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THE EUWAB-PROJECT: DISCUSSION

Matty DEMONT and Eric TOLLENS

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EUWAB-Project (European Union Welfare effects of Agricultural Biotechnology), Project VIB/TA-OP/98-07**:** "Micro- and Macro-economic Analysis of the Economic Benefits and Costs of Biotechnology Applications in EU Agriculture - Calculation of the Effects on Producers, Consumers and Governments and Development of a Simulation Model". This paper (pdf) can be downloaded following the link: http://www.agr.kuleuven.ac.be/aee/clo/wp/demont2002b.pdf

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Department of Agricultural and Environmental Economics
K.U.Leuven
Willem de Croylaan 42, B-3001 Leuven – Belgium
Tel. +32-16-321614, Fax +32-16-321996

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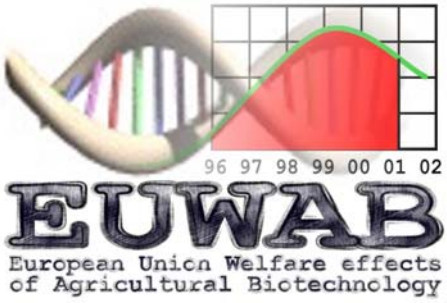
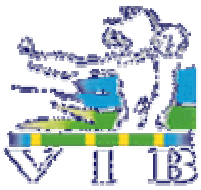
Matty Demont,
Flanders Interuniversitary Institute for Biotechnology (VIB),
Department of Agricultural and Environmental Economics, K.U.Leuven,
de Croylaan 42, B-3001 Leuven (Heverlee), Belgium
Tel.: +32 16 32 23 98, Fax: +32 16 32 19 96,
Email: matty.demont@agr.kuleuven.ac.be

Prof. Eric Tollens,
Department of Agricultural and Environmental Economics, K.U.Leuven,
de Croylaan 42, B-3001 Leuven (Heverlee), Belgium
Tel.: +32 16 32 16 16, Fax: +32 16 32 19 96,
Email: eric.tollens@agr.kuleuven.ac.be

The EUWAB-project (European Union Welfare Effects of Agricultural Biotechnology)
http://www.agr.kuleuven.ac.be/aee/clo/euwab.htm



Since 1995, genetically modified organisms have been introduced commercially into US agriculture. These innovations are developed and commercialised by a handful of vertically coordinated “life science” firms who have fundamentally altered the structure of the seed industry. Enforcement of intellectual property rights for biological innovations has been the major incentive for a concentration tendency in the upstream sector. Due to their monopoly power, these firms are capable of charging a “monopoly rent”, extracting a part of the total social welfare. In the US, the first *ex post* welfare studies reveal that farmers and input suppliers are receiving the largest part of the benefits. However, up to now no parallel *ex ante* study has been published for the European Union. Hence, the EUWAB-project (European Union Welfare effects of Agricultural Biotechnology) aims at calculating the total benefits of selected agricultural biotechnology innovations in the EU and their distribution among member countries, producers, processors, consumers, input suppliers and government. This project (VIB/TA-OP/98-07) is financed by the VIB - Flanders Interuniversitary Institute for Biotechnology, in the framework of its Technology Assessment Programme. VIB is an autonomous biotech research institute, founded in 1995 by the Government of Flanders. It combines 9 university departments and 5 associated laboratories. More than 750 researchers and technicians are active within various areas of biotech research. VIB has three major objectives: to perform high quality research, to validate research results and technology and to stimulate a well-structured social dialogue on biotechnology. Address: VIB vzw, Rijvisschestraat 120, B-9052 Gent, Belgium, tel: +32 9 244 66 11, fax: +32 9 244 66 10, www.vib.be



Introduction

The EUWAB-project (European Union Welfare effects of Agricultural Biotechnology) aims at calculating the total benefits of agricultural biotechnology innovations in the EU and their distribution among member countries, producers, processors, consumers, input suppliers and government. The present document summarizes the major comments and replies stemming from two evaluation workshops that have been held on the 19th of June 2002 in Leuven (K.U.Leuven), and the 4th of July 2002 in Tienen (IRBAB-KBIVB). Reviewers and discussants were Jozef Claes (Boerenbond), René Custers (VIB), José Falck-Zepeda (ISNAR), Olivier Hermann (IRBAB-KBIVB), Thierry Merckling (Monsanto), Jean-François Misonne (IRBAB-KBIVB), Marc Rosiers (SUBEL), and Johan De Rijcker (Tiense Suiker). The reviewed EUWAB working papers are Demont and Tollens (2002) and De Venter *et al.* (2002).

