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GTAP at Work in Denmark

Quantifying and Qualifying a Political Debate

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Abstract

In March 1999 the Danish Minister of Food, Agriculture and Fisheries invited key policy makers from the food industry, farmers' organisations, consumer organisations and labour unions in Denmark to discuss the future perspectives for the Danish agricultural and fisheries sectors in a national and global context.

In order to qualify and quantify the debate, the Danish Institute of Agricultural and Fisheries Economics (SJFI) was called upon to participate in the discussions and to assess the future development of the Danish agricultural sectors with the aim of identifying challenges and opportunities. SJFI was also asked to analyse the economic consequences of specific policy scenarios, including the impact of higher national standards in relation to environmental protection, animal welfare and food security.

This paper describes how the SJFI team has put GTAP to work in a specific policy context demonstrating the applicability of computable general equilibrium (CGE) models for practical policy advise purposes. It is concluded that such model-based analysis - in spite of its limitations - has influenced the political debate in Denmark and that the strength of the CGE approach lies not so much in the exact numerical results, but rather in the focus on important economic mechanisms and linkages, thereby providing a structured analytical framework. Moreover, the Danish experience illustrates that using more formal analytical approaches such as CGE modelling contributes to a more focused, disciplined and hence a more constructive policy debate.

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1. Introduction

In March 1999 the Danish Minister of Food, Agriculture and Fisheries invited key policy makers from the food processing industry, farmers' organisations, consumer organisations and labour unions in Denmark to discuss the future perspectives for the Danish agricultural and fisheries sectors in a national and global context.

The objective of this group, chaired by the Danish Minister of Food, Agriculture and Fisheries, was to discuss the future challenges and opportunities facing the Danish agricultural sector and food processing industries at both the national and international levels. Moreover, the group was to consider possible initiatives that could improve the prospects for these sectors and industries within this context.

The so-called “Idea Group”, as they became known, met over a 1½ year period where the discussions were centred on the following topics; (i) globalisation and marketing, (ii) ethics and consumer demands, (iii) research and development, (iv) labour force issues, work environment and education, and last but not least (v) the economic consequences of national demands for higher standards in relation to animal welfare, food security and environmentally friendly production methods in primary agriculture.

The SJFI research team was called upon to undertake a number of economic analyses to quantify the economic effects of these issues and in particular to asses the future prospects for Danish agricultural production and exports. An area of particular interest to the group was the impact of higher national standards related to environmental protection, animal welfare and food security on national production, exports and welfare.

This paper presents selected results from SJFI's work for the Idea Group[1]. Particular attention is given to the way in which the CGE approach has been used to address important issues of relevance to the Danish agricultural policy debate. We conclude the paper by drawing some general conclusions about the use of CGE models for policy advice purposes.

2. The design of the analyses

To begin with, the representatives of the food industries in the "Idea Group" undertook a number of so-called SWOT analyses of the individual industries thereby identifying their relative strengths, weaknesses, opportunities and threats. These industry-specific analyses provided the group at large with detailed industry-specific information and data as well as a common understanding of the opportunities and challenges facing Danish agriculture.

More specifically, costs and competitiveness, national regulations, productivity, global food demands and new consumer trends, research and development and finally labour market issues were all crucial matters that were discussed during the group meetings. The discussions also reflected the very different views on the relative importance of the various issues, and how and to what extent they impact on the prospects for Danish agricultural products on world food markets. By their very

[1] This paper describes only selected results of the work conducted for the "Idea Group". The full versions of the two papers (in Danish) presented to the group can be found on the SJFI web site (www.sjfi.dk), cf. Frandsen and Jensen (2000a) and (2000b).

nature, the SWOT analyses were partial in their approach and did not relate the analyses to the impact on the rest of the Danish economy through intersectoral linkages nor to the interactions with the world economy through international trade. Furthermore, the analyses were not quantified in any systematic way.

Moreover, as expected, there were divergent views on the 'prescription' necessary to improve the outlook for the agricultural sectors and food processing industries. The views varied from wishes to relax the burdens and regulations imposed on the agricultural sectors (the agricultural organisations) to suggestions that imply tightening and strengthening the regulations motivated by the desire to improve environmental conditions, animal welfare, food safety and quality (regulators and consumer organisations).

Given both the task and the composition of the group, it is evident that a large number of issues were discussed, and almost by definition the participants did not find common ground or understanding on the magnitudes and importance of the different issues at stake. Against this backdrop the need for systematic and quantitative economic analysis was identified and the SJFI team was called upon. The expectations of the requested quantitative (CGE) analysis were high, and consequently there was a high risk of not satisfying all needs and expectations.

It was therefore decided to hold a number of preparatory meetings with representatives from the ministries, industries and farmer organisations during which the data and methods to be used were discussed, including a thorough discussion of the strengths and weaknesses of the proposed (global CGE) approach. The discussions were finalised by a joint identification of the issues that were most suitable for this type of analysis (getting the expectations right). This phase turned out to be very important for ensuing common acceptance by all participants in the Idea Group of the results and subsequent policy advise generated from the analysis.

The scenarios

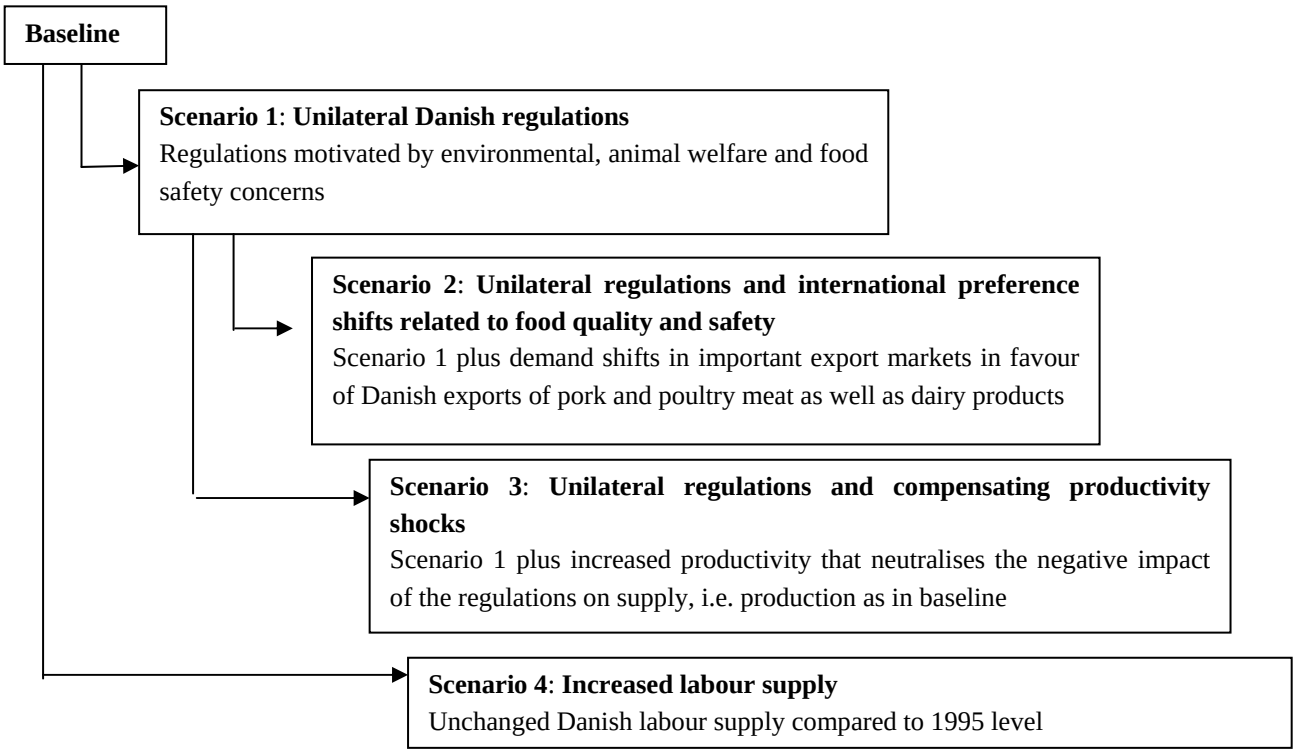
Based on these discussions and in co-operation with the SJFI team, a number of scenarios were identified by the Idea Group to highlight and quantify the sectoral and economy-wide effects of some of the most important challenges and opportunities confronting Danish agriculture, cf. Figure 1.

