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European Dairy Industry Model - EDIM

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Final Activity Report

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EUROPEAN DAIRY INDUSTRY MODEL

FINAL ACTIVITY REPORT

Objectives

- To design and use complementary modeling tools able to simulate the impact of alternative policy scenarios for the dairy sector over the medium term.

Methods

- Pooling of research expertise on dairy issues from different EU Member States
- Development of economic models of the dairy industry in the EU-25. Models are based on economics and econometric analysis

Expected results

- A comprehensive milk and dairy products database for the EU-25
- An operational model that simulates the impact of dairy policies on the main market variables for milk and 14 dairy products for the EU-25 and examines their implications for on-farm milk production
- Additional tools to perform in depth analysis of specific issues, such as the dynamics of farm structure, the location of milk production at regional level and the impact of direct income payments on EU milk supply
- Simulations of future dairy policy scenarios and interpretation of impacts
- A network of researchers specialized in the economics of the dairy industry

Partners

- Institut National de la Recherche Agronomique (INRA) – France
- Wageningen University – The Netherlands
- Università Cattolica del Sacro Cuore – Italy
- Bundesforschungsanstalt für Landwirschaft (FAL) – Germany
- VITAMIB – France

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Website of the project: http://edim.vitamib.com

Duration of the project: April 2004 – December 2005.

Results

- ***A comprehensive milk and dairy products database for the EU-25***

Two databases are designed from different sources. The first one is a consistent database to model milk supply in the New Member States (NMS). It gathers time series on milk and beef production, prices in acceding countries. The second one is a consistent database on year 2000 which provides the information on milk and dairy products markets in EU25. It provides information on production, consumption, price, export, and import for all dairy products as well product characteristics at the country level. For the new member states, the database distinguishes three countries, namely Poland, Czech Republic and Hungary, plus an aggregate of the 7 other countries. It also provides information on the domestic dairy policies as well as trade policies.

- ***An operational model that simulates the impact of dairy policies on the main market variables for milk and 14 dairy products for the EU-25 and examines their implications for on-farm milk production***

We have developed an improved version of the existing model of the European dairy industry that has been developed by the INRA-Wageningen consortium and has been used for the analysis of the Mid Term Review. The final model is a spatial model of the dairy industry in the EU25. It consider milk production, milk processing into 14 dairy products, demand for dairy products at the country level in the EU (18 countries or group of countries are considered). It also integrates a module that represents the Oceania dairy industry and a module on importing regions (four regions are considered). The model is designed to analyze the impact of policy reforms on the milk and dairy markets in the EU and on world markets. As compared to the initial model several improvements have been performed. The improvements are:

  - In depth analysis of milk production costs and milk quota rents in the EU15
  - Development of a milk supply model for each of the NMS
  - A better integration of the supply module in the EDIM Model
  - Enlargement of the EDIM Model to new member states
  - Improvement of the modeling of demand in the EDIM Model

- Development of a Rest of the world Module in the EDIM Model

- *In depth analysis of milk production costs and milk quota rents in the EU15*

A precise knowledge of milk production costs in the EU member states is a key element for any analysis of the dairy sector. Milk price will be reduced in the future and it is thus needed to have accurate estimates of production costs and quota rents to anticipate the level of milk production in the future.

The theoretical framework used for estimating production costs is based on a multi-input multi-output cost function. It is assumed that farmers employ a set of inputs to produce milk and an aggregate of other outputs. Depending on the time horizon, it is assumed that farmers cannot adjust the optimal level of some inputs. Thus, some of them are considered fixed. In the short-run family labour, land, hired labour, dairy cow stock, machinery and buildings are considered fixed. In the medium run family labour and land are fixed. Finally, in the long-run the only fixed factor is family labour.

Two studies were conducted. They use two different parametric specifications for the cost function: an ad-hoc functional form (AFF), the linear quadratic form, and a flexible functional form (FFF), the hybrid-translog cost function. For each EU-15 member state, an unbalanced panel of farms covering the period 1996-2001, taken from the Farm Accountancy Data Network (FADN), is used.

Table 1: Medium-run marginal costs evaluated under different estimation procedures on the sample of all dairy farms (1996-2001)

	AFF cost function			FFF cost function		
	Average reference quantity (t)	Medium-run marginal cost (€/t)[a]	Medium-run quota rent (€/t)	Average reference quantity (t)	Medium-run marginal cost (€/t)[b]	Medium-run quota rent (€/t)
Austria	64	186	114	67	169	131
Belgium	196	162	123	201	156	129
Denmark	374	242	97	390	228	110
Finland	114	240	95	113	219	114
France	198	173	137	207	195	115
Germany	171	180	129	179	169	140
Greece	n.a	n.a	n.a	17	232	83
Ireland	146	122	161	170	162	122
Italy	78	355	37	128	261	133
Luxembourg	224	169	148	n.a	n.a	n.a
The Netherlands	393	122	200	420	178	144
Portugal	52	296	-48	67	228	21
Spain	78	202	71	102	147	127
Sweden	194	309	34	247	270	73
The United Kingdom	458	181	111	495	163	130

(a) Computed from the average MC function evaluated at the sample mean

(b) Computed in each sub-sample as weighted average of the farm-specific MCs and then furtherly weighted with the share of farms represented by each sub-sample in the FADN population

Long-run marginal costs turn out to be higher than the milk price in a number of EU-15 countries (e.g. Denmark, Finland, France, Germany, and Sweden). In these countries, in the long run, the quota rents would be negative. Medium run marginal costs appear to be consistently lower than long-run marginal costs, a finding in contrast with expectations. Estimates differ according to the method used and the way the average marginal costs are calculated. Comparing the AAF estimates with the FFF estimates, marginal costs turn out to be quite robust for the majority of countries, except for the Southern countries (Italy, Spain and Portugal), for which the marginal costs estimated with the FFF cost function are substantially lower, and for Ireland, where the FFF marginal cost is much higher.

Finally, both studies show that, in many countries, a relevant share of farms in the FADN sample is producing their quota in the decreasing part of their marginal cost curves. This has important implications for the use of this type of results for policy simulations. In fact, all those farms that are not in the standard cost condition (i.e. in the increasing part of their marginal cost curves and above the minimum of the corresponding average cost curves) do not respond to the quota rents, but to the relationships between milk price and average cost. Thus, this result implies that any policy simulation carried out using an upward sloping implicit milk supply curve and the average quota rent should be taken with caution.

