Consortium INRA - University of Wageningen

Study on the impact of future options for the Milk Quota system and the common market organisation for milk and milk products

Summary report

This report gives an overview of the impact analysis carried out, at the request of the European Commission, by a consortium of experts from the "Institut National de la Recherche Agronomique" (INRA, France) and the University of Wageningen (Netherlands), in view of the preparation of the Commission's Report on Milk Quotas (SEC(2002)789 final).

Note: This report represents the view of the authors and does not necessarily reflect the views of the European Commission.

The final draft of the report was completed in June 2002.

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Table of contents

Study on the impact of future options for the Milk Quota system and the common market organisation for milk and milk products

List of Tables

List of Figures

1. Introduction

The framework for EU dairy policy has remained unchanged since the introduction of milk quotas in 1984. Agenda 2000, agreed in Berlin in 1999, includes some adjustments to the common organisation of the milk market but the main changes (price decreases accompanied by compensating direct payments and a small increase in quota) are not scheduled for implementation until 2005/06 to 2007/08. The quota system remains in place until 2008. What happens after that is not yet decided.

The objective of this study is to perform *ex ante* quantitative assessments of alternative dairy policies for the EU. The time period covered by the analysis is from 2000/01 to 2014/15. During this period, the context will change. In particular, the EU will be enlarged and a new WTO agreement will be reached. In this study, the impact of enlargement is not considered. Other studies suggest that its impact on market balance for EU-15 milk and dairy products is likely to be rather small in the period immediately after enlargement. For the longer term, there remains much uncertainty about the evolution of both supply and demand in accession countries. Regarding trade policy, it is assumed that a future WTO agreement will continue in the direction of the Uruguay Round Agreement by further constraining subsidised exports, as well as increasing import access to EU markets.

The study deals with milk production and dairy product markets in EU-15. It is based on models that represent the dairy sector in the 15 EU member states. In each member state, farm milk supply, milk processing and the markets for 14 different final products are modelled. At the farm level, the interaction between beef and dairy is taken into account as well as the dynamics of production due to lagged stock adjustment. All policy instruments at each stage in the production and marketing chain are represented. The models are used to simulate the impact on markets and revenues of alternative dairy policies.

Four groups of scenarios are considered in this study. They correspond to alternative EU dairy policies defined for the period 2000/01 to 2014/15. The four scenarios are given in Table 1 and are summarised as follows.

1. The *status quo scenario* corresponds to the Agenda 2000 policy package. It applies the policy changes decided in 1999 up to 2007/08, and thereafter a status quo policy. In 2014/15,

intervention prices of butter and skimmed milk powder (SMP) are thus 15 per cent lower than 2000/01 prices and quotas are 1.67 per cent greater that in 2000/01. Note that quota levels in 2000/01 already include the 0.8 per cent increase that took place between 1999/00 and 2000/01. Support price cuts are compensated by direct payments at the rate of €25 per ton of quota in the year 2001/02.

2. **Repeating the Agenda 2000 approach (Agenda 2000 bis scenario)** assumes that the Agenda 2000 reform is deepened over the period 2007/08 to 2009/10, followed by a status quo policy. In 2014/15, intervention prices of butter and SMP are respectively 30 and 20 per cent lower than 2000/01 prices and quotas are 4.67 per cent greater. Direct compensatory payments are by then € 41.66 per ton.

3. *Adjusting quota to consumption:*

3.1 The **two-tiered quota scenario** retains quotas but permits over-quota production for export. More precisely, it assumes that the Agenda 2000 reform is applied until 2007/08. Then, in 2008/09 quotas are decreased by 5 per cent relative to 2007/08, with production in excess of the quota exported to world markets without export subsidies. Therefore, exported over-quota production, if any, receives the world market price. Intervention prices are reduced in line with market prices in order to avoid structural intervention purchases of butter and SMP. Domestic demand and export subsidies are totally removed in 2008/09. Producers receive direct payments of €25 per ton of quota held in 2007/08.

3.2. The **cut quota scenario** assumes that quotas are decreased by 5 per cent in 2005/06. Intervention prices are reduced in line with market price so as to avoid structural intervention purchases of butter and SMP. Domestic demand and export subsidies are removed in three steps from 2005/06 to 2007/08. No direct payments are given to producers.

4. The **quota abolition scenario** assumes that quotas are abolished on 1 April 2008. Intervention prices are reduced enough to avoid structural intervention purchases of butter and SMP. Nevertheless, intervention prices would still be defined in order to protect the market from extreme short-term price disturbances. Domestic consumption aids and export subsidies are removed. Dairy producers receive direct payments of €50 per ton of quota held in 2004/05. These payments are assumed to be fully decoupled[1].

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[1] This assumption means that payments have no impact on the level of milk production. Producers choose their level of production according to the market price for farm milk while direct payments remunerate fixed factors.

Table 1: Definition of the scenarios

	Status quo scenario	Continuation of A2000 approach	Adapting quotas to consumption		Quota abolition
			Two-tiered	**Cut quota**	
Quota	Agenda 2000 (+1.67 % relative to 2000/1)	Status quo until 2007/08 +1% in 2008/09 +2% in 2009/10 +3% in 2010/11 relative to 2007/08	Status quo until 2007/08 -5% in 2008/09 relative to 2007/08	Status quo until 2004/05 -5% in 2005/06 relative to 2004/05	Status quo until 2007/08 Removed in 2008/09
Interv. Price[1] **Butter** Relative to 2000/01	-5% in 2005/06 -10% in 2006/07 -15% in 2007/08	Status quo until 2007/08 -22.5% in 2008/09 -30% in 2009/10	Status quo until 2007/08 Adjusted from 2008/09 to 2014/15	Status quo until 2004/05 Adjusted from 2004/05 to 2014/15	Status quo until 2007/08 Adjusted from 2008/09 to 2014/15
SMP Relative to 2000/01	-5% in 2005/06 -10% in 2006/07 -15% in 2007/08	Status quo until 2007 -17.5% in 2008/09 -20% in 2009/10	Status quo until 2007/08 Adjusted from 2008/09 to 2014/15	Status quo until 2004/05 Adjusted from 2004/05 to 2014/15	Status quo until 2007/08 Adjusted from 2008/09 to 2014/15
Consumption and export subsidies[2]	Adjusted	Adjusted	Adjusted	Adjusted until 2004/05 -33% in 2005/06 -66% in 2006/07 -100% in 2007/08 relative to 2004/05	Adjusted
Direct payments (€/ton)	€ 8.33 in 2005/06 € 16.67 in 2006/07 € 25.00 from 2007/08 to 2014/15	Status quo until 2007/08 € 33.33 in 2008/09 € 41.66 from 2009/10 to 2014/15	Status quo until 2007/08 € 25.00 from 2007/08 to 2014/15	No direct payments	Status quo until 2007/08 € 50.00 from 2008/09 to 2014/15

1 'Adjusted' (quota abolition, cut quota and A+C scenarios) means that intervention prices of butter and SMP are reduced enough to avoid structural intervention purchases of butter and SMP.

2 'Adjusted' (Status quo, Agenda 2000 bis scenarios) means that consumption and export subsidies are such that the EU prices of butter and SMP are very close to their respective intervention price.

2. Methodology

2.1. Modelling framework

The INRA-Wageningen simulation system for the EC dairy sector consists of two stand-alone models, one for milk and beef production on farms, the other for the processing of milk into dairy products and their allocation between domestic and foreign markets. The models simulate milk production, processing and market clearing in 14 EC member States (Belgium and Luxembourg are considered as one region).

The production model, developed at Wageningen University, is based on dual short-run profit and netput functions to which a stock and land adjustment component has been added. All behavioural equations are econometrically estimated. Additional input to parameterise the shadow supply function for milk has been provided by INRA-Rennes. The processing and demand model, developed at INRA-Toulouse, breaks total milk supplies down into fat and protein components. Market demands for milk products drive the derived demands for the milk components, which are reconstituted into dairy products at market level. This procedure ensures that product supplies are consistent with raw milk supplies. Domestic and world markets for 14 dairy products[2] complete the model. The model uses behavioural parameters and technical coefficients from a variety of sources.