The Sugar Sector as Case Study

One of our arguments in choosing the sugar sector as a relevant case study is the fact that sugar is an important export commodity in EU agriculture. As one of the reviewers correctly pointed out, an apparent contradiction emerges in Demont and Tollens (2002). However, we will show that this contradiction is only apparent. In the paper we argued that the majority of EU countries produce out-of-quota C-sugar as a precautionary act in order to fulfil its allocated quotas. In literature, only four countries (France, Germany, Austria, and the UK) are considered to respond significantly to world market prices (Frandsen *et al.*, 2001). Moreover, for the first group of countries this C-sugar production is in most of the years not profitable. Does this mean that sugar is not an important export commodity in the EU? Important to

note is that C-sugar is only a part of total EU sugar exports. Historically, sugar quotas have been set at a level that is superior to domestic consumption. This means that a part of B-quota sugar is also exported on the world market: Q_d in Figure 1 in (Demont and Tollens, 2002). Moreover, a part of the preferential imports from ACP-countries is re-exported on the world market, adding to total EU exports. Hence, there is no contradiction between the individual countries' low C-sugar response on world prices and the importance of EU sugar exports.

Another argument for a study on the EU sugar sector is the assumption that the acceptance of sugar produced from GM beets is 'realistic'. This assumption was commented to be 'unrealistic', since consumers will not accept the product as long as they do not see any functional (health, convenience, environment, etc.) advantage, independent of price. Our argument has to be interpreted as a relative one. Initially, in setting up our case studies we thought GM sugar to be less prone of consumer opposition since no genes nor traces of proteins can be found in this pure product, *in comparison with* the other relevant case studies (e.g. Bt maize). Moreover, the existence of a real observable consumer response to GM labels is still unproven (Noussair *et al.*, 2002, Marks *et al.*, 2002).

The sugar industry appears to be the major factor in the refusal of GM sugar beets. Our model (Demont and Tollens, 2002) and Figure 1 in the remainder of this paper show that hardly any benefit is being passed on to processors. Even in the US, the marketing concerns of sugar processors are a significant roadblock to the introduction of GM sugar beets, since Europe and Japan are reluctant to accept GM pulp from beets (Lilleboe, 2000). One of the reviewers correctly adds that the competition with

sugar cane is one of the driving forces in this behaviour. Sugar cane has the image of being 'the organic alternative sweetener'. Sugar cane and sugar beet account for respectively 71% and 29% of global sugar production (Demont and Tollens, 2002). Any bad image could quickly result in a loss of market share caused by consumers shifting from 'industrial' beet sugar to cane sugar, perceived as more 'natural'. It is clear that, in the absence of benefits, the sugar industry would not accept such a risk.

The EU's Impact on World Sugar Prices

In this context, reference was made to Brazil. In the first place, Brazil is a producer of energy (electricity and ethanol) from sugar, while sugar itself is a by-product. This producer would have a larger impact on world market prices than the EU. Our five-year averages reported in Table 1 (Demont and Tollens, 2002), however indicate an equal presence between these two producers, each responsible for 20% of global traded sugar. Moreover, econometric analyses by the FAPRI (Food And Policy Research Institute, Missouri) show the important influence of EU sugar exports on world sugar prices (Poonyth, 1998, Poonyth *et al.*, 2000). The importance of ethanol for Brazil's sugar production is consistent with Devadoss and Kropf (1996), who find a large cross price elasticity of -0.619 for sugar production in response to ethanol prices.