- *Development of a milk supply model for each of the NMS*

The supply model has been constructed according to clearly defined scientific principles. It is strongly based on production theory and has been constructed in a way that maximizes the contribution of empirical information on the sector studied. The main behavioral relationships of the model are econometrically estimated, using a combination of time series sample data and non-sample information (NSI) on technical, biological, structural and institutional parameters of the sector. The model is fully dynamic, allowing for immediate short-run adjustment of outputs and variable feed use, but also allowing for more gradual adjustment of the livestock numbers and land allocated to forage and grazing.

The underlying philosophy of the model is summarized by several key strategic features: similar framework for all countries, theoretical consistency, use of prior information (estimates from the literature, use of agronomic information, technical coefficients) and econometric estimation in order to allow time series data to “correct” prior information on individual parameters.

A special feature of the model is that beef and dairy production are fully integrated in a country-specific treatment. Integration operates as regards both the underlying decision making model and the trade-offs between the two types of production. This combined representation has been considered important for several reasons: in many parts of the EU milk is produced on farms that also engage in

beef production from non-dairy herds. Moreover, the dairy herd even on specialised dairy farms is a major source of beef production. Therefore, changes in policy regarding the production of milk, in so far as they affect dairy cow numbers, will have an important effect on the quantity of beef produced.

As compared to the EU-15 dairy model, for the eight new CEEC member states a simplified modelling structure was used (no distinction between dairy cows and suckler cows). The estimation philosophy (reliance on both sample and non-sample information) is the same as for the EU-15, but a different estimation procedure (mixed generalized maximum entropy estimation) was used in order to cope with the limited data availability, its often poor quality, and lacking degrees of freedom.

Table 2 provides an overview of the medium-run elasticities (dairy cow stock allowed to adjust) obtained for the new member states. As the table shows price responses are inelastic, beef and veal supply is more sensitive to own price than milk supply, and except for Latvia milk and beef and veal behave as complementary outputs (joint production).

Table 2: Medium-run price responses for dairy, beef and feed

Country	*Supply equation*	*Price responses*		
		cow milk	beef and veal	feed
Czech Republic	cow milk	0.3507	0.1040	-0.4548
	beef and veal	0.1579	0.5080	-0.6659
Estonia	cow milk	0.3745	0.0017	-0.3762
	beef and veal	0.0050	0.4683	-0.4733
Hungary	cow milk	0.2896	0.0711	-0.3606
	beef and veal	0.1519	0.4498	-0.6017
Latvia	cow milk	0.2419	-0.1020	-0.1399
	beef and veal	-0.2703	0.3971	-0.1268
Lithuania	cow milk	0.3177	0.0056	-0.3233
	beef and veal	0.0124	0.3878	-0.4001
Poland	cow milk	0.2625	0.0750	-0.3374
	beef and veal	0.1079	0.4811	-0.5890
Slovak Republic	cow milk	0.3819	0.0672	-0.4492
	beef and veal	0.1363	0.4963	-0.6326
Slovenia	cow milk	0.2949	0.0152	-0.3101
	beef and veal	0.0248	0.4972	-0.5220

- *A better integration of the supply module in the EDIM Model*

The milk supply model is too complex to be directly used in the dairy processing and demand model. In order to establish a linkage between the two models a (linearized) reduced form of the supply model was derived.

The own price response of this reduced form equation includes the direct impact of a change in milk price on milk supply (short-run response) plus the indirect impact of a change in milk price on the

quasi-fixed factors as well as the indirect impact of a change in quasi-fixed factors on milk supply. The same holds for the other price responses. Because the original supply model includes a milk supply and a stock equation with lagged variables, as well as autonomous shift variables (trend), the reduced supply form included in the dairy processing and demand model integrates an over time changing intercept of the milk supply relationship.

- *Enlargement of the EDIM Model to new member states*

The EDIM model is enlarged to the 10 new Member States. The processing / demand module is enlarged to the 10 new member states by adding the three main producing countries Czech Republic, Hungary and Poland, and one region, representing the seven other countries. Production, consumption and trade balances are constructed for 11 dairy products. Moreover the dairy policy instruments that were implemented in the new member states were modelled. From 2000 to 2004 that is during the pre enlargement period, the policy instruments are country specific as each of the new MS had its specific policies. From 2004 and onward, the dairy policy instruments in new Member States are those in place in the EU (implementation of milk production quotas, direct payments but at a lower rate, export subsidies, import quota, over quota and within quota tariff rates, …).

- *Improvement of the modeling of demand in the EDIM Model*

Previous work (INRA-Wageningen, 2002) has shown that the results of the EDIM model are very sensitive to the characteristics of demand for dairy commodities and particularly on the reaction of dairy product demand to prices (demand elasticity) and on how the demand changes over time (autonomous trend).

Because the previous version of the model used price elasticity parameters that were not estimated but derived from different studies of demand, we first have built and actualised a survey of the different existing studies. Secondly, we developed econometric estimates of the demand for dairy products in four EU countries (France, Germany, Italy, and United Kingdom). Due to data availability, we have developed two different procedures to estimate elasticities of demand in the selected EU countries. For two countries (France and Italy), it was possible to estimate an AIDS (Almost Ideal Demand System) model that was applied to a multi-stage budgeting allocation. On the other hand, for Germany and UK we estimated a Log Log model for the main dairy products. For the other countries, we have derived demand elasticities from these estimates. The elasticities used in the model correspond to unconditional, uncompensated elasticity at the factory gate, which are thus lower than at the consumer level. As a general result, we find that the price elasticities of most products are lower than 0.4 in absolute value (Table 3)

Table 3 : Estimated price elasticities at the wholesale level and at the consumer level. (France and Italy)

	France			Italy	
	Wholesale price	Consumer price		Wholesale price	Consumer price
Fresh dairy prod.	-0.053	-0.126		-0.172	-0.626
Cream	-0.389	-0.606			
Fluid milk	-0.133	-0.150		-0.351	-0.621
Butter	-0.103	-0.155		-0.159	-0.378
Cheese	-0.074	-0.177		-0.043	-0.252
PDO cheese				-0.030	-0.174

Autonomous changes in the demand, that is all changes that are not due to price changes, have been evaluated for the main consuming Member States (Germany, France, Italy, and Netherlands) in order to have trends which are country specific. For the other Member States (in EU15), we have estimated an aggregate trend. Due to a lack of data it was not possible to estimate consumption trends in the New Member countries. Estimation results for EU15 countries show that only butter and fluid milk experience a decrease in consumption over the period. All other products experience growth in demand (Table 4). The increase in the consumption of fresh dairy products and cheeses is large. In aggregate, the demand for fat increases by 0.4% per year and the demand for protein increases at a higher rate (1.0%). However, results show heterogeneity between trends at the country level.