The two models can be run separately (to simulate with-quota scenarios) or interactively (to simulate no-quota scenarios). Model outputs include production and prices of milk and dairy products, domestic and foreign off-take of dairy products, stock levels, beef output, feed use and stocking rates at member state level and for the EC as a whole. Producer and consumer surpluses, as well as the financial costs of a wide range of policy interventions, are also calculated.

More information on these models are available in Annex I. For further reference see Bouamra, Burrell, Guyomard, Jongeneel, Réquillart, *The INRA-Wageningen simulation system for the EU dairy sector*, paper presented at the EAAE Congress in Zaragoza; August 2002.

2.2. Main assumptions

The aim of the study is to quantify how dairy markets and production outcomes will be affected by alternative policy reforms. The time period under consideration is 2000/01 to 2014/15. During this time frame, not only can policy variables change but also intrinsic market conditions will evolve. In particular, one might expect that 1) domestic demand conditions, 2) milk yield, 3) world market conditions will be subject to underlying trends. A brief explanation of the main assumptions about these trends and related implications is presented in the following paragraphs.

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[2] Fluid milk, fresh dairy products, butter, cream, skimmed milk powder, whole milk powder, concentrated milk, casein, soft cheese, blue veined cheese, semi-hard cheese, fresh cheese, processed cheese, whey powder.

2.2.1. Domestic demand

Domestic consumption changes over time partly due to changes in prices. An increase in the price of a product causes a decrease in its consumption. This adjustment mechanism is at the basis of this analysis, and such responses are measured by the elasticity of demand for a product. However, changes in consumption over time are also partly due to other variables such as increasing population and consumer incomes, evolving tastes and preferences, and changing consumption habits and lifestyles. To deal with these exogenous changes in domestic demand, an 'autonomous growth in demand' for each dairy product in the EU[3] has been estimated. At the aggregate level, it has been estimated that EU demand for the dairy products will increase on average by 0.75 per cent per year. For some products the rate of increase is higher, while it is lower (or negative) for other products.

An autonomous change in domestic demand can induce changes to the level of support. If no change is made to the level of support, the increase in demand implies an increase in market prices. However, increasing demand and therefore higher prices allow, if this is considered desirable, for a gradual reduction to the level of support. In particular, an increase in domestic demand requires less subsidy (whether on domestic or export markets) in order to sustain prices. In this respect, an increase in demand due to autonomous trends translates into a subsidy decrease rather than a market price increase. This mechanism can operate as long as subsidies are positive or as long as support prices exist (intervention prices of butter and SMP). When subsidies cannot be adjusted, then an increase in demand translates into a price increase.

2.2.2. Supply side

On the supply side, autonomous trends in milk yields were estimated[4]. EU average milk yield was growing by 1.2 per cent in 2000/01 compared to the previous year, slightly less than the past long-term trend. It was assumed that the rate of growth would reduce gradually over time. In this study, the assumed yield growth rates imply that the average milk production per cow in the EU, which was 5964 kg/cow in 2000/01, will reach 6977kg/cow in 2014/15.

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[3] To estimate autonomous trend in dairy product demand, annual EU consumption data have been used over the period 1984 to 1999. Non linear trends were estimated to deal with saturation phenomena and consumption data have been corrected for the effect of price changes.

[4] Autonomous yield growth was estimated with data for the period 1984 to 1998 for each member state, after allowing for changes in feed use.

This increase in yield has two major effects. First, it means that, holding EU milk production constant, the number of dairy cows will decrease over time. This has implications for dairy producers' revenues and for the beef sector. For a given beef price, the revenues earned by dairy producers from selling animals culled from the dairy herd will decline. At the same time, there will be an increase in specialised beef production as more forage and grazing area becomes available to this sector. The impact on beef production is the net effect of these opposite movements in dairy and suckler cow numbers. Second, the technical progress driving yield increases induces a change in cost of production. In a quota regime, this change affects the value of quota rents while in a no-quota regime it influences the level of production.

At the start of the simulation period, 40 to 45 per cent of EU beef production originated from mature dairy cows. Revenue from these sales is a non-negligible part of dairy producers' revenue. At the same time, changes in the dairy herd have implications for total beef production. In this study, it has been assumed that beef market prices remain unchanged at the level of the basic price set by Agenda 2000. Direct payments to specialist beef producers are, of course, not included in the calculation of the economic surplus from dairy production.

2.2.3. World markets

Regarding world market demand, a prudent assumption has been adopted. It is assumed that there is no autonomous trend in demand from the rest of the world for EU dairy products. This does not mean that the EU cannot export more dairy products. This means that to do so, their price has to fall. This assumption is prudent relative to some other studies that assume an increase in future world demand for EU dairy products.

2.2.4. WTO negotiations

All scenarios share the same assumptions about WTO commitments. The working assumption is that the new agreement continues in the direction of the Uruguay Round Agreement (URA). In particular it assumes that a mechanical repetition of URA, starting in 2005/06, further reduces the volume of subsidised exports by 26.5% over 5 years, doubles the minimum access limit and decreases over-quota import tariffs by a further 36% over 5 years.

2.3. Estimation of quota rents

Supply management policies regulate both the level of production and the price received by producers. In the EU, milk production has been constrained by quota limits since 1984[5]. This means that for 18 years, the supply of milk each year has been less than what would have been produced at that year's producer price in the absence of quotas. Thus, the link between price and the level of milk output has been broken. Consequently, it has not been possible for many years to observe how responsive milk production is to price changes.

To predict how milk production would respond if the quota constraint were removed, it is necessary to have information about what is called the 'shadow supply function' for milk. To have a good idea of this function, two key parameters are required. First, it is important to know the current *milk shadow price*, which is defined as the producer price for milk that would induce dairy farmers to produce their current quota level in the absence of a quota constraint[6]. Second, it is important to know the *elasticity of milk supply*, which indicates how responsive milk output would be to changes in the milk price if producers were free to adjust their production level[7].

The milk shadow price is a crucial parameter for analysing dairy policy with and without quotas. Let us assume first that quota levels are fixed and the milk producer price is varied by policy makers. In this case, as long as the milk producer price remains above the milk shadow price, milk production does not react to price decreases. The difference between the milk price received and the shadow price is the *unit milk quota rent*. This is the component of price over and above the minimum necessary to obtain the quota-determined supply of milk. If the decrease in milk price exceeds the unit milk quota rent, the new milk price is lower than the milk shadow price. In this case, the quota limit is no longer constraining and milk production falls below quota. Hence, milk production in a quota regime is sensitive to a fall in milk price only when the fall is larger than the unit milk quota rent.

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[5] These limits are defined at member state level, at the level of milk-purchasing dairies and for individual milk producers (for both dairy deliveries and direct sales to final consumers).
[6] In a situation where a single producer cannot influence price (as for most agricultural commodities), the producer chooses the level of output where marginal cost equals price. Therefore, the milk shadow price corresponds to the marginal cost of production at the quota level.
[7] The elasticity of supply measures the percentage increase in supply following a 1 per cent increase in price.

When price support and quota constraints are removed, changes in both quantity produced and market price are observed. Conceptually, it is possible to decompose the total change into two stages. First, when market price remains supported at its pre-abolition level, supply expands until marginal production cost equals supported price. The expansion would be equivalent to the supply increase triggered by a price increase of the same magnitude as the milk quota rent. The actual size of the supply increase depends on the elasticity of supply.

If, however, market price support is removed at the same time that quotas are abolished, market price will fall. As market price falls, a second effect - demand expansion - occurs. Since market price will not fall by the full amount of the old quota rent, producers will still have a price incentive to increase supply from the old quota level. In fact, output will expand until the quantity supplied and the quantity demanded are in balance at the market-determined price. This price will be somewhere between the old supported price and the old milk shadow prices. Given the degree of demand response, the extent to which producers expand from the old quota level depends on the elasticity of supply. The more elastic supply is, the greater supply increases and the larger the price fall.