The analysis consisted of the construction of a baseline as well as a number of specific scenarios imposed upon this projection. The baseline was intended to stimulate a discussion of the future position of Danish agricultural products in world food markets (e.g. identifying major players and quantifying changes in market shares). In particular, this allowed the group to discuss the impacts of income and population growth, productivity growth rates, access to labour, capital and land, specific policy changes as well as the structural forces that shape the supply and demand of Danish food products.

The baseline provided a benchmark against which the alternative scenarios were compared. The baseline features projections of the world economy to the year 2010, cf. Table 1, plus the incorporation of major policy changes, including full implementation of the Uruguay Round and the changes in the Common Agricultural Policy of the European Union as outlined in the Agenda 2000 reform[2].

[2] The constructed baseline in this paper corresponds to the one presented in Frandsen and Jensen (2000).

FIGURE 1. **The scenarios**



As Table 1 reveals, relatively high rates of income (and productivity) growth in the Asian economies - particularly in China and a number of other developing countries ("catching up" effects) - shape the baseline. For a number of developed countries, including Denmark and the other members of the European Union, we have assumed annual growth rates of approximately 2-2½ per cent. The global annual growth rate in the baseline is 3 per cent (weighted average).

Important are also the assumed rates of growth of the labour force in the individual countries and regions. The baseline reflects an almost unchanged labour force in most European countries (in Denmark the labour force is even expected to decline by 0.4 per cent annually in the projection period) whereas the labour force in a number of other countries is expected to expand significantly. The US is one example with an expected annual growth rate of 0.9 per cent.

The first scenario - primarily initiated at the request of the farmers' organisations- was designed to stimulate a discussion of the impact of the unilateral Danish legislation that had been passed during the period 1995 to 2000. The policy instruments that were introduced in this period were motivated by demands for higher national environmental, animal welfare and food security.

TABLE 1**. Exogenous assumptions and annual growth rates, in selected regions, 1995-2010**

			Labour force			Total factor productivity		
	GDP	Population	Total	Unskilled	Skilled	Industry	Services and Nat.resour.	Primary agriculture
AUS	2.7	1.0	1.0	-1.0	5.2	0.75	0.38	1.05
JPN	1.9	0.1	0.0	-0.7	2.8	0.50	0.25	0.70
KOR	4.7	0.7	1.3	0.9	4.2	0.75	0.38	1.05
CHN	7.8	0.7	0.8	0.6	3.4	1.75	0.88	2.45
TWN	5.6	0.7	0.8	0.6	4.2	1.50	0.75	2.10
USA	2.6	0.8	0.9	-0.5	3.3	1.00	0.50	1.40
GBR	2.2	0.1	0.1	-1.2	2.6	1.00	0.50	1.40
DEU	2.3	0.1	0.1	-0.8	2.6	1.00	0.50	1.40
DNK	2.4	0.1	-0.4	-1.9	2.6	1.00	0.50	1.40
SWE	2.4	0.2	0.0	-1.6	2.6	1.00	0.50	1.40
FIN	3.0	0.2	-0.4	-1.6	2.6	1.00	0.50	1.40
REU	2.6	0.1	0.1	-0.8	2.6	1.00	0.50	1.40
FSU	0.9	0.1	0.5	-1.4	5.4	0.25	0.13	0.35
MEA	4.0	2.2	3.1	2.9	5.4	0.50	0.25	0.70

Source: Frandsen and Jensen (2000)

Table 2 shows the assumed increases in production costs (compared with the rest of the world) in the individual industries as a consequence. These are cost increases estimated by the farmers' union, which have been converted into GTAP commodity-specific output taxes. The total cost of the standard-related initiatives introduced in the agricultural and food sectors was estimated to amount to 1.7 billion Danish Kr. Viewing the cost increases at the sectoral level and in relation to sectoral production costs, the table reveals that the burden varied substantially from sector to sector. The cost increases were between 1.3 and 7.4 per cent of total costs in the crop sectors, for example. In the pig production sector, the costs amounted to 3.4 per cent of production value, corresponding to around 800 million Danish Kr. The costs were negligible in the food processing sectors.

TABLE 2. **Scenario 1: Assumed cost increases, per cent of production value.**

	Scenario 1
Wheat	3.6
Other grains	5.3
Fruit and vegetables	0.5
Oilseeds	7.4
Sugar beat	1.3
Other crops	3.2
Cattle and sheep	0.7
Pig and poultry	3.4
Milk production	0.7
Bovine meat	0.0
Pork and poultry meat	0.2
Oils	0.1
Dairy products	0.1
Sugar	0.1
Other food products	0.0

See Frandsen and Jensen (2000b) for more details.

By increasing the costs of production, these initiatives have adverse effects on the competitiveness of Danish agriculture. Nevertheless, the Minister of Food, Agriculture and Fisheries - while accept-

ing these effects in terms of market shares losses - argued that such initiatives could very well lead to an increased willingness to pay for Danish food products on global markets. Following this line of argument, such policy initiatives would therefore not only improve the aforementioned standards in Denmark but they would also have a positive impact on the price of Danish commodities and/or the quantities sold on world food markets.

Hence, scenario 2 was designed to stimulate precisely this discussion, with a particular focus on the possibilities of increased willingness to pay for high quality Danish food products on global food markets. Are consumers in the various export markets willing to pay for higher environmental and animal welfare standards in Denmark? And perhaps more relevant, are they willing to pay for higher veterinary standards and food quality – and if so, which markets and to what extent? More specifically, in this scenario it is assumed that consumers in the OECD countries would be willing to pay 10 per cent more for Danish exports of pork, poultry meat and dairy products.

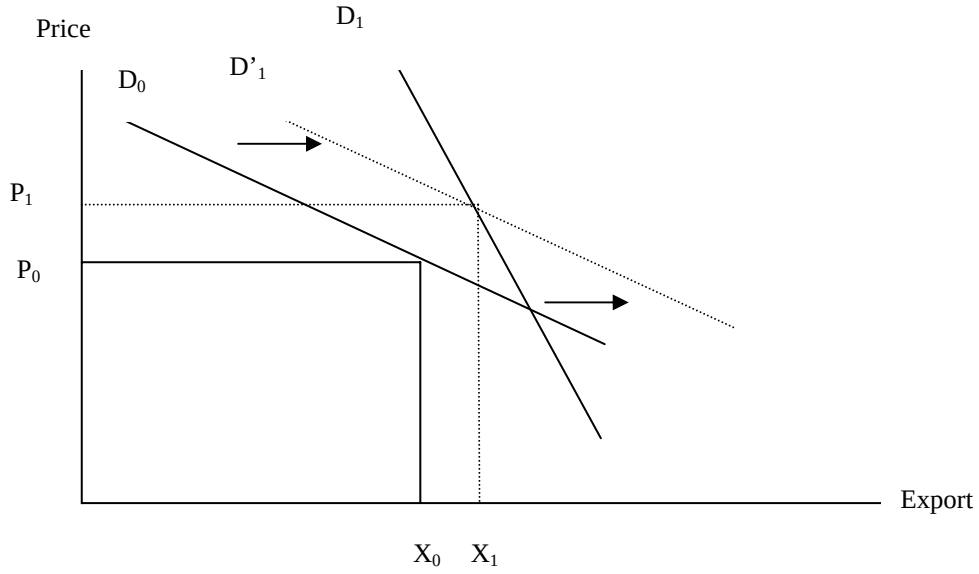
Figure 2 illustrates the design of this scenario. First, the export demand schedule for pork, poultry meat and dairy products is shifted outward by 10 per cent at the expense of other exporters to those given markets (D_0 to D'_1). This shift corresponds to an increased value of exports of around 10-15 per cent (an expansionary effect). Second, it is assumed that the unilateral Danish initiatives explicitly differentiates Danish commodities from commodities produced elsewhere, i.e. lowering the intensity of international competition on these markets (a lower elasticity of substitution – depicted by the steeping of the demand schedule from D'_1 to D_1). In sum, this scenario not only reflects the higher costs of production, but also the distinction between an expansionary and a substitution effect.