In De Venter *et al.* (2002), we do not take into account the effects of a declining world price (due to the technology) on the individual producer. Does this mean that we deny the importance of the EU as a sugar exporter? Do we have a contradiction here? The answer is 'aggregation'. In a micro-economic analysis, some factors such as price declines can be reasonable assumed zero. For an individual Belgian producer,

the effect of a declining price of his C-production, due to biotechnology adoption, is small. Once we start aggregating all effects stemming from the technology and distributing them to different stakeholders, we cannot deny even such small price changes. In this respect, macro-economic reasoning is different from micro-economic reasoning.

The EU's Common Market Organization (CMO) for Sugar

Another comment states that carrying out welfare analyses in imperfect markets, such as the EU Common Market Organization (CMO) for sugar, is prone for measurement errors if the model assumes a perfect market. This is a valid argument. However, our model has been adapted to include this market intervention and focuses entirely on the consequences of this market imperfection on the returns to biotechnology R&D. This methodology has been widely accepted in literature (Alston *et al.*, 1995).

Our economic view on the CMO as an 'inert regime', that has withstood any substantial reform since 1968, has been criticized. However, the arguments focus on the *sugar sector as a whole* that has been able to adapt itself to the changing market environment. Our view is only limited to the CMO sugar as a *commodity policy* (quotas, fixed prices, etc.), where essentially little change has been recorded for a long period, although we fully acknowledge that the underlying sector adjustment to this policy has been very dynamic (Demont and Tollens, 2001b). Regarding De Venter *et al.* (2002), questions have been raised about the relevance of an extensive literature review regarding the EU's CMO for sugar. We agree that questions about the economic efficiency in terms of welfare of the CMO are not within the scope of the paper. However, since profitability in the beet sector is directly associated with the

setup of the CMO for sugar, the latter will also influence the profitability of new technologies, such as agricultural biotechnology. Therefore, description and inclusion of this regulatory framework is essential for our study.

Reference has been made to a study carried out by Idea Consult (1999), in which the CMO is showed to be a second best policy instrument favouring price stability and security of supply, limiting welfare losses due to market interventions. This discussion is beyond the scope of our study. However, we want to point out that a vast collection of literature covers this topic, starting in 1987 (Sudaryanto, 1987), showing how the benefits from liberalizing world sugar trade are distributed among different stakeholders. We also want to warn for the fact that the effect of liberalizing trade on price stability is not conclusive in literature. Borrell (1999) argues that liberalization will increase world price stability, while others defend the opposite (Idea Consult, 1999, Boussard and Piketty, 2000). We finally want to warn for the use of elasticities reported in literature. A large diversity of elasticities can be found. Methodological problems as well as data limitations make the estimation of elasticities a difficult task (Demont and Tollens, 2001a). For example, there is a tremendous difference between the sugar supply elasticity estimates reported by Idea Consult (1999) and Devadoss and Kropf (1996). Instead of relying on one estimate, we include this uncertainty into the model by looking at all possible scenarios associated with different estimates of elasticities.

Modelling of Pricing Strategies

The absence of explicit modelling of pricing strategies of the input industry into the model is considered to be a weakness for our study in the light of the ongoing trend of

vertical integration in the sector. Since no market for GM sugarbeets exists, nowhere in the world, no information is available about the potential demand (adoption) and prices. Moreover, we argue that adoption of biotechnology in the EU is influenced by factors (political, ideological, etc.), that go beyond the underlying economic forces. As a result, any temptation to model and estimate the real adoption rate and market equilibrium price of GM sugar beets is prone of important errors, as long as these non-economic forces are not being taken into account. Modelling the adoption of agricultural innovations and biotechnology innovations in particular is very complex (Demont and Tollens, 2001a). In the workshop, risk perception and cultural differences were correctly referred to as an important driving force for adoption (De Rycker, 2001). However perceived risk is only one of them among a variety of other factors: profitability, learning effects, complexity of the technology, etc. (Hebert and Goldsmith, 2000) Attempting to model the complex system 'technology price vs. adoption' will therefore only add more uncertainty to the model, without adding any information. Therefore we chose not to explicitly model the diffusion process, and this is coherent with the objectives of the EUWAB-project, which aims at calculating the *benefits foregone* of agricultural biotechnology innovations, due to the non-adoption (moratorium) of these technologies. Including 'realistic' adoption rates will provide no information on potential benefits for countries that politically decide to ban GM crops. As a result, our welfare calculations have to be interpreted as functions, conditional on a given 'normally' S-shaped adoption curve, with a given adoption speed, i.e. half that of US Roundup Ready™ soybean adoption. Furthermore, we will carry out our analysis for a series of 'realistic' alternative technology prices and analyze the impact of all possible scenarios on the model outcomes. These prices, together with their probability, are assessed using expert

opinions. This approach will provide much comparable information for all EU countries on the benefits foregone from agricultural biotechnology.