Clearly, the larger the milk quota rent is, the greater the scope for market expansion when quotas are abolished. Therefore, it was important to obtain reliable estimates of quota rents for this study. To do this, data from individual dairy farms in the EU's Farm Accountancy Data Network (FADN) were used to estimate milk shadow prices and unit milk quota rents in the 15 member states. Results were obtained for the year 1998, which were then updated to the base year 2000/2001.

Table 2 describes the situation at farm level in 1998. Average milk production per farm varies considerably from one member state to another. It ranges from more than 400 t per year in Denmark, the Netherlands and the United Kingdom to less than 130 t in Austria, Greece, Italy, Portugal, Spain and Sweden. In the other member states, it is around 200 t per farm. Milk price received by producers also varies greatly across member states. The highest farm milk price (Italy) is one half larger than the lowest (Portugal). Farm milk price differences partly explain differences in unit milk quota rents. Obviously, a high milk price will tend to favour a higher unit quota rent, but rent depends also on the cost of producing milk in the different member states (milk shadow price).

Table 2:   Average milk production, milk market prices, milk shadow prices and milk quota rents in 1998

	Average milk output per farm (t/farm)	Average milk market price (ECU/kg)	Milk shadow price (ECU/kg) (1)	Milk quota rent (ECU/kg) (1)
Austria	71	0.290	0.158	0.133
Belgium	220	0.286	0.194	0.091
Denmark	438	0.332	0.194	0.138
Finland	187	0.348	0.263	0.085
France	200	0.307	0.198	0.108
Germany	210	0.309	0.170	0.140
Greece	32	0.329	0.207	0.121
Ireland	178	0.285	0.144	0.140
Italy	99	0.361	0.229	0.133
Luxembourg	227	0.319	0.226	0.093
Netherlands	420	0.322	0.206	0.116
Portugal	109	0.245	0.179	0.066
Spain	105	0.285	0.178	0.107
Sweden	126	0.329	0.279	0.050
United Kingdom	459	0.277	0.159	0.118

1. Evaluated for the 'average' farm.   Source : own estimates from FADN data

Milk shadow price varies from a low 0.144 Ecu/kg in Ireland to a high 0.279 Ecu/kg in Sweden. As milk shadow price is equal to the marginal cost of production at the quota level (see footnote 6), it means that the competitiveness of milk production at the margin varies across EU member states. According to these estimates, member states where marginal costs are the lowest are Ireland, Austria, the UK and Germany. Conversely, member states from the North of the EU (Finland and Sweden) and from the South (Greece and Italy) have the highest marginal cost. Belgium, Denmark, France and the Netherlands have marginal cost close to the EU average. As milk quota rent is the difference between milk market price and milk shadow price, high milk market price and/or low milk shadow price can explain high rents. Milk quota rents are the highest in Germany, Ireland and Denmark. In Germany and Ireland rent is high mainly due to a low milk shadow price, while in Denmark the high milk market price is the more important factor. Milk quota rents have intermediate values in France, The Netherlands and United Kingdom while they are the lowest in Sweden and Finland (high marginal cost) and Portugal (low milk market price).

It should be noted that for a majority of member states, the marginal cost of milk production will tend to decline over time due to technical change and farm restructuring. This is captured in the model, as the milk supply function shifts over time with yield increases.

The elasticities of supply used in this study were estimated for each member state at sector level rather than at individual farm level, using an approach that enables supply response to be derived implicitly from underlying production relationships during a quota-constrained period. These elasticities depend on levels of fixed factors in each year.

2.4. *Limitations of the models*

The analysis incorporates certain simplifying assumptions and simulation results are subject to some caveats even though they appear reasonable, consistent with underlying economic theory and not too difficult to interpret. A number of issues remain to be further developed. They can be classified in five categories.

- The first one concerns the robustness of simulation results to parameter estimation and/or calibration. In particular, it would be useful to analyse the empirical consequences of the choice of normalised quadratic cost and profit functions. On the demand side, in addition to more systematic analysis of robustness, it would be interesting to make demand parameter member state specific as they likely differ from one member state to another.

- The second concerns the modelling of dynamics of quasi-fixed factor demands and farm milk supply (in a no-quota regime). Here also, it would be useful to analyse the sensitivity/robustness of simulation results to adjustment parameter values.

- The third is tied to the modelling of technical change on the supply side. The assumption of an exogenous growth for milk yield implies that policy changes have no impact on farm milk yields. This can be questionable in a no-quota policy scenario, more generally in any scenario where policy changes can increase the rate of diminution of dairy farms. In practice, a weakness of the modelling framework is that it applies at an aggregate level ignoring dairy farm heterogeneity.

- The fourth is connected to the modelling of world markets, which is simplified in the current version of the model. This last point is important if the model is to be used to

evaluate impacts of multilateral scenarios of dairy policy reform, for example in the context of WTO negotiations.

- The fifth is related to price transmission in the model. It is assumed that price changes are transmitted to final consumers. This means that, in a long-term perspective, productivity gains in the agricultural sector significantly benefit to consumers. Nevertheless, with imperfect competition at the processing or retailing level, price transmission would not be perfect. This point needs further research to be incorporated in such models.

3   Impact assessment of different policy options

The model was used to simulate the different policy scenarios under these standard assumptions. Results are presented scenario by scenario. The following sections present, for each scenario, the policy impacts on dairy product markets, livestock numbers and beef production, and producer and taxpayer surpluses.

3.1   Status quo scenario

3.1.1   Description of the option

The ***status quo scenario*** corresponds to the Agenda 2000 policy package. It applies the policy changes decided in 1999 up to 2007/08, and thereafter a status quo policy. In 2014/15, intervention prices of butter and skimmed milk powder (SMP) are thus 15 per cent lower than 2000/01 prices and quotas are 1.67 per cent greater that in 2000/01. Note that quota levels in 2000/01 already include the 0.8 per cent increase that took place between 1999/00 and 2000/01. Support price cuts are compensated by direct payments at the rate of €25 per ton of quota in the year 2001/02.

3.1.2   Impact on milk and dairy product markets[8]

EU milk production follows the path determined by Agenda 2000 quota increases (Graph 1). Over the five-year period 2000/01 to 2004/05, there are only marginal changes in dairy policy and the main factors affecting the EU dairy industry are thus autonomous trends in milk yields and in domestic demand for milk products.

As explained above, domestic and export subsidies are assumed to decrease in order to keep butter and SMP prices very close to their intervention prices (Table 3). Subsidised domestic consumption of both these products declines in response to the decrease in subsidies. Conversely, as EU prices of butter and SMP remain constant, non-subsidised domestic consumption of butter and SMP is roughly stable. In total, domestic consumption and production of butter and SMP decrease over the five-year period 2000/01 to 2004/05 (Table 5). As prices of final products remain roughly constant during the period, so does the farm milk price (Graph 2).

Positive domestic demand growth for final consumption products (fresh products and cheese) leads to increases in corresponding domestic demands and in production (Table 5).

WTO constraints limit subsidised exports which remain roughly stable except for butter. For butter, exports decrease due to assumed export subsidy declines. In 2004/05, the EU exports 9 per cent of its milk fat production and 11 per cent of its milk protein, compared with 10 and 12 per cent respectively in 2000/01 (Table 6).

Over the three-year period 2005/06 to 2007/08, the policy changes agreed in the Agenda 2000 are very important. Intervention prices of butter and SMP are reduced by 15 per cent, milk quotas increase by 1.5 per cent, and consumption and export subsidies are cut in line with intervention price declines. This results in decreases in market prices, by 15 per cent for butter and SMP and by 12 per cent for farm milk (Table 5 and Graph 2). Market price falls for butter and SMP generate increases in non-subsidised consumption. But these price falls are not sufficient to offset subsidy decreases, so that the subsidised domestic demands of butter and SMP decrease. Changes in domestic demands (subsidised and non-subsidised), combined with import increases (mainly for SMP) and export decreases translate into decreases in production of industrial products (Table 6).

The farm-gate milk price decreases in response to the cut in butter and SMP prices. However, it declines by less than 15 per cent because production of butter and SMP decreases and this results in lower marginal costs of processing.