Higher productivity and various labour market initiatives could also improve the competitiveness of Danish agricultural products on global food markets. Therefore, scenario 3 was designed to stimulate the discussion of opportunities for increasing productivity in both the primary agricultural sectors as well as in the food processing industries. Specifically, scenario 3 was designed to illustrate the size of the productivity increases needed to neutralise the adverse impact on agricultural production of the policy initiatives analysed in scenario 1. The two questions asked were (a) whether Danish agriculture could contribute to a higher overall level of productivity growth in the Danish economy, and (b) in which areas could initiatives in general (e.g. research and development) strengthen productivity growth?

The final scenario 4 was inspired by one of the insights resulting from the baseline scenario, namely the adverse impact on the Danish (and European) economy of a declining labour supply over the coming years. According to the International Labour Office and Statistics Denmark, the labour force in Denmark will be reduced by 0.4 per cent annually in the period 1995 to 2010, corresponding to 190,000 full-time employees. Scenario 4 was therefore designed to illustrate the effects of initiatives that would increase the labour force corresponding to the decline assumed in the baseline. The scenario was intended to allow the group to discuss possible labour market initiatives. These ranged from initiatives to increase immigration, the strengthening of rules and conditions related to the availability of the unemployed, lowering the level of unemployment benefits, lowering marginal tax rates on labour income, and increasing the retirement age [3].

[3] A number of other scenarios were presented to the group, including a sensitivity analysis of the importance of a shift in the composition of the labour force.

FIGURE 2. **Scenario 2: Preference shifts and a lower elasticity of substitution**



3. Selected results

The results from the baseline provided the group with an overview of the general trends facing the Danish economy at large as well as a large number of commodity-specific analyses, including changes in Danish market shares in the various markets. As expected, the presentation of trends in the individual markets and in particular the changes in market shares across the individual commodities attracted quite a bit of interest. In a number of cases the discussions of the future development of Danish agricultural products confirmed the trends projected by the model.

The baseline

In 1995 exports of agricultural commodities amounted to more than 20 per cent of total Danish exports of commodities and services. Among the most important commodities are pork (more than 6 per cent of the total Danish export value) and dairy products (4 per cent). Among the most important importers of Danish pork are Japan (24 per cent of Danish pork exports are sold to Japan), the UK (18 per cent) and Germany (15 per cent), while the Middle East (27 per cent) and Germany (17 per cent) are important importers of Danish dairy products.

The estimated changes in production and exports of the Danish food products are determined in a rather complicated interaction between the (assumed) demand and supply driven forces in the baseline. These include the income and population growth assumptions in important export markets (and the assumed income elasticities) as well as changes in the competitiveness of the Danish agricultural and food processing industries. The latter is determined by the (relative) changes in productivity and policy changes across industries and countries as well as by changes in the real costs of the factors of production in the individual countries and regions. The latter, in turn, is determined by relative changes in the supply of factors of production (e.g. the supply of labour).

In 2010 the broad pattern described above is still valid in spite of the relatively large changes assumed in shaping the baseline. Nevertheless, agricultural commodity exports decline from 20 to about 18 per cent of total exports from Denmark, and countries outside Europe are predicted to become even more important recipients of Danish exports in the future. This is clearly explained by the growing importance of the economies in Asia, including Japan and China.

In spite of constituting a lower share of overall Danish exports, production and exports of Danish agricultural commodities is projected to increase in the baseline period. For pork and poultry meat, for example, the annual growth rates are estimated to be 1.6 and 1.8 per cent, respectively, cf. Table 3. The growth rates correspond approximately to the historical growth rates of these products. Exports to the Japanese and German markets are estimated to enjoy annual growth rates of 2.3 and 2.7 per cent, respectively, whereas exports to the United Kingdom are estimated to increase by only 0.4 per cent. Exports to the US, Canada and Finland decrease somewhat.

According to the GTAP database (version 4) Denmark was the largest single exporter of pork and poultry meat in 1995. The Danish share equals 12.6 per cent of global trade in these products – closely followed by the United States (11.3) and Taiwan (5.9), cf. Table A1 in the Appendix. Given the assumptions shaping the baseline, the situation changes somewhat in the period 1995 to 2010 as the US becomes the largest single country exporting pork and poultry meat (the market share equals 21.4 per cent of total trade), cf. Table A2 in the Appendix. The US production of pork and poultry meat is estimated to increase by 1.8 per cent annually in the period considered (not shown).

It is also interesting to note that the important destinations for Danish exports of pork – Japan, the UK and the rest of the EU – are estimated to be of less importance measured in terms of their shares of global import demand in 2010, cf. Figure 3. In contrast, a rapidly growing economy such as the Chinese become a rather large importer – increasing their share from 5 to 20 per cent of global demand for pork and poultry meat imports.

Figure 3. Shares of global import of pork and poultry meat, per cent.

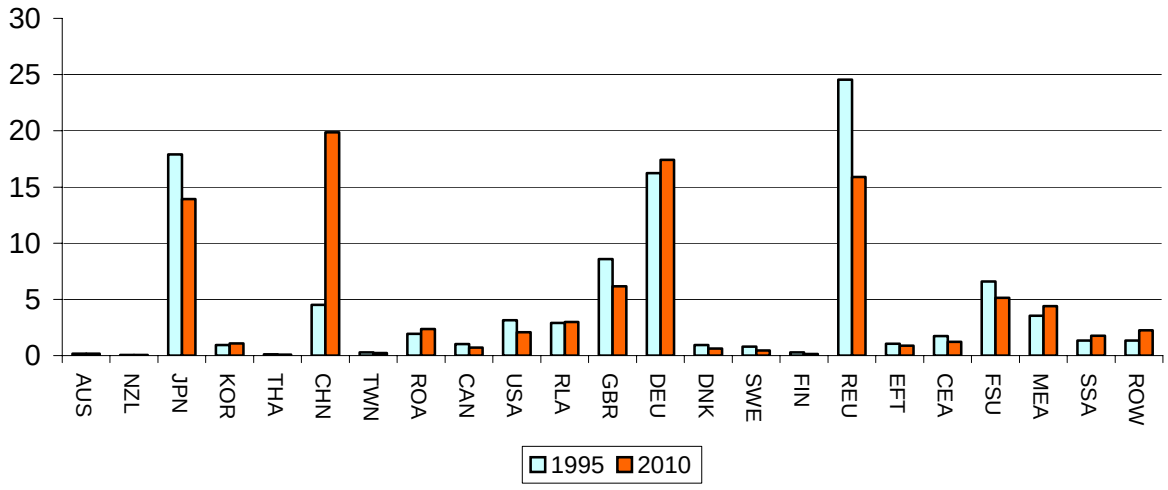
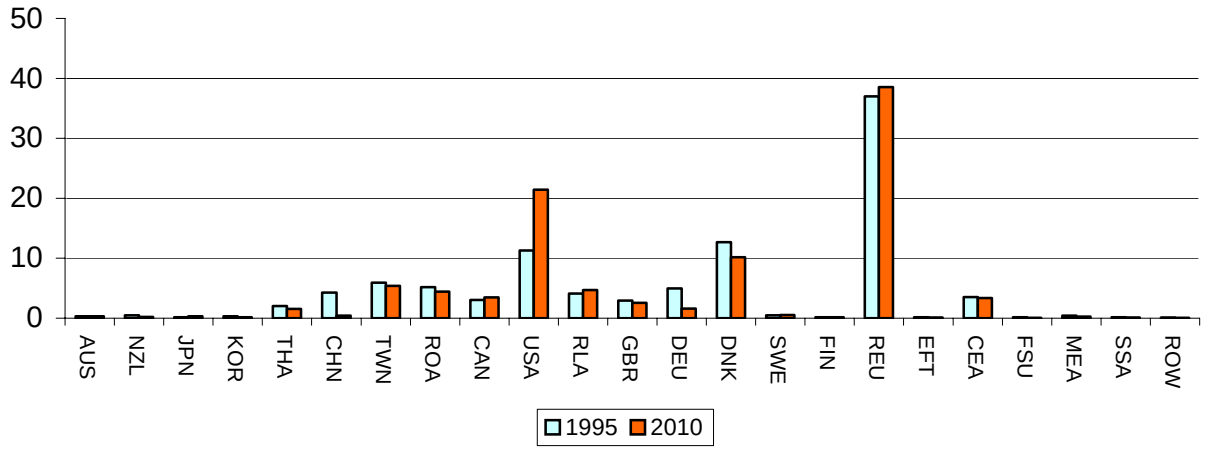


