ha)**

Source: Conventional performance data derived from Brookes (2005a), which itself draws on data from the Slovak Agricultural Economics Institute (VUEPP)

Notes:

1. Assumed yield impact is +18% based on trials by Monsanto in the late 1990s in the Czech Republic – these are also consistent with trial results in Poland (see Brookes & Aniol (2005))
2. Price of sugar beet based on the post 2006 reforms minimum support price for A quota sugar beet
3. Cost of technology (seed premium) assumed to be between +€30 and +€40/ha (based on Brookes (2005), May (2003))
4. Herbicide costs on conventional sugar estimated to be 75% of total crop protection expenditure (ie, €203.25/ha). Herbicide costs for GM HT sugar beet based on 3 spray runs of 2 litres of glyphosate. Assumed price of glyphosate in range of €3.17 to €5.67/litre

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