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[8] Throughout the text, it has been distinguished between two groups of dairy products. A first group, named 'industrial products', includes butter, skimmed milk powder and whole milk powder. The second group, named 'final consumption products' comprises drinking milk, fresh products and cheese.

Increases in domestic consumption of final consumption products are larger in this three year-period relative to the previous period because their market prices fall. This has a positive effect on consumption, which reinforces the positive trend effect (Table 5). Shares of fat and protein used for producing cheese, drinking milk and fresh products increase at the expense of shares in industrial products (Table 6).

Subsidised exports decrease in response to export subsidy reductions. Non-subsidised export increases do not fully offset the fall in subsidised exports, so that total exports decrease. In the case of cheese, WTO constraints on exports are binding only in 2005/06.

During the period 2008/09 to 2014/15, changes to the level of support are again minor. The underlying economic mechanisms are thus the same as those described for the period 2000/01 to 2004/05: once prices remain above support level, subsidies are less needed and are gradually reduced. However, it is not possible to continue reducing support because some subsidies reach zero before 2014/15 (Table 3). In the case of butter, for example, domestic consumption subsidies are zero from 2007/08 onwards, and export subsidies are zero from 2012/13 onwards. As a result, from 2012/13 on, it is no longer possible to reduce EU support for butter and therefore price increase of 3 per cent by the end of this 7-year period. Given the price effects, EU butter consumption decreases as does butter production, which declines by 7 per cent over this seven-year period (Table 5). Unlike butter, SMP price remains close to intervention price level for the whole period 2008/09 to 2014/15. Exports of SMP are stable while subsidised and non-subsidised consumption decrease. The production of SMP declines by 10 per cent over the seven-year period.

During this period, farm milk price increases by 6 per cent from its lowest point in 2007/08-2008/09. The increase in total demand for milk products together with unchanged milk production leads to an increase in butter price, which translates into a higher farm milk price. Changes in the allocation of milk among processed products also partly explain the increase in farm milk price.

As already observed during the period 2000/01 to 2004/05, production and domestic consumption of final consumption products increase in response to autonomous demand growth (Table 6). The trend towards using more fat and protein to produce fresh products, drinking milk and cheese at the expense of industrial products continues during this period

(Table 6). At the end of the period, the EU exports only 4 per cent of its milk fat production and 8 per cent of its milk protein production. As a consequence world market prices are significantly higher than in 2000/01. Almost all exports are by then unsubsidised. In this situation, WTO commitments on subsidised exports are no longer an issue for the EU dairy sector.

This outcome is the consequence of the decrease in support level (intervention prices) *and* of the increase in domestic demand, which is larger than the increase in production. These developments in supply and demand allow the EU to cut all domestic consumption and export subsidies. This result relies, however, on the assumed rates of autonomous demand growth in the EU. If demand growth is actually lower than assumed, then the decrease in domestic and export subsidies will be slower, thus delaying the date by which subsidies are fully removed. Under the standard assumptions, per unit subsidies in 2007/08 are only 1/3 of their 2000/01 value (Table 3).

Comparing 2014/15 with 2000/01, farm milk price is 6 per cent lower. Prices of industrial products are 15 per cent lower, whereas prices of final consumption products decline only marginally. By 2014/15, EU production is more oriented towards the domestic market. Production of industrial products declines by 15 to 25 per cent, whereas production of final consumption products increases by 5 to 10 per cent (Table 6). EU exports drop significantly. All domestic and export subsidies have been phased out by 2014/15 because EU demand has increased at a faster rate than production, which is still subject to quota.

3.1.3 Impact on livestock numbers and beef production

Dairy cow numbers fall over the whole period, since with increasing milk yields a declining number of cows is sufficient to produce a given quantity of milk. Suckler cow numbers initially fall as farmers adjust livestock numbers in response to the beef price reductions of Agenda 2000. However, this trend is reversed already in 2004/05 as the declining dairy herd leaves spare grazing capacity that allows suckler cow numbers to expand. This substitution effect continues for the rest of the period. By 2014/15, suckler cow numbers in the EU are about 10 per cent higher than in 2000/01. The net effect of these opposite trends in livestock

numbers is to keep beef output steady from 2006/07 onwards, at about 5 per cent below its level in 2000/01 (Graph 3). [9]

3.1.4   Impact on producers, budget, consumers and processors

In the status quo scenario, producer surplus[10] without direct payments remains roughly constant from 2000/01 to 2004/05, then decreases by €1.8 billion per year during the three-year period of quota expansion and price reduction. Subsequently, from 2009/10 onwards, producer surplus without direct payments increases by about €300 million per year until the end of the period (Graph 4). During the first period, the relative stability of producer surplus is the net result of increasing milk revenues, which boosts the milk quota rent, and decreasing revenue earned from selling dairy culls. The latter effect is the consequence of the decrease in the beef price at the start of the period due to Agenda 2000, and the decline in dairy culls due to shrinking dairy cow numbers. Revenue from selling beef decreases by about €1.5 billion during this first period.

The evolution of producer surplus during the second and the third periods is mainly explained by the evolution of farm milk price. Producer surplus is very sensitive to the farm milk price. A change in farm milk price of 1 per cent translates into a change in producer surplus of € 300 to 350 million. Compared to its 2000/01 value, producer surplus without direct payments is lower by €5.6 billion in 2008/09 and by €3.5 billion in 2014/15. In 2014/15, the decrease in revenue from selling animals explains over €2 billion of the reduction in producer surplus compared with 2000/01.

Clearly, the fall in producer surplus without direct payments overstates the loss of dairy producers. When direct payments are included, the net loss is smaller. By the end of the "reform" period (2007/08), direct payments amount to €2.9 billion, which partly offsets the surplus losses. At the end of the period of analysis, and assuming direct payments remain

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[9] Assuming constant beef prices.

[10] The total revenue earned by a dairy farmer consists of the revenue earned by selling milk plus the revenue earned by selling animals from the dairy herd plus direct payments (if any). Producer surplus is the revenue earned by producers in excess of what is required to remunerate the variable factors of production used. Usually, over time, the market values of fixed factors adjust so that the producer surplus is entirely used up to remunerate the fixed factors in line with their market values. In the very short term, however, before the market values of fixed factors begin to adjust, an increase (decrease) in producer surplus can be interpreted as an increase (decrease) in profit.

constant at €2.9 billion per year, total producer surplus is just €0.6 billion lower than its level in 2000/01.

The cost of domestic and export subsidies declines continuously over the simulation period. Starting from €2.6 billion in 2000/01, it is only €0.5 billion in 2007/08. By 2014/15, domestic and export subsidies have disappeared. The removal of 'market support' subsidies plus the increase in import tax revenue almost completely offset the additional cost of direct payments. As a consequence, the net cost of dairy policy to the EU budget in 2014/15 (€ 2.6 billion) is only slightly higher than its 2000/01 level (€ 2.3 billion) (Graph 6) [11].

3.2   Repeating the Agenda 2000 approach (Agenda 2000 bis)

3.2.1   Description of the option

The **Agenda 2000 bis scenario** deepens the Agenda 2000 reform by further intervention price decreases and quota increases over the three-year period 2008/09 to 2010/11. It corresponds thus to a reform scenario applied over six years, from 2005/06 to 2010/11 (Table 1), followed by a status quo policy. In 2014/15, intervention prices of butter and SMP are respectively 30 and 20 per cent lower than 2000/01 prices and quotas are 4.67 per cent greater. Direct compensatory payments are now € 41.66 per ton.

3.2.2   Impact on milk and dairy product markets

By construction, there is no difference between the Agenda 2000 scenario and the Agenda 2000 bis scenario over the period 2000/01 to 2007/08. However, in the following three years, the combination of quota increases, intervention price decreases and accompanying decreases in subsidies for domestic consumption and export depress the prices for processed products below status quo levels.