TABLE 3. **Danish production and exports, annual growth rates, 1995-2010, per cent**

			---------- Distribution of exports across destinations ----------																				
DENMARK	Production	Exports	AUS	NZL	JPN	KOR	THA	CHN	TWN	ROA	CAN	USA	RLA	GBR	DEU	SWE	FIN	REU	EFT	CEA	FSU	MEA	SSA	ROW
Wheat	1,1	3,1	0,0	0,0	0,0	0,0	0,0	8,8	0,0	0,8	0,0	0,0	0,0	2,1	1,6	1,9	3,2	2,2	10,2	-3,2	-1,8	3,2	1,4	4,3
Other grains	1,5	4,4	0,0	-4,5	0,0	0,0	0,0	7,3	0,0	-13,8	0,0	0,0	-1,8	5,9	4,1	3,7	5,9	5,7	3,6	-4,6	-2,9	0,8	0,0	3,7
Fruits and vegetables	3,0	8,9	11,6	0,0	6,6	0,0	13,0	0,0	0,0	19,9	6,5	7,3	9,0	5,3	5,4	5,3	6,3	6,0	5,1	5,8	6,7	17,8	11,0	14,8
Oilseeds	0,6	1,8	0,0	3,9	0,2	0,0	0,0	0,0	0,0	12,6	0,5	0,8	3,1	1,0	0,6	2,3	1,9	0,8	1,5	2,0	2,4	6,8	6,7	10,5
Sugar beat	0,0	-4,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-6,2	-3,7	0,0	-5,4	-6,3	-3,4	0,0	-10,5	0,0	0,0	-4,5
Other crops	4,5	5,3	9,0	6,5	6,8	12,0	9,3	21,4	9,5	14,2	6,9	7,0	7,5	4,6	4,3	3,8	3,6	5,0	3,7	7,1	7,7	11,6	9,6	12,1
Cattle and sheep	0,4	0,7	0,9	0,0	0,0	0,0	2,0	0,0	0,0	2,6	0,0	0,5	1,7	0,2	-1,0	0,1	0,8	-0,5	-0,5	0,9	-0,2	1,6	2,8	2,3
Pig and poultry	0,8	1,8	1,2	0,1	1,0	3,3	1,5	5,8	3,0	3,1	0,8	0,6	2,0	0,2	-0,1	0,2	0,7	0,9	-0,3	0,7	-0,6	3,0	2,6	2,3
Milk	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Wool	5,9	8,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	6,9	7,9	0,0	0,0	8,4	6,0	7,1	0,0	0,0	0,0	0,0
Fisheries	0,6	1,0	10,3	9,2	5,3	5,4	0,6	19,0	11,3	19,1	4,6	6,5	9,1	2,2	0,7	1,8	1,0	0,0	1,9	6,0	1,6	12,4	3,8	7,4
Natural resources	1,7	4,0	6,2	10,8	6,4	11,0	7,6	25,8	14,0	14,4	8,0	9,2	11,1	4,7	7,8	1,1	2,4	4,4	5,1	5,2	3,0	12,0	19,2	12,1
Beef and veal meat	1,9	2,6	-7,2	0,0	-13,6	-11,6	-6,2	-5,9	-12,7	-4,8	-14,3	-13,3	-10,4	3,3	7,1	2,7	2,4	2,0	-8,6	-8,3	-6,0	-6,6	-4,6	-1,5
Pork and poultry meat	1,6	1,8	5,2	3,9	2,3	4,9	5,8	16,3	4,8	8,8	-0,6	-0,4	2,8	0,4	2,7	0,1	-1,6	0,0	2,0	0,6	1,3	5,6	6,5	7,6
Oils	1,2	3,0	3,5	5,5	2,6	2,6	0,0	8,3	0,8	6,2	1,1	0,6	3,9	2,5	2,5	1,9	2,4	2,4	1,3	1,8	4,0	4,9	5,3	7,7
Dairy products	0,5	1,2	4,9	-2,5	3,3	-1,6	-1,8	3,2	-4,2	1,5	-5,8	-5,2	-3,3	2,4	1,4	7,1	4,6	1,9	5,8	-4,8	-2,5	-1,0	1,4	-0,1
Sugar	0,2	0,1	0,0	0,0	2,4	0,8	0,0	1,9	0,0	0,8	-1,9	0,0	-2,3	-2,5	-1,7	-2,9	-0,4	-1,0	1,2	-3,7	-2,3	1,3	0,6	1,1
Other food products	0,8	1,1	1,4	1,7	-1,2	2,5	1,1	6,1	-0,8	2,5	-0,8	-0,4	0,0	0,3	1,2	2,4	-0,6	0,8	1,2	-1,0	0,6	2,8	3,9	3,6
Beverages and tobacco	3,2	5,1	3,9	2,9	-0,3	2,9	2,1	6,3	4,4	2,2	1,5	1,7	2,3	3,6	6,9	2,5	0,1	4,4	5,2	4,2	3,5	1,3	4,8	2,3
Manufacturing	1,9	2,3	2,1	1,7	-1,6	0,9	0,0	1,0	0,9	3,6	1,1	0,4	1,5	1,3	3,4	2,0	1,8	2,3	2,8	3,3	2,6	3,0	3,8	2,1
Services	1,7	1,6	0,0	-0,6	-2,2	0,8	1,6	4,5	4,8	1,7	0,7	0,9	2,0	1,3	3,0	0,7	0,0	1,2	2,2	1,9	-2,4	-0,9	0,3	-0,3

In 1995 the 'Rest of EU', Denmark and the US supplied 37, 13 and 11 per cent of global exports of these commodities, cf. Figure 4. In the baseline, Denmark is predicted to loose 2.5 percentage points of global market demand for pork, whilst the US increases its share by approximately 10 percentage points. Part of this increase is explained by a slower growth rate in real wages in the US due to a significantly higher growth rate in the supply of labour compared with the situation in the Danish and European labour markets.

FIGURE 4. **Shares of global export of pork and poultry meat, per cent**.