Reduction of Herbicide Costs

A comment on De Venter *et al.* (2002) is that the reduction of herbicide use due to the new technology is overestimated. The argument is that herbicide use has been steadily decreased during the last decade and that the maximum potential for a further decrease is more or less reached. When we look at actual herbicide programmes and compare them with 2 or 3 postemergence glyphosate applications, still a significant potential for herbicide cost reduction is possible since glyphosate is relatively cheap and pre-emergence applications can be entirely eliminated.

Another argument is the fact that the cost of traditional techniques will decline as a reaction on the increased competition. This effect has been included in our model through the conventional herbicide price decline *k*. The latter has also been a point of discussion. Should this price decline be included? The US experience shows that price declines are possible. This clearly shows that both technologies are being commercialized in imperfect markets. Because of the imperfect market, input suppliers are able to charge oligopolistic prices, that are higher than the prices that would prevail in a perfect market. Comparing transgenic seed with conventional herbicide-based technologies essentially shows the 'price advantage' of transgenic crops. It would make no sense to attribute the ability to price technologies at a level which is competitive with conventional technologies, only to the biotechnology industry and not to the chemical industry. Both sectors are operating in imperfect markets and their pricing strategies are interdependent. On a macro-economic level

(Demont and Tollens, 2002), including pricing reactions essentially shifts some of the benefits to non-adopters. On a micro-economic level on the other hand, herbicide price declines erode the benefits of transgenic sugar beets for adopters and should be included.

We fully agree that these parameters are crucial for our calculations, but observe that our cost reduction estimates are very consistent with literature (Burgener *et al.*, 2000, May, 2000, Desquilbet *et al.*, 2001, Lemarié *et al.*, 2001). Another related comment is the fact that in Belgium a lot of paid labour is used in the weeding of sugar beets. The introduction of GM sugar beets would have a marginal impact on this cost item. We do not agree with this comment since we observe that the labour cost reduction associated with the elimination of only one application is important and varies between 0.25 and 0.44 €/ton: Table 8 in De Venter *et al.* (2002). Moreover, our sensitivity analyses suggest that changes in the number of applications are the third most important factor influencing the benefits from GM sugar beets: Figure 10 and 11 in De Venter *et al.* (2002).

Adoption of Herbicide Tolerant Sugar Beets

One of the reviewers interestingly points out that the adoption of HT sugar beets would be stepwise, according to three classes of adopters. Approximately 5% of beet growers face tremendous problems with volunteer beets, engendering important costs in beet cultivation. These growers would have a high willingness-to-pay (WTP) for HT sugar beets and would be the first to adopt this new technology. The second group faces high weed control costs, due to weed populations that are difficult to control. The third group would consist of growers that face normal weed populations, for

which it is still economical to use HT crops. Important is the fact that HT sugar beets are only a short-term solution for controlling volunteers. If negligence is the major cause, the problem will still remain after the introduction of HT crops.

Shift in Weed Populations

Important parameters for the performance of HT crops are the possibility of weed population shifts and the emergence and proliferation of a glyphosate-resistant weed population. We do not explicitly model these potential effects, since (1) no scientific agreement exists on the extent of these problems and (2) the inclusion of these parameters would only add to the much higher uncertainty in the model regarding the technology fee and the potential adoption, without providing more information. Therefore, our approach is to focus on the most important uncertainties. However, the effects of these problems can be assessed using our sensitivity analysis, depicted in Figure 10 in Deventer *et al.* (2002). One effect of the emergence of weed populations that are difficult to control would be a decrease of the yield boost, due to competition of the sugar beet crop with the poorly controlled weed population. A decrease of the yield boost with one percent would translate into a decrease of the benefits of 0,71 € per tonne sugar beets. Another effect would be the increase of application costs, if the glyphosate application is combined with additional pest control techniques (e.g. mechanization) due to weed resistance. These costs would simply add to the labour and capital costs and would further decrease the profitability of the new technology.