Table 4: EU-15 Consumption of dairy products in 2000 and 2010

	Consumption estimated in 2000 (kt)	**Consumption estimated in 2010[(1)] (kt)**	**Growth rate 2000-2010**	**Annual average growth rate[(2)]**
Butter	1695	1475	-13.0%	**-1.4%**
Cheese	6425	7602	18.3%	**1.7%**
Processed cheese	465	535	15.1%	**1.4%**
Fluid milk	32755	30926	-5.6%	**-0.6%**
Cream	1811	2056	13.5%	**1.3%**
Fresh dairy products	7837	9952	27.0%	**2.4%**
Whole milk powder	430	494	14.7%	**1.4%**
Condensed milk	1047	1240	18.4%	**1.7%**
Total Fat	4371	4541	3.9%	**0.4%**
Total Protein	3204	3550	10.8%	**1.0%**

(1) 2010 estimated consumption is computed from country results. GDP is supposed to increase by 1% per year between 2004 and 2010.

(2) Computed as exponential growth rate.

- *Development of a Rest of the world Module in the EDIM Model*

A complete module for the rest of the world has been implemented. This module is divided in two blocks. The first block is a supply module from Oceania, the main exporting country on world markets. It exports tradable dairy commodities on world markets without any trade policy. For Oceania, we thus design a milk supply function and a dairy processing module. Since Oceania does not produce the same variety of dairy products than the EU countries, the processing module for Oceania considers a subset of the dairy products. The domestic demand in Oceania, which is relatively small as compared to production, is modelled in a very simple form.

The second block represents the demand for imports in the four main importing areas (Africa and Middle East countries, America, Asia and the Rest of Europe). To parameterize the import demand in each importing areas, we have estimated import demand elasticities for three of the main importing areas. Modelling import demand from aggregate zones was rather difficult because of several problems (heterogeneity of the goods, definition of import price, aggregation problem in relation to the determination of average import prices, existence of TRQ in some countries, availability of data, etc.). Estimations were made at the country level and average elasticities weighted by the average import share of the countries were computed.

With the explicit modelling of the rest of the world dairy markets, it is possible to model trade policies on world markets. We thus integrate over quota import tariffs for each of the importing areas. Due to aggregation problem, it was not possible to include all tariff rate quotas in the importing zones.

- ***Additional tools to perform in depth analysis of specific issues***

The I-W model is developed to analyze the markets consequences of dairy policy reforms at the level of the different member states. We develop additional tools to provide a better knowledge of the dairy sector in the EU and how it will change in response to the different foreseen reforms. In particular, we develop:

- A tool to analyze milk supply and dairy farm incomes within different EU member states.
- A tool to analyze the dynamics of farm structure in different EU member states.
- Models based on imperfect competition in order to assess the robustness of results obtained under a perfect competition framework.

- *A tool to analyze milk supply and dairy farm incomes within different EU member states*

Milk price reductions and the decoupling of direct payments are likely to induce many adaptations in the dairy sector, concerning both total supply and regional allocation of milk production. This will lead to both a considerable structural change and to changes in the systems of quota trade/transfers. Changes in farm income are mainly induced by price changes, level and specification of direct payments and especially the implementation of decoupling based on historical or regionally based entitlement reference.

To address the above issues, the already existing farm group model FARMIS has been further developed under the EDIM project, such that it can be used for EU-wide analysis (EU-FARMIS).
EU-FARMIS is a comparative-static programming model based on Farm Accountancy Data Network (FADN) data, with individual farm data being aggregated to farm groups.

The core of EU-FARMIS is an optimisation matrix which contains in the current version 27 activities of crop production and 22 activities of livestock production. A Positive Mathematical Programming (PMP) procedure is used to calibrate the model to the observed base year. FARMIS has been developed for 5 EU member states: Germany, France, United Kingdom, The Netherlands and Hungary.
The results for *Germany* show that despite lower milk prices and the decoupling of direct payments, milk production will only be reduced in a few farm groups in the target year 2013. The total quota will be fully used if quota trade is possible. Quota will be transferred from small towards larger farms. The results for *France* show that the milk quota is still fully used. The analysis shows a reallocation of milk quota between the regions and size classes in case of quota trade at the national level. Milk production will be further concentrated in the East and West of France. In these areas, medium and large farms increase and small farms slightly reduce milk production. The quota comes mainly from small farms in the South and the Centre. The results for the *United Kingdom* show that the sector milk quota is still fully used, even under decoupling and a strong milk price decline as within the reference scenario. The changes in milk production over the regions and size classes are mainly affected by milk quota trade, but also by the decoupling schemes, which differ by region. Under CAP reform conditions, milk production slightly declines in England, Wales and Scotland and increases in Northern Ireland. The results for *The Netherlands* show that the quota price in each farm group remains greater than zero, therefore milk quota is still binding and milk production will not be reduced. Quota trade lead to a reduction of milk production in smaller farms over time. CAP reform induces a reduction of milk production in farms with a high share of fodder maize in the base year. As in other countries a substitution of fodder maize in the feed ration is induced by decoupled payments. The results for *Hungary* show that milk market reform, including decoupling, should not heavily affect

milk production in Hungary. However, milk quota trade at the sector level leads to important structural change and reallocation of milk production. Regions that have a low share of total milk production in the base year are expected to decrease milk production.

- *A tool to analyze the dynamics of farm structure in different EU member states.*

The European dairy sector have been experiencing a strong dynamics in the farm size distribution for many years: basically, the number of farms has been decreasing and therefore their average size has increased.

The study on dairy farm size distribution aims to provide a better understanding of the dynamics in farm size distribution in Europe, stressing a possible relation with policy variables.

The study uses a Markov model which is a system of equations that relates transitions between different states (i.e. size classes) over time: the relation between states over time is given by a matrix of coefficients (probabilities). The main result of the analysis is the estimation of this matrix. In our study, this matrix is not assumed to be constant over time, since this assumption rules out the possibility that changes in the environment (i.e. changes in the relevant economic, policy, financial, demographic, marketing and policy analysis) will have an impact on the dynamics of farm size distribution.