The Danish market shares in the individual (importing) markets and the structure of Danish exports by destination in 1995 and 2010 are illustrated in figure 5 and 6, respectively. The Danish market share increases in for example Japan, Korea, “Rest of Asia” and Sweden, while the market share tends to decline in the US, UK and German markets. Clearly, the more distant markets (China, Japan, Korea, and “rest of Asia”) are growing in importance at the expense of more nearby markets (UK, Sweden, Finland and the “rest of EU”), cf. Figure 6. Germany is an exception, however, as the German import demand increases somewhat due to a relatively limited capital growth in the baseline (1.7 per cent annually) with a slight loss of competitiveness as a result.

FIGURE 5. **Danish market shares of total pork and poultry imports, per cent**

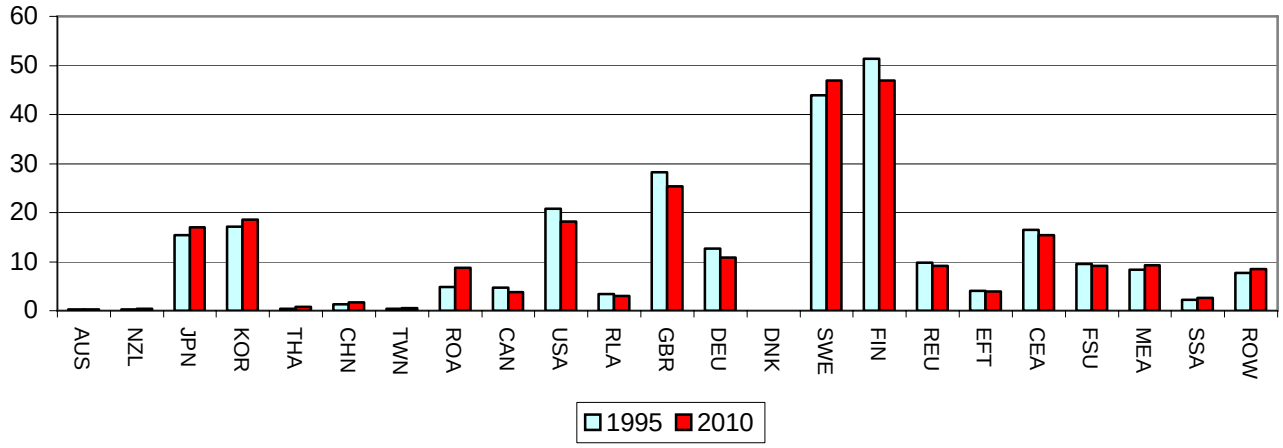
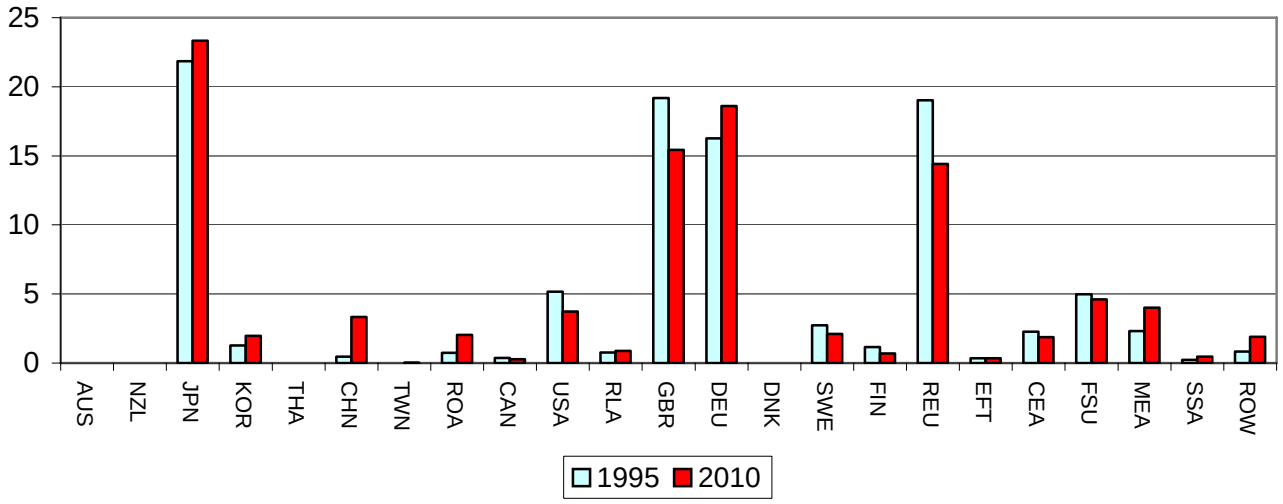
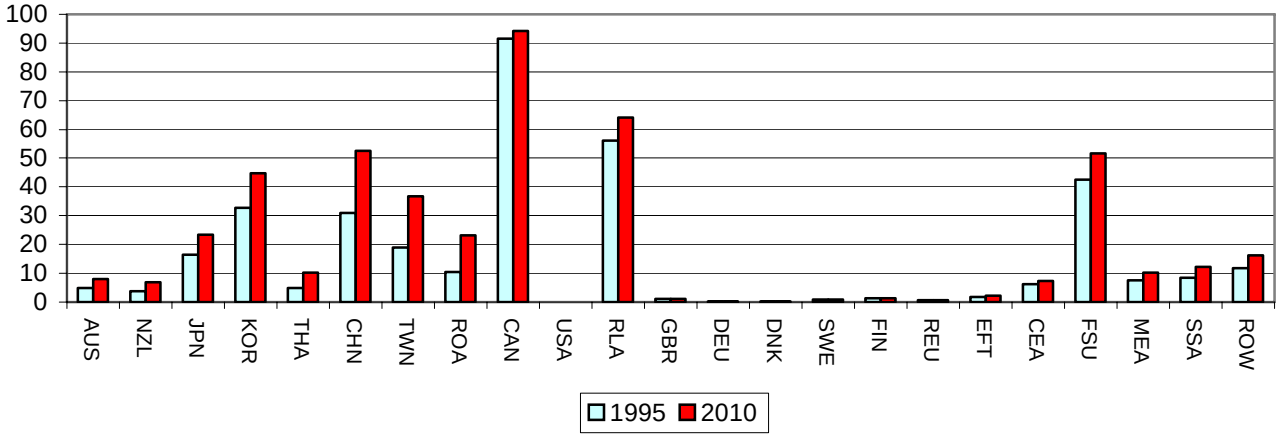


FIGURE 6. **Distribution of the Danish exports of pork and poultry, per cent**



In summary, the projection of the database to 2010 showed that Denmark's share of global agricultural exports will not change radically, and furthermore, it highlighted the importance of the growing Chinese economy and its increasing demand for food imports. The members of the Idea Group, including the industry representatives, accepted the underlying premises for the analysis. They found the overall description plausible, and particularly the picture of a relatively weak European position vs. a stronger US position in the global food markets was found relevant and an interesting basis for their discussions. The strengthening of the US position is illustrated in Figure 7 where the US gains market shares in all the important markets and particularly so in the rapidly growing economies in Asia. The relatively limited increases in US production costs (in contrast to the European case, the US labour force is not declining) explains this as well as the fact that the US seems to be better established in these markets (larger initial market shares).

FIGURE 7. **US market shares of total pork and poultry meat imports, per cent**



The Scenarios

The results of the four scenarios described above are illustrated in the following tables. In this paper we present only selected results focusing on the aggregate effects on production and exports, the economy-wide effects as well as a brief summary of the reactions and discussions that followed the presentations of the results.

Scenario 1

Imposing unilateral output taxes or quantitative restriction as described in scenario 1 leads to higher costs of production and thereby losses of competitiveness and market shares in both domestic and foreign markets. The estimated production losses in pork and poultry meat industries, for example, equal 0.6 percentage points as the growth rate in the baseline (1.6 per cent) is reduced to 1.0 per cent in scenario 1, cf. Table 4. Pork and poultry meat exports are reduced by 0.7 percentage points compared with the estimated growth in the baseline. The important policy initiatives driving these results are increased costs due to environmental regulations that have been introduced to protect drinking water from nitrate pollution, animal welfare measures that ban the strapping down of pregnant sows, and initiatives to reduce the occurrence of salmonella.