From 2010/11 onwards, consumption and export subsidies paid on butter and other 'fat-rich' dairy products are zero, whereas these subsidies are still positive for protein dairy products (Table 3). Intervention butter price is reduced by 30 per cent (relative to 2000/01) while SMP

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[11] Net cost of dairy policy is equal to the cost of domestic and export subsidies plus the cost of direct payments to milk producers, minus the revenues from import tariffs.

intervention price cut is limited to 20%. Consequently, some positive domestic and export subsidies to protein dairy products are required to sustain the SMP market price.

From 2011/12 on, there are no further policy changes and market developments are mainly driven by autonomous trends in supply and demand. As in the status quo, prices of processed products increase over this last four-year period but in 2014/15 they are still lower in the Agenda 2000 bis scenario than in the status quo (between 2 and 7 per cent lower depending on the product).

Farm milk prices exhibit the same pattern over time as product price changes: they decrease by 9 per cent between 2007/08 and 2010/11, and then increase by 4 per cent from 2011/12 to 2014/15. By 2014/15, farm milk prices are 10 per cent lower in the Agenda 2000 bis scenario relative to the status quo (Graph 2).

Despite lower prices, the supply of processed products is higher in the Agenda 2000 bis scenario than in the status quo scenario because of the larger quota increase. Lower prices translate into higher domestic consumption and higher exports. The trend towards using more fat and protein to produce final consumption products at the expense of industrial products is also observed in the Agenda 2000 bis scenario (Table 6).

Both the status quo and the Agenda 2000 bis scenarios lead to decreases in EU exports relative to 2000/01. However, exports are higher in the Agenda 2000 bis scenario than in the status quo scenario. This means that the increase in domestic consumption induced by further price reductions cannot absorb the whole increase in production of dairy products. Furthermore, and more importantly, exports in the Agenda 2000 bis scenario are no longer subsidised at the end of the simulation period (Table 3). Relative to the status quo, the cut in domestic and export subsidies occurs earlier in the Agenda 2000 bis scenario, as almost subsidies are at zero by 2010/11. This implies that WTO constraints on subsidised dairy exports are even less an issue in the Agenda 2000 bis scenario than in the status quo.

Results are closely linked to the assumptions on autonomous demand growth which have been retained in this study. However, a sensitivity analysis of lower demand growth has been carried out and is presented in section 4.

Table 3: Value of export and domestic subsidies for selected products under two scenarios (€/kg)

	Status quo scenario				Agenda 2000 bis scenario			
	2004/05	2007/08	2010/11	2014/15	2004/05	2007/08	2010/11	2014/15
Domestic subsidies								
Butter	0.53	0	0	0	0.53	0	0	0
SMP	0.65	0.27	0.19	0	0.65	0.27	0.20	0.02
Export subsidies								
Butter	1.43	0.53	0.23	0	1.43	0.53	0	0
SMP	0.36	0	0	0	0.36	0	0	0
Semi-hard cheese	0.88	0.30	0.14	0	0.88	0.30	0	0

3.2.3 Impact on livestock numbers and beef production

Dairy cow stock and suckler cow stock move inversely. This is because, with fixed milk output and increasing milk yields, a decreasing number of dairy cows is required for milk production. The decline in dairy cows gives scope for an increase in the suckler cow herd. It is noticeable that increasing milk production after 2005/06 slows down the rate of decline in dairy cow numbers, but is not sufficient to reverse the trend even temporarily. The net impact on beef production is that, by 2014/15, about 60 thousand tons more beef is produced than in the status quo. This is, however, 5 per cent below the level of beef production in 2000/01.

3.2.4 Impact on producers, budget, consumers and processors

Relative to the status quo, the Agenda 2000 bis scenario leads to larger decreases in dairy producer surplus without direct payments. In both scenarios, producer surplus without direct payments decreases by about €1.8 billion per year from 2005/06 to 2007/08. For Agenda 2000 bis, however, it continues to fall by about €1.4 billion per year over the next two years since positive effects due to quota increases are small relative to negative effects due to price decreases. After 2009/10, producer surplus begins to increase by €0.4 billion per year on average thanks to milk price increases. Nonetheless, without direct payments and relative to the initial situation in 2000/01, dairy producer surplus is still €8.3 billion lower in 2010/11 and €6.3 billion lower in 2014/15. As in the status quo scenario, decreases in revenues obtained from selling animals explain about €2 billion of this income loss.

When direct payments are included, the decrease in dairy producer surplus is obviously less dramatic. By 2010/11, direct payments are equal to €4.8 billion. This means that they offset about 60 per cent of producer surplus loss in this year, but by 2014/15 they compensate more than 75 per cent of producer surplus loss. As a result, producer surplus with direct payments in 2014/15 is just €1.4 billion below the 2000/01 level (Graph 5).

As in the status quo scenario, domestic consumption and export subsidy expenditures decrease in the Agenda 2000 bis scenario and reach zero by the end of the simulation period. However, total net expenditure on dairy policy is higher in the Agenda 2000 bis scenario relative to both 2000/01 and for the status quo scenario. This is, of course, due to the higher rate of direct payments. Total net dairy policy expenditure is €2.4 billion in 2000/01, but has risen to €4.6 billion by 2014/15. It is not possible, however, to reach conclusions about the overall ranking of these two scenarios in terms of economic welfare, since other stakeholder groups also experience changes in surplus. For example, consumers' surplus clearly increases in the Agenda 2000 bis scenario relative to both 2000/01 and to the status quo scenario, thanks to consumer price decreases.

3.3   *Adjusting quota to consumption*

3.3.1 Two-tiered quota system

3.3.1.1 Description of the option

The **two-tiered quota scenario** retains quotas but permits over-quota production for export. More precisely, it assumes that the Agenda 2000 reform is applied till 2007/08. Then, in 2008/09 quotas are decreased by 5 per cent relative to 2007/08, with production in excess of the quota exported to world markets without export subsidies. Therefore, exported over-quota production, if any, receives the world market price. Intervention prices are reduced in line with market prices in order to avoid structural intervention purchases of butter and SMP. Domestic and export subsidies are totally removed in 2008/09. Producers receive direct payments of €25 per ton of quota held in 2007/08.

3.3.1.2 Impact on milk and dairy product markets

A two-tiered quota system is implemented in 2008/09. This system allows over-quota production for export only. Milk produced within the quota is called A-milk, and the products processed from A-milk are called A-products. A-products are mainly destined for EU consumption. In the same way milk produced for export purposes is called C-milk and the products processed from this milk are C-products. C-products are exclusively exported on world markets without any subsidies. In this scenario, all subsidies are removed and A-quota is 5 per cent lower than 2007/08 quota levels. In this two-tiered quota system prices of A-products are expected to be higher than those of C-products.

Production of A-milk is equal to the A-quota. A-production needs to be used on the EU market and is no longer exported, because A-products are uncompetitive with respect to C-products on world markets. The diversion of A-milk onto the domestic market is greater than the 5 per cent quota decrease, so the net result is an increase in supply coming onto the domestic market and a negative impact on the price of A-milk. A-milk price drops by 9 per cent in 2008/09 (as compared to the status quo scenario).

Although the A-quota is smaller than the quota level in 2007/08, total production increases in 2008/09 because milk production at the margin is not constrained by quota (Graph 1). Yet, despite the absence of quota constraints at the margin, EU milk production does not expand as much as in the quota abolition scenario. This is because the price of C-milk is lower than the milk price in the quota abolition scenario. This is explained by the fact that, in the quota abolition scenario, the milk price is actually an average of domestic and export prices, and the domestic market still enjoys some price protection due to import tariffs. By contrast, C-milk is devoted exclusively to exported products and therefore reflects world market price levels.

From 2009/10 to 2014/15, the price of A-milk increases in response to increasing domestic demand. During the same period, C-production continues to increase, because the long-run supply elasticity is larger than the short-run elasticity due to the lagged adjustment of dairy stock and land. As a consequence of increasing C-production and the assumption of static demand on world markets, the C-milk price decreases. Thus, the gap between A-price and C-price widens.

EU prices of butter and SMP are greatly affected by the two-tiered pricing system. As compared with the status quo, SMP price is lower while butter price is higher. By 2014/15, the EU butter price is 10 per cent above its 2014/15 status quo value while SMP price is more than 10 per cent lower. The EU no longer exports A-skimmed milk powder. Equilibrium is achieved with only a fall in domestic price for this product. Prices of final consumption products are lower than in the status quo by 3 to 4 per cent. In terms of production, as total milk production increases so does the production of processed products.