World Sugar Price

Another comment is the thought that the world sugar price is not relevant for the underlying production costs. 80% of global sugar production is sold on the domestic

market at higher prices than the world market price. The world market is a residual market. The latter is certainly true, but despite this fact, different arguments exist showing that during the decade 1988-1998, the world market price was in equilibrium (Hannah, 1999). While the world market price is mostly irrelevant for domestically protected production in developed countries, this is not necessarily the case for developing countries (Borrell and Pearce, 1999). However, despite this fact we can reasonably assume that declining word prices, due to the introduction of GM beet in the EU and the ROW, will engender welfare effects in the ROW to at least one of the stakeholders. In regions where no market intervention applies, impacts will be distributed among producers and consumers. Regions protecting their domestic production through fixed prices have to cover the increasing gap between the world price and the domestic price by increased taxes. As a result, the taxpayer looses. In the end someone pays and someone benefits from declining world prices. The way these effects are distributed is strongly dependent on the commodity policy in place. Since we are mainly interested in the EU, we prefer to approach the ROW region very roughly by speaking about the net effect the technology will have ('net ROW') in this region, whoever pays or receives the money. For the EU on the other hand, we try to distribute these effects, the central aim of the EUWAB-project.

Welfare Impact

A comment on Demont and Tollens (2002) is that our most important welfare impact is caused by a decline of the world market price (net ROW = 53%, EU producers = 30%, input industry = 17%). This is an interpretation error. Net ROW represents the sum of the benefits from GM sugar beet adoption in the ROW beet area, plus the consumer benefits minus the costs to ROW cane producers, both stemming from

declining world prices. ROW consumer benefits slightly overcompensate ROW cane producer losses, such that the global effects of a decline of the world price are roughly zero (0.6% of global benefits). The fact that half of the benefits go to the ROW is mostly due to the fact that half of global beet sugar (51%) is produced in the ROW, gaining from the new technology. The world price decline on the other hand, is essentially welfare redistribution from growers to consumers.

The impact of the EU on the ROW is commented to be overestimated. We emphasize the fact that in our model, not only the EU adopts GM beets, but all beet regions together adopt the technology at the same modest adoption rate. This yields comparable impact estimates among all adopting regions, conditional on a fixed adoption pattern. As a consequence, the impact on the ROW is also conditional on this adoption pattern and has to be interpreted as such. Further, the only way the EU influences world prices is through technology-induced export expansion. Econometric studies show that any increase in EU's sugar exports has a significant influence on world prices (Poonyth, 1998, Poonyth *et al.*, 2000). Moreover, we only attribute the capacity to expand exports due to technology adoption to regions that significantly respond to world sugar prices. In literature, four countries are reported to do so: France, Germany, the UK, and Austria (Frandsen *et al.*, 2001). We assume that only these four countries will expand their C-sugar exports in response to the new technology. This certainly is a conservative assumption and will provide us a lower bound of the purely EU-induced price impact.

EU producers gain 34% of global benefits. A comment was made in relation to the definition of 'producers'. According to the reviewers, only growers are able to benefit

from the new technology. This is due to the existence of a fixed minimum price agreement between growers and processors, limiting any spillover of benefits from growers to processors through beet price declines. We largely agree with this statement. However, we do believe that some scope for price negotiation exists between growers and processors. This can be hidden in contractual agreements, related to quantity, quality, timing, etc. In Figure 1 we try to visualize a hypothetical distribution of beet prices, paid by processors to beet growers, in relation to some characteristic φ, which can be negotiating power, timing, etc. Beet price markups are positively correlated with this parameter φ. The right-hand side represents the situation after the adoption of GM beets. As long as the price does not reach the minimum price yet, GM beet growers who face lower production costs will be willing to accept a somewhat lower price for their produce. For the same characteristic φ, beet prices will be somewhat pushed towards the minimum beet price, decreasing the variance of observed beet prices. This effect, although marginal, is the only way benefits can be passed on from growers to processors under the EU's CMO for sugar.