The farmers' union used these results to argue against further initiatives of this nature and indeed to request a reduction of the existing burdens of the unilateral Danish policy initiatives. The model results were therefore found to be very instructive and useful in illustrating the impact of the initiatives that have been passed since 1995 at the industry level. However, the farmers' organisations expressed substantially more scepticism when the derived welfare effects were discussed. The model simulations illustrated – given the explicit representation of the instruments of the Common Agricultural Policy (domestic subsidies and border protection) - that the Danish economy had in fact gained in terms of economic welfare (although only marginally (0.05 per cent)) since the initiatives counteracted the distortionary effects of the existing farm subsidies and protection measures. The scenario also generated a positive terms of trade effect given the assumed degree of product differentiation (an Armington specification), cf. Table 5.

The representatives from the Ministry of Food, Agriculture and Fisheries did not fully endorse the size of the negative impacts on agricultural production and exports. They believed that the effects were overestimated given the assumptions applied, including the specific cost calculations undertaken by the farmers' organisations (not taking into account for example certain rebates) and the assumption that all the initiatives were represented as output taxes. However, they found the welfare effects to be very instructive and noteworthy. The consumer organisations and the Ministry also stressed that the simulations did not take into account the positive (welfare) effects in terms of a cleaner environment, improved animal welfare and better food safety.

In spite of the critical remarks, the results were accepted and the group certainly found the model results worth debating, including the pros and cons of the specific initiatives and the derived impacts on Danish agriculture and the economy in general. The debate clearly reflected a willingness to discuss the major economic mechanism at play. Even important model assumptions did succeed in generating common ground among the different participants in the group. Examples include acknowledgement of the need for a long-term analysis, understanding of the degree of competition in

TABLE 4. **Danish production and exports, 1995-2010, annual changes, per cent.**

	Baseline		Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	Production	Exports	Production	Exports	Production	Exports	Production	Exports	Production	Exports
Wheat	1,1	3,1	0,7	2,5	0,7	2,3	1,1	3,3	1,1	3,1
Other grains	1,5	4,4	0,6	3,0	0,7	2,8	1,5	4,6	1,5	4,4
Fruits and vegetables	3,0	8,9	3,0	9,0	3,0	8,9	3,0	8,9	3,1	8,9
Oilseeds	0,6	1,8	-0,1	0,5	-0,1	0,4	0,6	1,8	0,7	1,7
Sugar beat	0,0	-4,0	0,0	-3,9	0,0	-3,9	0,0	-3,8	0,0	-4,2
Other crops	4,5	5,3	3,9	4,6	3,8	4,5	4,5	5,3	4,5	5,3
Cattle and sheep	0,4	0,7	0,4	0,7	0,3	0,7	0,4	0,7	0,4	0,7
Pig and poultry	0,8	1,8	0,4	1,8	0,8	1,8	0,8	1,8	0,8	1,8
Milk	0,1	0,0	0,1	0,0	0,1	0,0	0,1	0,0	0,1	0,0
Wool	5,9	8,0	6,2	8,3	6,1	8,2	6,0	8,1	5,9	8,0
Fisheries	0,6	1,0	0,6	1,1	0,6	1,1	0,6	1,1	0,6	1,0
Natural resources	1,7	4,0	1,7	4,0	1,7	4,0	1,7	4,0	1,7	3,6
Beef and veal meat	1,9	2,6	1,9	2,6	1,9	2,5	1,9	2,6	1,9	2,6
Pork and poultry meat	1,6	1,8	1,0	1,1	1,6	1,9	1,6	1,8	1,6	1,7
Oils	1,2	3,0	1,0	2,8	1,1	2,7	1,2	3,1	1,3	3,1
Dairy products	0,5	1,2	0,5	1,2	0,5	1,2	0,5	1,2	0,5	1,1
Sugar	0,2	0,1	0,2	0,1	0,2	0,1	0,2	0,1	0,2	-0,2
Other food products	0,8	1,1	0,8	1,1	0,8	1,0	0,8	1,1	0,9	1,1
Beverages and tobacco	3,2	5,1	3,3	5,2	3,3	5,1	3,3	5,1	3,4	5,0
Manufacturing	1,9	2,3	2,0	2,4	1,9	2,4	1,9	2,3	2,2	2,5
Services	1,7	1,6	1,7	1,6	1,7	1,6	1,7	1,6	2,0	1,6

Note:
Scenario 1 = Unilateral Danish regulations
Scenario 2 = Scenario 1 plus 10 % demand increase for Danish exports of pork, poultry meat and dairy products
Scenario 3 = Increased productivity to neutralise the negative production impact as determined in scenario 1.
Scenario 4 = Higher labour supply (0,4 per cent annually).

the global food markets and appreciation of the fact that competition is not only a concept related to output markets but that the agricultural and food-processing industries compete with other sectors in the economy in the input markets.

Scenario 2

Following this debate the group discussed the economic effects of the initiatives in scenario 1 combined with an assumed increased willingness to pay for Danish agricultural commodities. Exports and production increase significantly – more or less neutralising the negative impact of the 'soft initiatives', cf. Table 4. In welfare terms the income change amounts to 992 million Danish Kr., being explained entirely by the assumed terms of trade gain and the efficiency gain, cf. Table 5.

In general, the group found the results of the scenario interesting, although the food processing industry representatives found the specific scenario hard to believe. They questioned such a large additional willingness to pay for products being produced in a more environmentally and animal friendly manner. Rather, their presumption was that higher environmental and animal welfare standards as well as the enforcement of higher veterinary standards would (only) contribute to maintaining market shares in the future. The group generally agreed that due to the relatively strong competition on global food markets, more than a 1-2 per cent premium on Danish prices would seriously undermine the relatively strong position of Danish agricultural commodities on world food markets.

TABLE 5. **Welfare changes**

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Utility per capita, per cent	0.051	0.092	0.139	4.650
Income change (EV), mill 1995-kr.	552	992	1496	49933
Of which				
Efficiency gains	353	282	179	8628
Terms of trade	277	721	-49	-359
Technical progress	0	0	1404	0
Endowments	0	0	0	42909
Transfers to EU budget	-71	4	-9	-259
Other effects	-7	-15	-28	-985

Scenario 3

Along the way, the discussions within the Idea Group stressed the need for increasing productivity in both the agricultural and food processing sectors to improve the future outlook for Danish agriculture and to counteract the burdens being imposed on the agricultural sectors through various policy initiatives. Scenario 3 therefore estimated the productivity increases needed to exactly neutralise the adverse impacts of the burdens analysed in scenario 1. The estimated required increases in productivity range from 0.1 to 0.4 percentage points annually, cf. Table 6, some of them rather large in relative terms. The possible means by which such increases could be realised were also discussed, including the need for both the sector itself as well as the society at large to undertake research and development activities, to promote and use new technologies and to improve management practices. Moreover, the TFP increases estimated in this scenario spurred the debate about a pending innovation bill that was in fact passed by Danish Parliament at a later time.

TABLE 6**. Required productivity growth to neutralise adverse production impact in scenario 1**

	Baseline	Scenario 3	Change	Per cent change
Wheat	1.40	1.59	0.19	13.6
Other grains	1.40	1.71	0.31	22.1
Fruit and vegetables	1.40	1.42	0.02	1.4
Oil seeds	1.40	1.76	0.35	25.0
Sugar beet	1.40	1.48	0.08	5.7
Other crops	1.40	1.58	0.18	12.9
Cattle and sheep	1.40	1.48	0.07	5.0
Pig and poultry	1.40	1.64	0.24	17.1
Milk	1.40	1.40	0.00	0.0

Scenario 4

Increasing the labour supply by 0.4 per cent benefits the economy in general as the production capacity of the economy increases correspondingly. In economic welfare terms the per capita utility increases by 4.7 per cent, cf. Table 5.