The estimation of the non-stationary model has been carried out using an information theoretic estimation approach (maximum entropy estimation) that exploits prior information. A set of explanatory variables influencing transition probabilities is used. This model has been estimated for 4 countries: The Netherlands, Germany (West and East separately), Hungary and Poland.

Using the estimated model, farm size distributions have been predicted until 2010; three policy scenarios have been considered: a status-quo scenario (milk prices and quota/production maintained at year 2000 level), the Luxembourg scenario (the current policy scenario), and a WTO scenario. The evolution of milk price is based on the simulation done with the I-W model (see further details below).

Despite of the small impact elasticities, changes in the explanatory variables may affect the dynamics in the sector; differences can be found among scenarios. Although both the Luxembourg and the WTO scenarios show a similar pattern, significant differences can be found with the status-quo scenario. In the baseline (status-quo) scenario we register a general reduction in the total number of farms: over the simulated period (2003-2010) the reduction in the total number of farms ranges from 11% in Poland to 26% in West Germany.

Table 5 summarizes the main results. The first column gives the calculated rates of change for the status quo scenario. The second and third columns indicate how the total number of dairy farms in 2010 deviates from the number predicted for the status quo scenario. As the Table shows both the Luxembourg reform and the WTO scenario will lead to a lower number of active farms than in the

status quo in particular for West-Germany and to a lesser extent also for the Netherlands and Poland. For East Germany and Hungary just the opposite holds.

Table 5: Summary of simulated changes in the number of dairy farms

	Annual rate of change in Status Quo scenario	Percentage deviation from Status Quo scenario of total number of dairy farms in 2010 under …	
		Luxembourg reform	WTO-aggreement
Netherlands	-3	-3.6	-3.5
West-Germany	-8	-22.5	-19.8
East-Germany	-1	10.5	0.2
Hungary	-2	8.9	1.8
Poland	-3	-14.0	-9.6

Taking the status-quo scenario as the baseline, it is shown that changes in the environment will impact significantly the farm size distribution. For example, in West Germany, policy changes will affect negatively the number of the smallest farms. In East Germany major differences with the baseline can be registered for the largest farms. Regarding the new entrants, while Hungary will be only slightly affected by policy changes, with some small changes for the smallest farms, a greater impact will be found for Poland, where subsistence farms will be further reduced.

A different method was used to analyse dairy farm dynamics in Italy. It focuses more on the analysis of micro-economic determinants of production dynamics. Seven factors that can influence the decision on the structure of the farm have been identified: technology, milk quality, services, family, farm flexibility, specialization, milk destination. These factors have been used to explain the evolution of farm output. The main policy implication of the analysis comes from the non-significance of some factors (milk quality, degree of specialisation, milk destination and farm services provided by local associations). Although these results need to be confirmed by further investigations, they raise questions on the effectiveness of policy tools aimed to provide services and opportunities to farmers, especially for those included in the rural development programs.

- *Models based on imperfect competition in order to assess the robustness of results obtained under a perfect competition framework.*

The I-W simulation system assumes perfect competition at the processing stage and product homogeneity within each class of dairy products. In reality, this is not fully the case since the processing and retailing sectors are concentrated and they can exert some market power. Moreover, for some products (cheese in particular) product differentiation within each class can be very important,

and this is a second source of market power. Finally there exists PDO products whose production is subject to important constraints.

Dealing with these sources of imperfect competition needs a specific research investment. While it is a long term objective to incorporate in the simulation system some elements of imperfect competition, within the time frame of this project it has been possible to test the impact of incorporating some elements of imperfect competition on a simplified form of the model.

A first step has been to highlight the structure and the conduct of the European dairy industry, with special focus on the imperfect competition issue. Secondly, drawing from the available literature on imperfect competition, two models are developed for policy modelling using different approaches.

The results show how the introduction of market power in the spatial dairy industry model changes the market equilibrium characteristics. The main qualitative results of the simulation exercise showed that the existence of market power on some markets:

1. significantly modifies the implicit price of milk components;
2. could lead to an increase in EU exports as firms price discriminate among countries; with market power, domestic price is not the adequate indicator of competitiveness;
3. modify dramatically the distribution of surplus among agents;
4. is potentially an important source of welfare losses. Losses from market power exercise could be as high as welfare losses generated by distorting policies such as export subsidies policy.

This analysis suggests that agricultural economists should devote much more attention to imperfect competition in the agricultural and food sector.

Using a model that represents the Italian dairy sector, we conduct policy simulation of the Luxembourg reform. Results show that a significant degree of market power for some products has a substantial implication on the projected policy scenario: for example, the price of liquid milk is increasing under imperfect competition while it is decreasing in the perfectly competitive case.

Although the econometric results are not definitive, as in the case of the spatial model, considering imperfect competition leads to different conclusion of the policy impact on the different products. Moreover, it allows more flexible behaviour of market variables that can better reflect real world situations.

- ***Simulations of future dairy policy scenarios and interpretation of impacts***

Using the new calibrated version of the I-W model, we have first run a reference scenario (Baseline) that corresponds to the dairy policy that was decided in Luxembourg in June 2003. It thus represents dairy market equilibrium when only the EU policy changes. Seven baseline scenarios were defined

and simulated in order to evaluate the sensitivity of the baseline results to alternative assumptions on key parameters of the model (such as quota rents and trends in the demand in EU15, EU10 as well as in the rest of the world).

The Luxemburg reform has a significant impact on the farm milk price which first declines till 2006-2007 because of the decrease in the intervention prices. Then it remains stable till 2008-09 as the potential negative impact on prices of the increase in quota is fully compensated by the increase in the domestic demand. From 2009-10 and onwards, the reform is over and then the EU milk price increases in response to the increase in demand (Graph 1). The accession, in 2004, of the new member countries tends to increase prices in EU10 but the milk price in EU10 remains lower than in EU15. Milk quotas were not binding initially in EU10 countries allowing for a gradual increase in production.

With respect to dairy products, prices of final commodities are first reduced following the reform. However, at the end of the reform period, the prices of butter and SMP remain above the intervention price (Graph 2 and 3). This is a consequence of the increase in the demand for processed commodities. This increase in demand results both from an increase in consumption due to a decrease in the prices of dairy products and an increase in consumption due to trend effects (in particular for cheese and fresh products). This increase in demand generates additional demand and makes the EU market less dependent on exports. It should be noted that EU export subsidies are set to 0 at the end of the reform period. After the reform period, prices of dairy commodities start to increase and continue to increase gradually until the end of the period.