EU exports are significant and comparable to their 2000/01 level, as about 11 to 12 per cent of milk production is exported. The allocation of raw milk supplies between industrial products,

cheese and drinking milk and other fresh products is similar to that observed in the quota abolition scenario.

3.3.1.3 Impact on livestock numbers and beef production

The yield-driven decline in dairy cow numbers is reversed at the start of the two-tiered implementation period. In 2009/10 dairy cow numbers rise slightly. However, after 2012/13, they begin once more to decline. An inverse pattern is observed for suckler cow numbers: their upward trend halts during 2009/10-2011/12, but then begins gradually to increase again.

As a consequence of these livestock changes, beef production increases in 2009/10 and 2010/11, before resuming a gradual decline. In 2014/15, it is 2 per cent (146 thousand tons) above the status quo scenario. Feed input increases in line with milk output and is about 5.5 per cent (1.9 million tons) above the status quo outcome in 2014/15.

3.3.1.4 Impact on producers, budget, consumers and processors

The implementation of the two-tiered quota system has a strong negative impact on producer surplus, which drops by almost €4 billion in 2008/09 as compared with the 2007/08. This is the consequence of the fall in price for the A-milk and the decrease in A-production. The positive impact of C-production is small relative to the reduction in the surplus received on milk subject to quota. Without direct payments, producer surplus in 2008/09 is €9.3 billion lower than the 2000/01 producer surplus. Including direct payments, the loss is lowered and amounts to €6.4 billion. In this first year, direct payments compensate nearly one third of the loss of dairy producer surplus.

As the A-price increases after 2008/09, the producer surplus increases from 2009/10 onwards. Nevertheless, in 2014/15, uncompensated producer surplus is still €4.7 billion lower than its 2000/01 value. Lower revenue from selling dairy culls explains about €1.8 billion of this difference and the rest is due to price effects. Direct payments offset nearly two thirds of this loss. Including direct payments, producer surplus is €1.8 billion below that of 2000/01, and only €1.2 billion lower than in the status quo scenario for 2014/15. Therefore, as was the case in the status quo and agenda 2000 bis scenarios, the rate of effective compensation varies over time because of price changes due to market conditions.

As all domestic and export subsidies are removed in this scenario, direct payments are the only cost to the budget. Including revenue from import tariffs, the net taxpayer cost remains constant from 2008/09 onwards and amounts to €2.6 billion. In 2014/15, it is equal to the net taxpayer cost in status quo scenario.

Consumers benefit from the decrease in price. In 2008/09, consumer surplus increases by more than in Agenda 2000 bis. From 2009/10 onwards, prices of A-products increase and thus the consumer gain decreases over time. At the end of the period, consumers are still better off relative to status quo scenario, but lose relative to the Agenda 2000 bis scenario.

3.3.2 Simple quota reduction

3.3.2.1 Description of the option (cut quota)

The ***cut quota scenario*** assumes that quotas are decreased by 5 per cent in 2005/06. As in the quota abolition scenario, intervention prices are reduced in line with market price so as to avoid structural intervention purchases of butter and SMP. Domestic demand and export subsidies are removed in three steps from 2005/06 to 2007/08. No direct payments are given to producers.

3.3.2.2 Impact on milk and dairy products markets

In this scenario, it is assumed that quotas are cut by 5 per cent in 2005/06, and export and domestic subsidies are removed over three years to reach zero in 2007/08. In 2005/06, the decrease in market support subsidies has a negative impact on prices, but this impact is more than offset by the impact of the production decrease. As a result, farm milk price increases by almost 10 per cent (Graph 2). During the next two years of the reform, farm milk price as well as final product prices decrease in response to the sharp decrease in market support subsidies. Subsequently, however, from 2008/09 onwards, the farm milk price increases by almost 2 per cent per year in response to increasing EU demand for dairy products. In 2014/15, farm milk price is 13 per cent higher than in 2000/01 and product prices are generally higher than in 2000/01, with the important exception of SMP whose price is 7 per cent lower (Table 5).

This scenario has a strong impact on the allocation of raw milk between products. The EU produces increasingly smaller volumes of industrial products. Their production decreases by

25 to 35 per cent over the 15 years. Both domestic consumption (which in the latter part of the period does not benefit from consumption subsidies) and exports decrease. Conversely, the production of final consumption products increases because autonomous demand growth outweighs the negative impact of higher prices. As a consequence, production of industrial products uses only 29 and 15 per cent of EU milk fat and protein resources respectively by 2014/15 (Table 6).

As export subsidies are removed and prices remain roughly stable or increase, EU exports decrease considerably. They represent only 3 and 6 per cent of EU production of milk fat and protein respectively by 2014/15. Moreover, the EU imports some products at 'over-quota' rates of tariff.

3.3.2.3 Impact on livestock number and beef production

By 2014/15, dairy cow numbers are 17 per cent lower than in 2000/01, due to the combined effect of lower quotas and higher-yielding cows. The implications of these changes for related markets are that beef production is 7 per cent below its level in 2000/01, and feed use is 3 per cent lower than in 2000/01. It is also worth noting that in this scenario grazing and forage land used for EU dairy and beef production is 860 thousand hectares lower than in the most expansive scenario, namely the quota abolition scenario.

3.3.2.4 Impact on producers, budget, consumers and processors

As price effects are much more important than quantity effects in the EU milk market, the producer surplus changes in line with the farm milk price. Thus, producer surplus increases in 2005/06, then decreases for two years and finally increases steadily from 2008/09 to 2014/15. At the end of the period it is €1.4 billion higher than in 2000/01 and € 2 billion higher than in status quo scenario. The increase in farm milk price and decreasing production costs have a positive impact on producer surplus, which dominates the negative impacts of lower milk production and smaller revenues from selling dairy culls.

With this scenario, there is no taxpayer cost of dairy policy from 2008/09 onwards. This is because domestic and export subsidies are removed after 2007/08, and because there are no direct payments for producers. In fact, the net budget position is positive due to budget revenue of about €0.5 billion from import taxes levied on dairy products. Contrary to the

previous scenarios, final consumers lose with respect to 2000/01. In practice, the cut quota scenario puts an end to public expenditure in the dairy sector but at the same time makes consumers worse off. To the extent that member states' shares of contributions to the EU budget differ from their shares of dairy consumption and milk production, the net welfare changes at member state level will not be identical.

3.4   Abolition of quota regime

3.4.1   Description of the option

The *quota abolition scenario* assumes that quotas are abolished on 1 April 2008. Intervention prices are reduced enough to avoid structural intervention purchases of butter and SMP. Nevertheless, intervention prices would still be defined in order to protect the market from extreme short-term price disturbances. Domestic consumption aids and export subsidies are removed. Dairy producers receive direct payments of €50 per ton of quota held in 2004/05. These payments are assumed to be fully decoupled[12].

3.4.2   Impact on milk and dairy product markets

In the quota abolition scenario, it is assumed that the quota scheme is abolished on 1 April 2008 (Table 1). At that date, all remaining domestic consumption and export subsidies are also removed. Dairy producers receive annual direct payments of €50 per ton of milk. These direct aids are calculated on quota levels in 2004/5 and are modelled as fully decoupled transfers from taxpayers to producers.

In this scenario, dairy producers freely choose their production level so as to equate marginal cost to price. In the first year of abolition, this results in a production increase of 5 per cent and a decrease in farm milk price of 18 per cent (Graphs 1 and 2). Milk production continues to increase in the following years as livestock numbers and land use adjust. The rate of increase progressively slows down and then stabilises at 0.6 per cent a year. Thus, by the end of the period, milk production and aggregate demand experience similar rates of growth. As a consequence of these adjustments, farm milk price continues to decrease in the post-quota years at a declining rate (-18% in 2008/09, -5% in 2009/10, -3% in 2010/11) and then

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[12] This assumption means that payments have no impact on the level of milk production. Producers choose their level of production according to the market price for farm milk while direct payments remunerate fixed factors.

stabilises by the end of the period. In 2014/15, EU milk production is 11.9 per cent higher than in 2000/01[13] while milk prices are 39 per cent lower. In 2014/15, EU milk production is 10.8 per cent higher in the quota abolition scenario than in the status quo scenario while milk price is 34 per cent lower. These figures are a direct consequence of low price elasticities of final demand, which imply that any increase in production translates into a more than proportional drop in price, other things constant.