According to Table 3, the growth rate of exports and production of agricultural products corresponds closely to the growth rate as determined by the baseline. It is worth noting that the agricultural and food processing industries are relatively intensive users of unskilled labour as compared to skilled labour. Since this scenario is based on the assumption that the share of unskilled labour in the total labour force falls significantly, the increased total labour force mainly benefits the manufacturing and services sectors. The annual growth rate of production is 0.3 per cent points for each of these two aggregate industries as compared to the growth rates in the baseline[4].

4. Summing up

The members of the Idea Group generally accepted the economic analyses, including the underlying data and model applied, and the insight provided by the analyses and their results was highly appreciated by all members of the group. Nevertheless, most of the members of the group also stressed that the results are indeed uncertain, while at the same time they accepted the signs and relative magnitudes of the results found. In the final report from the group it is concluded *"that the analyses gave a good basis for a structured debate of the effects and perspectives of the important structural changes as well as the industry-specific and economy-wide consequences"(MFAF (2000)).*

In terms of policy conclusions drawn from the analyses, the members of the group stressed the need for a continued focus on the 'soft issues' (high quality products, environmental and veterinary standards, animal welfare, control and documentation etc.), initiatives to improve the competitiveness of Danish agriculture including the strengthening of research and development, export promotion initiatives, and initiatives to enhance education and on-the-job training. Labour market issues were also stressed as extremely important for the outlook for the Danish food processing industries. The

[4] A sensitivity analysis illustrating the effects of both an increased overall labour supply of 0.4 per cent annually as well as an unchanged share of unskilled labour in the total clearly shows a positive impact on agriculture in terms of higher annual growth rates in both exports and production. However, lowering the average level of education of the overall labour force leads to a negative impact on economic welfare (which even dominates the positive effect of a higher overall level of employment).

members accepted the forecast of a slightly diminishing overall Danish labour force over the coming years, however they found that the projection of the share of unskilled labour to be falling – a tendency clearly demonstrated by recent trends - to be a much larger threat to agriculture and the food processing industries.

Naturally it is very difficult to determine to what extent a formal economic analysis has had an impact on the 'practical policy decision making process'. The reports from the Idea Group nevertheless conclude that the analysis undertaken and the accompanying discussions have influenced several of the recent reforms and reform proposals initiated by the Danish Government. These include for example the new innovation law, the new food policy strategy of the Ministry of Food, Agriculture and Fisheries, initiatives to obtain a more transparent and effective control and administration, and finally, initiatives to improve education and on-the-job training specifically targeted toward agriculture and the food processing industries.

5. Are there any lessons to be learnt from using CGE analysis in a policy advice context?

The analysis presented in this paper is the most recent example of how the SJFI team has used an applied general equilibrium model in a specific policy advice context. The present use of the (GTAP) model and database did not in itself involve serious new developments of the model or database. Given the expertise in using this type of model, the 'CGE tool box' was relatively smoothly adapted to the questions at hand. This time the task was more one of designing relevant scenarios of interest to the policy makers represented in the Idea Group, and furthermore to communicate the 'economic stories and mechanisms' involved in their discussions.

During the past five years the SJFI team has been developing and applying a national as well as a global general equilibrium model for different policy advise purposes[5]. The analyses often require new developments both in terms of the database and the model representation. Apart from the issues addressed here, the models have been used to analyse the enlargement of the European Union, reforms of the Common Agricultural Policy, bans against the use and imports of genetically modified organisms, environmental regulations (pesticides and nitrogen legislation) and the impacts of organic farming, cf. Frandsen (2001).

A number of conclusions of importance to users of CGE models in a practical policy advice context can be drawn from our experiences. First, the use of CGE models has brought the concept of taking an economy-wide perspective of an issue into the Danish agricultural economic and policy debate. This is an achievement of key importance since it allows a broader discussion of e.g. possible trade-offs between industry-specific effects and economic consequences in other parts of the economy. From a theoretical micro economic point of view it also allows us to undertake 'correct' welfare economic analysis.

Second, we have found it extremely important to co-operate with other experts (experts in agronomic, biological or institutional matters) – a co-operation that in all cases has proved to be extremely important for the acceptance and understanding of the economic (CGE) analysis and its re-

[5]Our national model is inspired by the Australian ORANI tradition, while the basis for the global model and database is the GTAP framework. Both the models and the underlying databases have been adjusted to the Danish/European context as well as other specific needs as relevant. Moreover, both models have in a number of cases demonstrated their merit in specific policy advice contexts.

sults. Typically, data and/or institutional features have been used as important and crucial inputs to the CGE analysis. The co-operation with such experts has proven to be very efficient in generating the needed credibility, enabling communication and acceptance of the economic analyses.

Third, we have found that the CGE-based analysis has proven very efficient not so much in the exact numerical results, but rather in the focus on important economic mechanisms and linkages, thereby providing a structured analytical framework. This structured and systematic approach has in a number of specific policy relevant cases demonstrated its ability to focus and structure an intense policy debate and has so far lead to a general acceptance of the main economic effects of the questions being addressed.

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Appendix

TABLE A1. **The 10 largest competitors on the world market for imported commodities in each of the shown commodities, 1995, per cent**