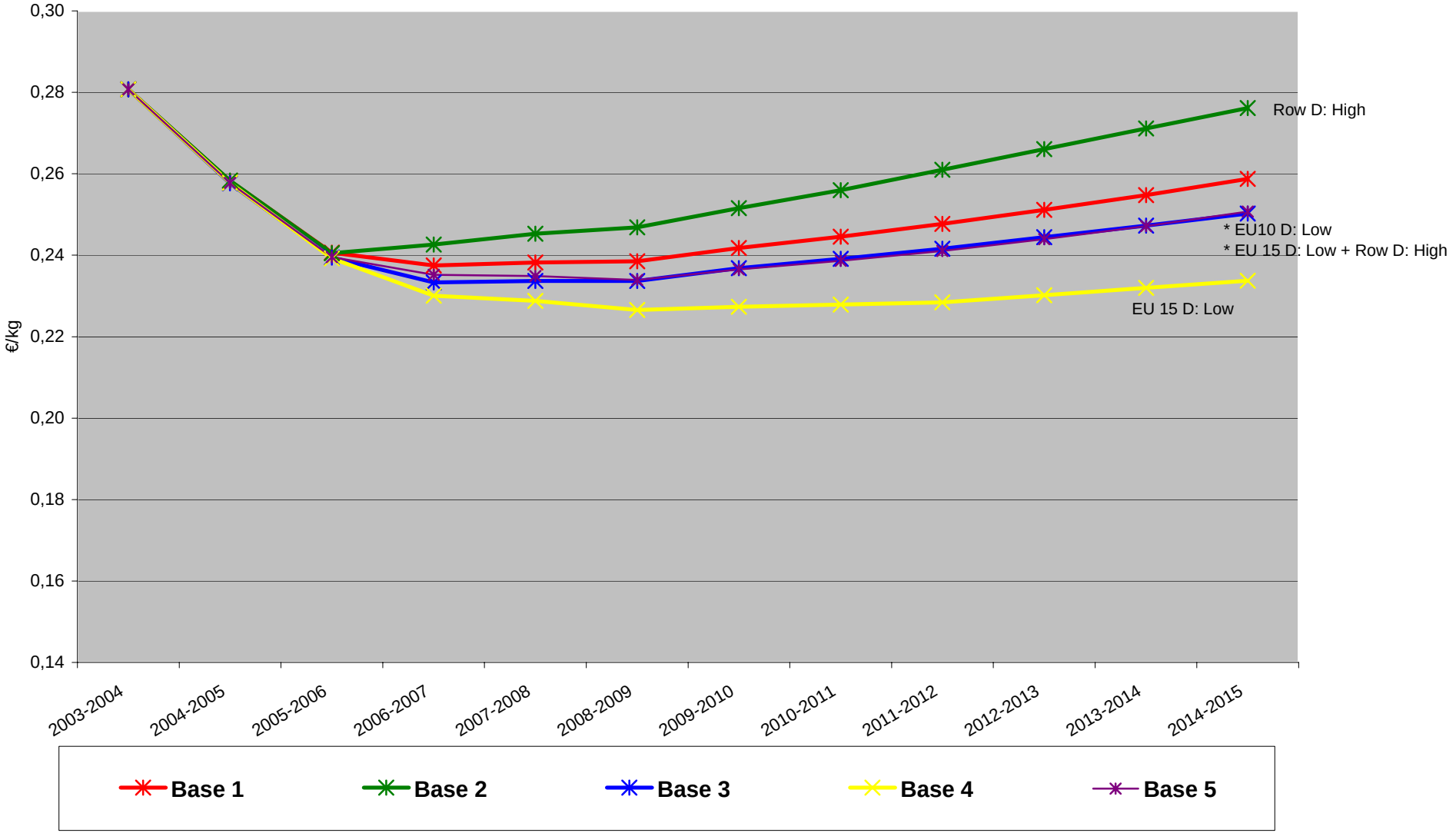
As shown on Table 6, results are sensitive to the evolution of demand in the future. This is a consequence of both the existence of a quota system and the global inelasticity of demand that makes prices highly sensitive to the level of demand.

From a welfare point of view, the Luxemburg reform generates a loss of surplus for producers because it affects prices and because the decrease in the price is not fully compensated by the implementation of direct payments. However, at the end of the period producers recover their initial level of surplus thanks to the positive effect of the evolution of demand on prices.

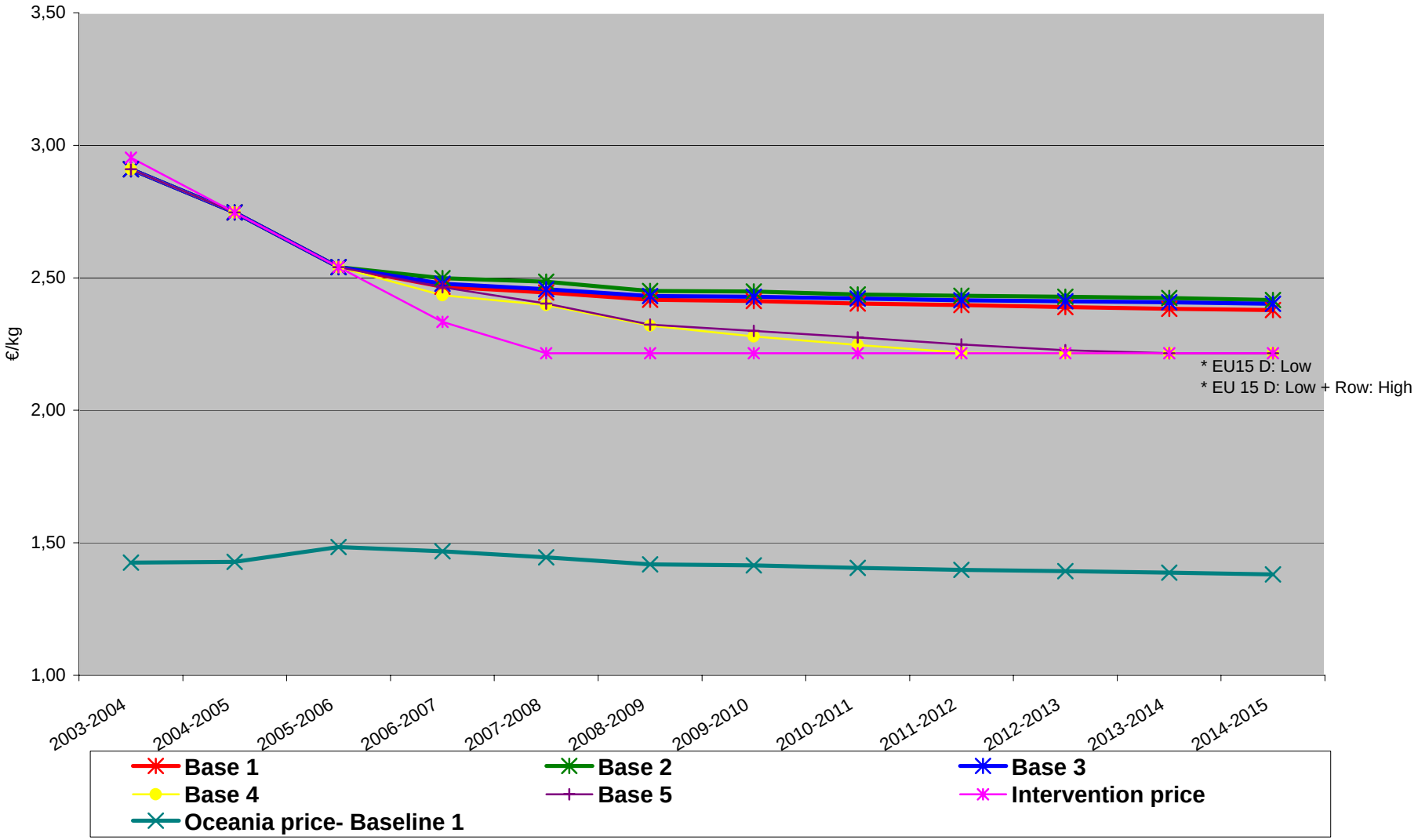
Thanks to the improvements made in the model, it is also possible to derive the impacts of the Luxembourg reform on the Oceania market. The prices of milk and dairy products at the end of the period have increased following the positive trend in the demand for dairy products. And as a result, the productions of milk and dairy products have increased.