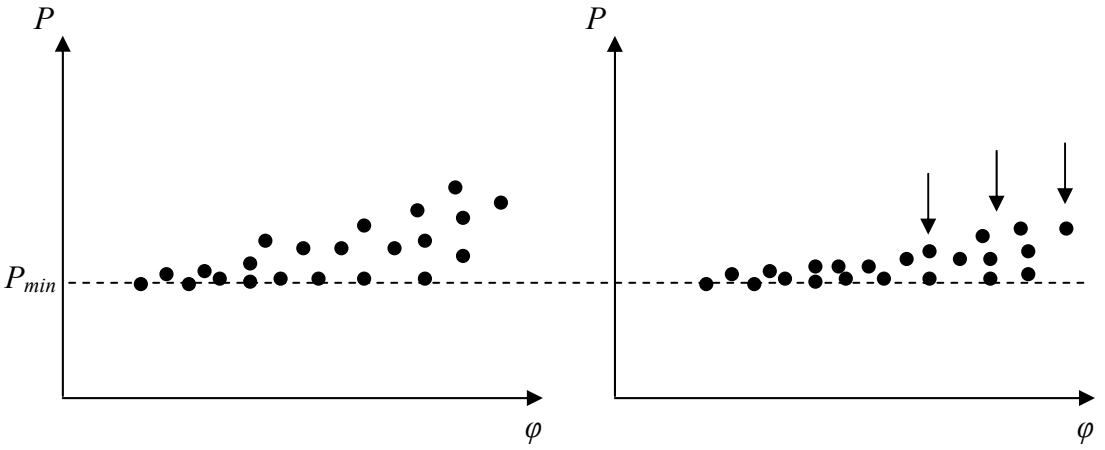


Figure 1: Negotiated Beet Prices Before and After the Introduction of a New Technology in the Agricultural Sector

Our model results suggest that EU consumers will not gain from the introduction of GM beets, due to the fixed intervention price stated in the CMO for sugar. The reviewing committee correctly pointed out that this is not necessarily due to the CMO, but also to the market power of the transformation and distribution sector. The French sugar industry for example is characterized by a CR4 [1] of 58% and a HHI [2] of 0,12 (Lavergne *et al.*, 2001). Even in the absence of the CMO, this oligopolistic sector would absorb most price declines due to the introduction of new technologies in the raw (agricultural and processing) sector (Cuni, 2000), so consumers[3] would not benefit anyway. However, we do not agree with the argument that, since demand for sugar and sugar-containing products is inelastic, potential welfare increases would be limited anyway for EU consumers. In industrial countries it is well known that, due to inelastic demand for agricultural products, consumers benefit the most from agricultural innovations[4].

Land Contraction

Finally, one of the central points in Demont and Tollens (2002) is the assumption that exporting low-cost regions not responding to world prices have no possibilities for output expansion. Instead, they will respond to new technologies by freeing up land allocated to sugar beets, so that their total production remains unchanged. This

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[1] concentration index of the four largest firms (%)

[2] The Herfindahl-Hirschman index of concentration is defined as the sum of squared firms' market shares for all firms operating on a given market. For firms of equal sizes, HHI is simply the market share of a firm operating on the market.

[3] direct and indirect consumption through sugar-containing products

[4] This phenomenon is known as the 'agricultural problem'.

phenomenon of land contraction in quota systems negatively affects demand for the new technology and explains why the input industry is not able to extract a larger part of the benefits. One of the reviewers correctly points out that this land contraction happens only once, i.e. after adoption. Once a constant level of adoption is reached, no further land contraction is expected, purely due to the HT technology.

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nr. 4 BEERLANDT, H. en L. DRIESEN, *Evaluatie van gemanipuleerde planten met biopesticide eigenschappen afkomstig van Bacillus thuringiensis aan criteria voor duurzame landbouw,* Afdeling Landbouweconomie, K.U.Leuven, januari 1994, 32 p.

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