In this scenario, the increase in farm milk production is not decided by quota allocation as in status quo or Agenda 2000 bis scenarios. Therefore, not surprisingly, it is not distributed equally over member states. Rates of expansion differ between member states and are determined by differences in autonomous yield growth, speed of livestock adjustment and quota rents. Table 4 summarises the increases in milk production at member state level, comparing 2014/15 with 2000/01.

Table 4: Comparison of milk production increase by member state under quota abolition

	Below EU average	About EU average	Above EU average
Increase in milk production %	B, E, I, NL, A, P, S, FIN	F, UK	DK, D, GR, IRL

The forces driving expansion rates on the supply side also encounter different local demand characteristics. Prices in Germany, Ireland and the UK fall much more sharply than the EU average under pressure from increasing supply. Prices in Sweden and Finland fall considerably less than the EU average. Price in Greece and Italy remain above the EU average, reflecting the fact that these are deficit markets that can absorb supply increases without provoking such large price falls.

Relative to the status quo, increases in milk production from 2008/09 induce increases in production and decreases in prices for all processed dairy products (Table 5). In 2014/15, prices of butter and SMP are about 20 per cent lower in the quota abolition scenario than in the status quo scenario. For final consumption products, price gaps are limited to 10 per cent. This increased price competitiveness stimulates increases in domestic consumption for all dairy products (Table 5) as well as an increase in exports. Consequently, the production of all dairy products significantly increases from 2008/09 to 2014/15. While production of butter

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[13] This is 12.5% higher than before the first Agenda 2000 quota increases that took place in 1999/2000.

and SMP is about 20 per cent higher in the quota abolition scenario than in the status quo scenario, cheese production is just 10 per cent higher. These figures show that the price effects induced by quota abolition offset to a large extent the trend effects that in the status quo scenario led to the use of more fat and protein for final consumption products at the expense of industrial products. In the quota abolition scenario, the relative shares of fat and protein used for these two product categories are roughly the same in 2014/15 as in 2007/08 (Table 6).

In the quota abolition scenario, the EU can export large volumes of dairy products without export subsidies. In 2014/15, EU exports (without subsidy) are 50 per cent of the 2000/01 export volume for butter, 112 per cent of base period volume for SMP and 110 per cent of 2000/01 export volume for cheese. On the whole, 7 per cent of fat production and 11 per cent of protein production is exported on the world market without subsidies.

3.4.3   Impact on livestock numbers and beef production

Over the period 2000/01 to 2007/08, quotas are in place and the number of dairy cows falls as yields rise. After quota abolition in 2008, however, the decline in dairy cow numbers is reversed, triggered by increasing milk output. Dairy cow numbers peak in 2011/12 and thereafter begin to fall again, as yield increases are more than adequate to cover any further market-driven increases in milk output. By 2014/15, the EU produces 11.9 per cent more milk, but with 3.7 per cent fewer dairy cows, compared with the situation in 2000/01.

Beef output follows the trend in cow numbers. In 2014/15, beef output is 3.4 per cent lower than in 2000/01, but 2.2 per cent higher than in the last with-quota year, 2007/08. Since feed use by the dairy/beef sector follows more or less in line with milk output, the quota abolition scenario has the highest level of feed use of all the scenarios studied here. By 2014/15, feed use is 12 per cent higher than 2000/01, and 9.2 per cent higher than in the status quo scenario. This represents an increase, relative to the status quo, of about 3.2 million tons of (non-roughage) feed.

3.4.4   Impact on producers and consequences for the budget, consumers and processors

The quota abolition scenario induces a dramatic decrease in dairy producer surplus. The immediate effect of quota removal is to cut producer surplus measured without direct

payments by more than €7 billion. This sharp decrease is due to the fact that the negative price effect, whereby milk quota rent falls to zero, is very large compared with the positive effect due to the larger output of milk. In the years following abolition, producer surplus without direct payments is roughly constant at a level that is about €13 billion lower than the 2000/01 level. This occurs because, during these years, the gradually worsening negative price effect (relative to 2000/01) is balanced by the gradually improving positive output effect.

When direct payments at the rate of €50 per ton of past quota are included, dairy producers' annual loss of surplus is reduced by about €6 billion. Compensation is thus less than 50 per cent. In this scenario, budgetary expenditure amounts to €5.3 billion in 2014/15 as against €2.4 billion in 2000/01. As in the two previous scenarios, final consumers gain with respect to 2000/01. In practice, it appears that the quota abolition scenario leads to the highest public expenditure but simultaneously to the largest gains for final consumers.

Table 5: **EU production, consumption and price of selected dairy products under five options (2000/01=100)**

	2004/05	2007/08	2014/15	2014/15			
				Repeating Ag. 2000 approach	Adapting quotas		Quota Abolition
	Status quo scenario				Two-tiered Quota	Cut Quota	
Butter							
Production	95.2	92.0	84.6	89.4	95.6	75.3	102.3
Consumption	96.2	98.9	95.9	99.5	90.6	87.2	109.1
Price	99.7	84.7	87.2	80.7	96.0	101.4	65.9
SMP							
Production	93.2	84.7	76.1	81.4	88.6	65.9	96.1
Consumption	94.1	92.6	82.3	87.0	91.8	74.2	99.2
Price	98.9	83.1	84.3	79.3	73.7	93.0	65.7
WMP							
Production	96.0	90.7	80.2	89.1	115.1	64.7	111.0
Consumption	110.0	122.9	142.6	144.0	140.7	138.6	148.5
Price	102.3	88.3	87.7	83.6	93.2	99.0	71.5
Fluid milk							
Production	101.1	102.7	104.6	104.9	105.1	103.5	106.2
Consumption	101.1	102.7	104.6	104.9	105.1	103.6	106.2
Price	101.1	96.0	98.6	96.3	95.0	107.3	86.1
Cheese							
Production	102.4	106.5	108.6	111.1	112.8	102.8	117.5
Consumption	102.8	108.5	111.4	113.5	113.5	106.6	118.9
Price	102.1	95.7	99.0	95.1	95.3	107.6	84.1

Table 6: Utilisation of milk in the EU under five options (% of total production).

| | Status quo scenario | | | | 2014/15 | | | |
| | 2000/01 | 2004/05 | 2007/08 | 2014/15 | Repeat A2000 approach | Adapting quotas | | Quota Abolition |
						Two tier	Cut Quota	
Collected Milk (mt)	**114**	**115**	**116**	**116**	**120**	**124**	**109**	**129**
FAT CONTENT PRODUCTION								
Industrial products	37	35	33	31	32	34	29	34
Drinking milk and fresh products	31	32	33	35	35	33	37	33
Cheese	32	33	33	34	34	33	34	33
SUBSIDISED USES								
EU consumption	8	7	0	0	0	0	0	0
Exports	9	8	5	0	0	0	0	0
EXPORTS								
Total exports	10	9	7	4	5	11	3	7
PROTEIN CONTENT PRODUCTION								
Industrial products	23	21	19	17	18	20	15	21
Drinking milk and fresh products	33	34	35	37	36	34	38	34
Cheese	44	45	46	47	46	45	47	46
SUBSIDISED USES								
EU consumption	9	8	7	0	6	0	0	0
Exports	11	10	6	0	1	0	0	0
EXPORTS								
Total exports	12	11	10	8	9	12	6	11

4. Sensitivity analysis

Additional simulations were performed assuming lower rates of domestic demand growth, positive growth in export demand, higher and lower rates of yield growth, and lower initial quota rents. Results of some of these sensitivity analyses are presented as an example.