When considering higher initial marginal cost, results remain similar. The production in the EU is slightly lower and prices slightly higher. Other results remain relatively unchanged. On the contrary, the assumption on the evolution of demand both on the domestic and on the world markets is a key parameter of the evolution of dairy markets in the future. The magnitude of the reduction in prices due to the reform will depend on this assumption. The higher the demand and especially the demand in the EU, the lower the reduction in EU prices will be.

Graph 1: Raw Milk Price in EU25



Graph 2: Butter Price in EU25



Graph 3: SMP Price in EU25

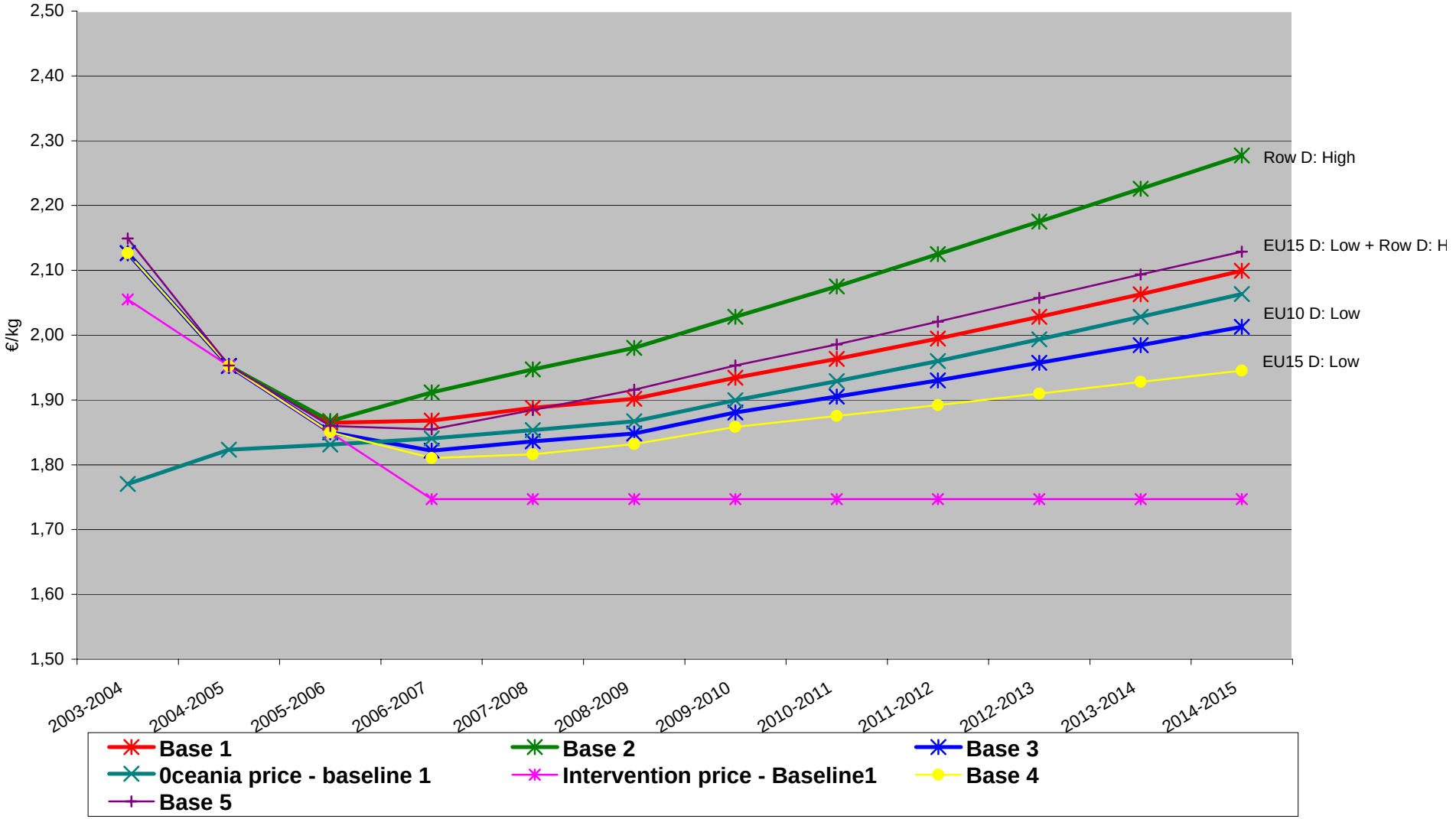


Table 6: Sensitivity of market equilibrium variables to alternative evolution of demand for dairy products in EU 25. Relative results, Index 100 = result in 2012-13 for Baseline 1.