	The largest exporter	The 2nd largest exporter	The 3rd largest exporter	The 4th largest exporter	The 5th largest exporter	The 6th largest exporter	The 7th largest exporter	The 8th largest exporter	The 9th largest exporter	The 10th largest exporter
Wheat	USA (32.4)	REU (19.8)	CAN (17.1)	AUS (7.3)	RLA (6.7)	DEU (5.1)	CEA (3.9)	GBR (3.4)	MEA (1.6)	**DNK (1.4)**
Other grains	USA (55.8)	REU (17.3)	DEU (5.8)	RLA (5.5)	CAN (3.7)	GBR (2.8)	SSA (2.1)	CEA (1.4)	**DNK (1.3)**	FSU (0.9)
Fruits and vegetables	REU (40.8)	RLA (17.6)	USA (11.9)	MEA (8.5)	SSA (3.7)	ROA (3.6)	CHN (2.8)	CAN (1.6)	DEU (1.5)	CEA (1.3)
Oilseeds	USA (46.1)	RLA (16.6)	CAN (12.2)	REU (7.8)	CHN (4.3)	ROA (2.5)	CEA (2.5)	FSU (1.8)	SSA (1.7)	DEU (1.7)
Sugar beat	RLA (48.9)	AUS (17.4)	THA (11.5)	SSA (10.9)	ROW (3.6)	ROA (2.1)	REU (1.8)	CHN (0.9)	DEU (0.7)	FSU (0.5)
Other crops	RLA (19.3)	ROA (16.5)	REU (15.9)	SSA (13.0)	USA (11.3)	THA (5.2)	FSU (3.6)	MEA (2.5)	DEU (2.3)	CHN (2.2)
Cattle and sheep	REU (34.6)	CAN (13.3)	RLA (11.1)	DEU (8.5)	AUS (6.3)	CEA (6.3)	USA (5.1)	GBR (4.8)	MEA (4.0)	SSA (1.7)
Pig and poultry	REU (25.8)	USA (17.4)	CHN (7.5)	DEU (6.6)	GBR (4.3)	FSU (4.2)	CAN (3.8)	**DNK (3.7)**	MEA (3.2)	AUS (3.2)
Wool	AUS (52.9)	NZL (17.2)	CHN (6.6)	RLA (5.6)	REU (4.3)	FSU (3.8)	GBR (3.1)	SSA (1.9)	DEU (1.5)	ROA (0.7)
Fisheries	REU (13.2)	RLA (11.9)	EFT (11.7)	ROA (9.2)	SSA (5.7)	FSU (5.3)	**DNK (5.1)**	CHN (4.8)	ROW (4.5)	GBR (4.2)
Natural resources	MEA (32.2)	RLA (9.4)	SSA (8.7)	ROA (8.0)	REU (6.3)	EFT (6.0)	FSU (5.7)	CAN (5.3)	GBR (4.5)	AUS (3.9)
Beef and veal meat	REU (28.9)	USA (19.3)	AUS (12.0)	RLA (10.3)	NZL (7.7)	GBR (6.4)	DEU (5.9)	**DNK (2.5)**	CAN (2.5)	SSA (0.9)
Pork and poultry meat	REU (37.0)	**DNK (12.6)**	USA (11.3)	TWN (5.9)	ROA (5.2)	DEU (5.0)	CHN (4.3)	RLA (4.1)	CEA (3.5)	CAN (3.1)
Oils	ROA (32.1)	REU (22.9)	RLA (18.6)	USA (7.9)	DEU (5.2)	MEA (2.9)	CAN (1.6)	SSA (1.3)	CHN (1.2)	ROW (1.1)
Dairy products	REU (51.2)	DEU (16.9)	NZL (6.1)	**DNK (5.9)**	GBR (4.2)	AUS (3.6)	USA (2.9)	EFT (2.0)	CEA (1.7)	RLA (1.6)
Sugar	RLA (27.5)	REU (27.2)	THA (8.7)	AUS (8.5)	DEU (6.1)	SSA (5.7)	ROA (2.9)	USA (2.5)	GBR (2.5)	ROW (1.6)
Other food products	REU (26.6)	RLA (11.7)	USA (9.6)	ROA (7.4)	DEU (7.0)	THA (5.7)	EFT (3.8)	GBR (3.4)	CHN (3.1)	CAN (2.9)
Beverages and tobacco	REU (45.9)	GBR (13.4)	USA (11.3)	DEU (7.5)	RLA (4.0)	CHN (3.4)	ROA (2.7)	CEA (1.9)	CAN (1.8)	**DNK (1.2)**
Manufacturing	REU (21.7)	USA (12.1)	DEU (11.6)	JPN (11.1)	ROA (6.1)	CHN (5.4)	GBR (4.7)	CAN (3.8)	RLA (3.7)	TWN (3.0)
Services	REU (24.7)	USA (17.7)	DEU (7.1)	GBR (6.0)	CHN (5.9)	JPN (5.5)	ROA (5.3)	MEA (3.8)	RLA (3.7)	EFT (3.4)

TABLE A2. **The 10 largest competitors on the world market for imported commodities in each of the shown commodities, 2010, per cent**

	The largest exporter	The 2nd largest exporter	The 3rd largest exporter	The 4th largest exporter	The 5th largest exporter	The 6th largest exporter	The 7th largest exporter	The 8th largest exporter	The 9th largest exporter	The 10th largest exporter
Wheat	USA (42.2)	CAN (19.8)	REU (12.2)	AUS (7.7)	RLA (5.3)	CEA (4.1)	DEU (2.8)	GBR (2.8)	**DNK (1.3)**	MEA (1.0)
Other grains	USA (70.7)	REU (9.2)	RLA (4.8)	CAN (3.8)	DEU (2.9)	GBR (1.9)	SSA (1.6)	**DNK (1.3)**	CEA (1.3)	FSU (0.7)
Fruits and vegetables	REU (36.1)	USA (22.5)	RLA (15.7)	SSA (3.6)	AUS (3.5)	CAN (2.8)	MEA (2.5)	ROA (1.9)	NZL (1.6)	THA (1.6)
Oilseeds	USA (55.4)	CAN (15.0)	RLA (13.3)	REU (6.7)	CEA (2.4)	FSU (1.7)	SSA (1.1)	ROA (1.1)	DEU (1.1)	AUS (0.4)
Sugar beat	RLA (60.5)	AUS (17.8)	THA (9.5)	SSA (6.6)	ROW (1.3)	KOR (1.1)	REU (0.9)	CEA (0.6)	ROA (0.5)	FSU (0.3)
Other crops	USA (21.4)	RLA (19.1)	REU (17.8)	SSA (10.8)	ROA (7.2)	THA (4.8)	FSU (4.1)	DEU (2.0)	AUS (1.9)	**DNK (1.9)**
Cattle and sheep	REU (27.9)	RLA (12.8)	CAN (12.8)	AUS (8.9)	DEU (8.6)	CEA (5.8)	MEA (5.1)	GBR (5.0)	USA (4.4)	SSA (2.4)
Pig and poultry	REU (19.1)	USA (16.6)	CHN (15.6)	DEU (5.6)	NZL (4.8)	FSU (4.1)	ROA (3.8)	GBR (3.5)	AUS (3.2)	**DNK (3.2)**
Wool	AUS (46.7)	NZL (24.0)	GBR (7.7)	REU (5.7)	RLA (3.5)	FSU (3.4)	USA (1.6)	CHN (1.4)	DEU (1.4)	SSA (1.1)
Fisheries	JPN (19.6)	REU (16.6)	EFT (7.7)	FSU (5.5)	ROA (5.3)	RLA (5.0)	ROW (4.9)	THA (4.2)	USA (4.2)	CAN (3.7)
Natural resources	MEA (27.6)	RLA (8.9)	SSA (7.5)	ROA (7.4)	REU (7.1)	FSU (6.9)	CAN (6.3)	USA (6.2)	EFT (5.0)	GBR (4.6)
Beef and veal meat	USA (39.6)	REU (21.9)	RLA (12.5)	NZL (7.0)	AUS (5.8)	**DNK (2.6)**	CAN (2.3)	GBR (2.1)	CEA (1.9)	SSA (1.0)
Pork and poultry meat	REU (38.6)	USA (21.4)	**DNK (10.2)**	TWN (5.4)	RLA (4.7)	ROA (4.5)	CAN (3.5)	CEA (3.4)	GBR (2.6)	DEU (1.6)
Oils	ROA (30.2)	RLA (20.8)	REU (20.4)	USA (14.3)	DEU (3.6)	MEA (2.4)	CAN (1.3)	CEA (1.2)	GBR (1.1)	CHN (1.0)
Dairy products	REU (44.5)	DEU (15.5)	USA (9.3)	NZL (7.7)	**DNK (6.2)**	CEA (4.3)	GBR (3.1)	RLA (2.4)	AUS (1.9)	CAN (1.6)
Sugar	RLA (35.0)	REU (20.9)	THA (8.8)	AUS (8.4)	SSA (4.7)	DEU (4.2)	USA (3.6)	GBR (2.9)	ROA (2.3)	KOR (1.9)
Other food products	REU (24.6)	RLA (15.6)	USA (11.4)	ROA (7.0)	THA (5.1)	DEU (4.8)	GBR (4.0)	CAN (3.1)	EFT (3.0)	**DNK (2.7)**
Beverages and tobacco	REU (40.5)	GBR (16.2)	USA (12.7)	RLA (4.6)	ROA (4.6)	CHN (3.5)	DEU (3.2)	CAN (2.6)	CEA (2.3)	**DNK (1.6)**
Manufacturing	REU (17.4)	CHN (13.4)	JPN (13.1)	USA (11.0)	ROA (9.4)	DEU (5.4)	TWN (4.3)	KOR (4.1)	GBR (4.0)	RLA (3.7)
Services	REU (20.5)	USA (15.8)	MEA (11.0)	JPN (8.5)	ROA (6.9)	CHN (5.3)	GBR (4.7)	RLA (3.7)	DEU (2.9)	KOR (2.6)