EU 25	Base 2	Base 3	Base 4	Base 5	Base 6
Farm milk					
Price	105.9	97.3	91.7	97.1	100.8
Production	100.1	100.0	99.9	100.0	100.0
Butter					
Price	101.6	100.9	92.7	93.2	95.3
Production	99.5	101.3	103.0	102.1	101.5
Oceania price	109.2	101.4	96.7	106.9	107.4
SMP					
Price	107.2	96.5	94.2	101.4	104.5
Production	98.9	106.4	107.8	106.6	101.0
Oceania price	107.4	96.4	94.1	101.4	104.5
WMP					
Price	106.1	97.9	94.5	100.6	103.0
Production	104.9	104.4	116.6	125.2	116.6
Oceania price	106.6	97.7	94.1	100.7	103.3
Cheese					
Production	100.5	97.6	96.5	96.8	99.4
SHC					
Price	104.4	97.6	94.6	98.7	101.5
Production	101.5	97.7	99.6	100.5	103.3
Oceania price	105.9	97.0	92.9	99.3	102.0
FLM					
Price	103.4	98.3	95.9	99.2	101.1
Production	99.4	100.3	103.1	102.5	102.2

Base 1: estimated trend of demand in EU15, EU10 and no trend in Rest of the world

Base 2: Base 1 except a 2% increase of demand in Rest of the world

Base 3: Base 1 except no trend in EU 10

Base 4: Base 1 except ½ estimated trend in EU15

Base 5: Base 1 except ½ estimated trend in EU15 and a 2% increase of demand in Rest of the world

Base 6: Base 5 except twice the estimated trend in EU10

We used the model to simulate some scenarios of policy reforms. First, we assume a WTO reform that consists in removing export subsidies and reducing import and over quota tariffs in all countries. We use the Mandelson proposal and assume that the agreement starts in 2008-09 and is put in place gradually over a 5-year period.

We found that the WTO reform has a positive impact on the milk price both in EU and Oceania. Actually, the reduction in tariffs in the rest of the world importing areas generates an increase in the demand from the rest of the world. This increase in demand has a positive impact on the world price as well as on Oceania exports. For the EU, the reform has two effects that go in opposite direction. The reduction in tariffs and the removal of export subsidies have a negative impact on prices while the increase in demand in the rest of the world has a positive one. We find that the positive impact is larger than the negative one. This is because in the baseline scenario, the EU does not use export subsidies and EU imports remains marginal.

Table 7: Impact of alternative scenarios on market equilibrium variables in EU 25. Relative results. Index 100 = result in 2012-13 for Baseline 5.

2012-13	B5WTO	B5WTO1Q	B5WTO2Q
Farm milk			
Price	103.4	92.0	86.2
Production	100.3	103.8	105.5
Butter			
Price	98.8	85.9	77.9
Production	98.8	104.0	106.3
Oceania price	109.8	105.1	104.0
SMP			
Price	104.7	98.3	95.3
Production	95.5	105.5	109.2
Oceania price	104.5	98.1	95.1
WMP			
Price	103.7	97.3	93.8
Production	103.4	128.5	139.6
Oceania price	104.0	97.1	94.1
SHC			
Price	102.8	96.0	92.8
Production	102.0	106.1	108.9
Oceania price	103.7	97.5	94.2
FLM			
Price	102.1	96.7	94.2
Production	99.6	100.6	101.0
Cheese			
Production	100.0	102.3	103.4

B5WTO: WTO scenario;

B5WTO1Q: B5WTO + 1% increase in quota/year

B5WTO2Q: B5WTO + 2% increase in quota/year

We tested other scenarios where in addition to WTO reform, we assume an increase in the EU milk quota. We test a 1% and a 2% per year increase of the milk production quotas starting in 2008-09. Due to the increase in quota, the production of milk increases and the milk price decreases. In a lot of countries the quota is no longer binding which means that the change in milk production is lower than the change in milk quota. Finally, prices of dairy commodities decrease and their production increase and the reduction in prices make them more competitive on the world markets, so that exports of EU also increase. We also find that the price of SMP remains above the intervention price while this is not the case for butter, whose price is significantly lower than the intervention price.

The results that are presented above rely on an assumption of perfect transmission of price changes along the food chain. This needs to be acknowledged when interpreting the results. In particular, if decreases in wholesale prices of dairy products are not transmitted to the final consumers then the increase of EU domestic consumption could be lower. In that case, it is possible that the EU needs to use more extensively export subsidies in order to equilibrate the markets of dairy products, in particular of fatty dairy products.

The supply, allocation and income effects of the different scenarios at the country level have been analysed using the EU-FARMIS model for Germany, the United Kingdom, the Netherlands and Hungary using the change in milk quota as well as in the farm milk price derived in the European dairy industry model.

The underlying scenarios assume price reductions in EU-15 ranging from around 10% in the baseline to 23 and 27% in the WTO scenarios, the latter combined with additional quota of 5 and 10%, respectively. Equilibrium rental quota prices decrease by about 3.8 and 7.6 ct/kg in the WTO-1 and WTO-2 scenarios, respectively. Additional quota in WTO-1 will not fully be used in Germany and France. Additional quota in WTO-2 will not fully be used in Germany and France and the United Kingdom. Thus, quota will be fulfilled in all scenarios only in the Netherlands and Hungary.

Quota will be reallocated between regions and between size classes. The regional reallocation of milk production largely depends on the rental quota prices assumed for the base year calibration of the model. In countries where quota trade is possible, these assumptions are based on observed values, in others they are based on calculations.

Income effects of the scenarios are clearer. Positive income effects are predicted for favourable milk price development in the baseline 1 scenario (especially for Hungary). Large price decreases under WTO scenarios induce drastic income losses. Additional quota under WTO cannot prevent from income losses, especially if milk prices are so low that quotas become no longer binding.

Publishable Results

*This section provides a publishable summary of **each exploitable result** the project has generated, and should therefore be included **only when** the consortium is ready to publicise and have taken the appropriate measures to protect their IPR*[1].

Tool to analyse the economic impact of EU domestic policy and trade policy reforms in the dairy sector.

Abstract: The EU dairy industry is facing major changes due to the Luxembourg reform, the EU enlargement and the WTO negotiations. In order to analyse the impacts on milk and dairy markets of these changes, a tool that represents the EU dairy industry has been developed. The model developed is a spatial partial equilibrium model of the whole dairy industry which allows testing the economic impact of policy reforms. The model covers EU 25 (distinguishing 18 groups of countries), Oceania, the main importing zones. It distinguishes 14 final dairy products. It takes into account the policy instruments that are used in the EU dairy policy and has also a detailed modelling of trade policy instruments (TRQ, tariffs, exports subsidies). It provides results over the period 2004-2014. The results concern the production, consumption, exports, imports and prices for milk and dairy products in each region.

The model has been used to test some policy scenarios such as the Luxembourg reform, WTO agreement in 2008 and alternative scenarios of further change in the EU domestic policies.

Results of the study are of interest for policy makers and professionals of the dairy sector.

It is conceivable to transfer a copy of the model to a potential user that would like to update and maintain the model for further analysis. A specific agreement should be defined. In any case this will require from the potential user an important period of training. This is a sine qua non condition for any transfer to a user as the product is very specific and should be used by high skilled people.

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[1] Please beware that only information which is readily available in the public domain should be included as this might affect the owner's right to seek protection (eg patent) the results.

Impacts of 2003 CAP reform and of milk quota transfer on milk supply and income in the main milk producing countries in the EU

Abstract: Impacts of CAP reform and of milk market policy options on milk supply and farm income in the main milk producing countries in the EU are anlysed. For the quantitative analysis the farm group model EU-FARMIS is further developed. The model is specified wrt. decoupling, quota trade and structural change. FADN data is used for the the selection and aggregation of homogeneous farm groups and the generation of input and output coefficients. The database is completed by other sources based on national statistics, expert statements and farm management handbooks. Innovative software concepts are implemented. EU-FARMIS provides a comprehensive framework to analyse the impacts of complex changes in the policy environment on farms in different countries. The model is applied for Germany, France, Netherland, United Kingdom and Hungary. The CAP reform will notably affect the income of dairy farms. However, the CAP reform has only limited impacts on milk production. The milk quota is still binding and therefore is fully used. Quota trade will become more important due to changing economic conditions.
The results are of interest of policy makers and professionals in the dairy sector.

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Estimation of milk quota rents in the EU-15

Abstract.

Milk production quotas characterises the EU agricultural policy since 1984, and the 2003 reform has prolonged the quota regime till 2015. However, international and domestic factors are challenging the European dairy sector. From recent trade talks, one can foresee the reduction of price support measures and the progressive elimination of export subsidies, extensively used in the dairy sector. On the other hand, the EU is substituting price support measures with green box policy instruments. For example, the 2003 CAP reform introduced a decoupled payment per ton of milk quota to compensate dairy farmers from the cuts in butter and skim milk powder guaranteed prices.

In order to evaluate the dairy farmer reactions to these new policy changes, a key issue is to ascertain whether the milk quota rents (ie. the difference between milk price and marginal cost) are currently positive and what will be their size under these new policy scenarios. In fact, a milk price increase (respectively decrease) will simply increase (respectively decrease) the value of the quota rents, and hence farms profits. As long as the unit quota rent is positive, a change in the milk output price will have no effect on milk supply. But, if milk quota is not binding (i.e. unit quota rent is zero), milk production will respond to changes in its output price. Moreover, in case of quota removal, marginal cost curves represent the "potential" supply curve under which milk producers will expand/contract their production.

Under the EDIM project, marginal costs and quota rents for the EU-15 member countries have been estimated on the FADN data, under two different estimation procedures. The methodology adopted allows to measuring both the size of the marginal cost and the position of each farm on its marginal cost curve, thus providing some crucial insights on the likely impact of policy reforms.

The results of this study are of interest for policy makers and professionals of the dairy sector

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Estimation of milk supply functions in the EU25 member states

Abstract:

Although some national studies exist, there has been no model available that depicts the milk-producing sector at EU-25 level in sufficient detail to articulate the types of policies currently implemented or under discussion.

The supply model has been constructed according to clearly defined scientific principles. It is strongly based in production theory and has been constructed in a way that maximizes the contribution of empirical information on the sector studied. The main behavioral relationships of the model are econometrically estimated, using a combination of time series sample data and non-sample information (NSI) on technical, biological, structural and institutional parameters of the sector. The model is fully dynamic, allowing for immediate short-run adjustment of outputs and variable feed use, but also allowing for more gradual adjustment of the livestock numbers and land allocated to forage and grazing.

A special feature of the model is that beef and dairy production are fully integrated in a country-specific treatment. Integration operates as regards both the underlying decision making model and the trade-offs between the two types of production.

The underlying philosophy of the model is summarized by several key strategic features: similar framework for all countries, theoretical consistency, use of prior information (estimates from the literature, technical coefficients etc) and econometric estimation in order to allow time series data to "correct" prior information on individual parameters.

As compared to the EU-15 dairy model, for the eight new CEEC member states a simplified modeling structure was used (no distinction between dairy cows and suckler cows). The estimation philosophy (reliance on both sample and non-sample information) is the same as for the EU-15, but a different estimation procedure (mixed generalized maximum entropy estimation) was used in order to cope with the limited data availability, its often poor quality, and lacking degrees of freedom.

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Tool to analyse changes in dairy farm size distribution taking into account the impact of dairy policy

Abstract: Farm numbers have been declining drastically over the past decades, whereas farm size increases. Farm size and structure have long been issues considered by agricultural policy both in Europe and the US. To an important part this is related to the (social) goal of agricultural policy, aimed at supporting farmers incomes, in particular helping the 'weak' ones (small scale farmers, farmers with difficult production circumstances, e.g. mountaneous areas).

The tool developed in the project analyses the farm size distribution of the Dutch, West and East German, Polish and Hungarian dairy sectors, with a particular focus on tracing out how technological change (structural variable) and past adjustments in common agricultural policy (CAP) affected this distribution. More in particular, it provides a framework to analyse the implications of new changes in the EU dairy policy on the dairy farm size distribution. The central concept is the empirically estimated non-stationary transition probability matrix. This matrix which governs the change in the farm size distribution over the years, is itself a function of technological change, and policy variables. Besides the estimation module, the modelling framework also has a prediction module. Predictions for the farm size distributions can be made for different scenario's and different time periods. As an example within the EDIM project projections are made for the period 2003-2010 for a baseline Luxembourg Reform scenario and a new WTO agreement scenario.

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