A key parameter is the rate of autonomous demand growth. When supply is fixed by quotas, a change in autonomous growth, whether in domestic or export demand, impacts on prices and subsidy adjustments. Thus, lower domestic demand growth implies a lower price of milk and a smaller decrease in consumption subsidies than under the standard assumption. When domestic demand growth is one third lower than the standard assumption, the farm milk price in 2014/15 is 5 and 7 per cent lower in the status quo and Agenda 2000 bis scenarios respectively (Table 7). As a result, producer surplus is lower by € 2.0 to 2.4 billion depending on the scenario.

Conversely, positive growth in export demand generates additional demand for EU dairy products. It allows export subsidies to be cut more quickly and induces higher prices within the EU. Farm milk price reacts to this increase in demand. Assuming export demand growth of 2 per cent per year implies that, by 2014/15, the farm milk price is 7 to 8 per cent higher. As a result, dairy producer surplus is higher, by up to €3 billion.

When supply is not fixed by quota and adjusts to market demand, the impact on prices is significantly lower. For example, a lower rate of increase in domestic demand means both a decrease in milk production and in milk price. The sensitivity of farm milk price to demand exogenous changes is smaller when supply can adjust.

Table 7: **Impact on the farm milk market and dairy producer surplus in 2014/15 of alternative assumptions on key parameters (change relative to the standard solution)**

	Status quo		Quota abolition	Agenda 2000 bis	
	Low domestic demand growth [1]	Positive export demand growth[2]	Low quota rents [3]	Low domestic demand growth[1]	Positive export demand growth [2]
Farm Milk					
Production	0%	0%	-2.2%	0%	0%
Price	- 4.8%	+ 7.0%	+ 9.9%	-7.2%	+8.0%
Producer surplus (€ billion)	-2.0	+2.5	+3.2	-2.4	+2.8

1. rate of domestic demand growth is one third lower than under the standard assumption.
2. rate of world demand growth is 2% (standard assumption: zero growth).
3. quota rents in the EU are assumed to be 25% lower than the standard levels.

The effect of lower quota rents is also analysed. When quotas are in place, the level of the quota rent per unit of milk has no impact on market equilibrium (as long as it is positive). It only influences the size of the producer surplus. However, when quotas are removed, then the initial levels of quota rent affect the market outcome. Under a lower quota rents assumption, the increase in milk production is lower (2.2 per cent lower by 2014/15 in the sensitivity analysis compared to the standard assumption) and the decrease in farm milk price is also smaller (by almost 10 per cent). As a consequence, the producer surplus decreases less than under the standard assumption. It should be stressed that the initial surplus (in 2000/01) was also lower.

5. Overview of main results

- In all scenarios, domestic demand increases for dairy products allow both domestic and export subsidies to be reduced. Demand expansion is a consequence of autonomous demand growth and support price decreases. It means that, in most scenarios, subsidies disappear or are close to zero after 2010/11. In all scenarios, they are zero by the end of the simulation period 2014/15. Therefore, WTO commitments on subsidised exports are no longer an issue as far as dairy products are concerned. This result is contingent on the positive autonomous domestic demand growth assumed in the simulations. However, even when domestic demand growth is one third lower than the standard assumption, export subsidies fall significantly and in many cases are close to zero by the end of the period. Moreover, if autonomous growth in world demand is positive, rather than the standard assumption of zero, this would facilitate cuts in export subsidies.

- In the scenarios where the quota scheme is retained, farm milk price decreases in the years when support price is cut by policy reform, but thereafter begins to increase again in response to domestic demand growth. For unchanged quota levels and unchanged subsidies, a 1 per cent increase in domestic demand translates into a 3 per cent price increase. By contrast, when production is not constrained by quotas, farm milk prices do not rise in response to increasing demand. Instead, the adjustment is made by expanding production. In this case, any positive effect of demand on prices is cancelled by increases in milk supply.

- In all scenarios, production of final consumption products (drinking milk, fresh products and cheese) increases. Rates of increase depend on the particular scenario; they are the lowest in the cut quota scenario and the highest in the quota abolition scenario. The direction of changes in industrial product supply (butter and milk powders) varies with the scenarios: their output increases when milk supply is no longer restricted by quotas (quota abolition scenario and two-tiered quota policy) but declines otherwise. Moreover, prices of industrial products appear more sensitive to policy design than prices of final consumption products.

- In the with-quota scenarios, the fact that production is increasingly oriented towards the EU domestic market without consumption subsidies leads to an increased use of milk for final consumption products, whose domestic demand is growing faster.

- The total number of dairy and suckler cows falls in all scenarios, with dairy cow and suckler cow numbers moving in opposite directions. Even in the quota abolition scenario,

no member state reaches stocking densities that would imply a breach of EU environmental limits (assuming current norms are maintained).

- Total beef production falls in all scenarios. By 2014/15, beef production in the cut quota scenario is 7 per cent (500 thousand tons) below its 2000/01 level, but just 2.4 per cent (170 thousand tons) below with quota abolition.

- Due to the low elasticity of aggregate demand for dairy products, any increase in milk supply translates into a more than proportional decrease in milk prices and hence to revenue losses for dairy producers. Conversely, when supply is fixed by quota, a 1 per cent increase in domestic demand generates a 3 per cent increase in farm milk price (everything else held constant, including domestic and export subsidies). Thus, with the quota system in force, the adjustable factor in the milk market is the milk price, and because demand is price-inelastic, milk price is very sensitive to any change in the quantity supplied (such as an increase in quota) or in the quantity demanded (such as an autonomous growth trend).

- Thus, both milk quota rent and consumer surplus are sensitive to changes in demand conditions. For example, in the status quo scenario, if domestic demand growth is one third lower than the standard assumption, producer surplus by 2014/15 is €1 billion lower despite the fact that, in this case, the negative price impact of lower demand is cushioned by intervention prices acting as a floor price.

- By contrast, when output is not restricted, increasing demand mainly translates into a supply increase and to a lesser extent into a price rise. The larger the elasticity of supply the larger the impact on production and the smaller the impact on price. As a consequence, when production is not restricted, an increase in domestic demand has rather small effect on producer surplus. Thus, in the quota abolition scenario, producer surplus first dramatically decreases because the quota rents disappear but then remains stable.

- In the two-tiered quota scenario, the change in producer surplus is mainly due to changes in quota rent associated with A-production and only marginally to the surplus from C-milk. Thus, any change in domestic demand will have a large impact on EU prices, provoking changes (in opposite directions) in dairy producer surplus and consumer surplus. However, demand growth for exports will affect the production of C-products but with only marginal effects on dairy producer surplus.

- Evolution of dairy producer surplus also depends on revenue from selling cows culled from the dairy herd. In this study, beef price is assumed constant at the level set by

Agenda 2000. The changes in revenue from selling dairy culls therefore depend on the changing number of dairy cows. Although this varies between scenarios as output incentives vary, it is dominated by rates of autonomous yield growth. In most scenarios, the reduction in income from dairy culls results in a loss of surplus of about €2 billion per year by 2014/15.

- Results suggest that unconditional direct compensation for intervention price cuts may in fact over-compensate (or compensate beyond the policy maker's intention) in circumstances where the intervention price does not become operational as a floor price.

- In all scenarios with quotas, EU domestic prices are still above world market prices in 2014/15 due to quotas and protection measures that continue to isolate the EU market from world markets.

- The unweighted sum of surpluses of milk producers, processors, consumers and taxpayers is of the same order of magnitude in all scenarios. However, winners and losers vary depending on the scenarios (Table 8). Moreover, dairy policy changes cause changes in the surpluses of other stakeholders (for example, in the feed and beef sectors) which are not reported in this study.

Table 8: Ranking of the options for the different groups based on their surplus in 2014/15.

	Status quo	Agenda 2000 bis	Two-tiered	Cut quota	Quota abolition
Milk producers	2	3	4	1	5
Processors	4	3	2	5	1
Consumers	4	2	3	5	1
Taxpayers	2	4	2	1	5

(1=best option, 5 = worst option)

The ranking of scenarios, according to the surplus criterion, is similar on the one hand for producers and taxpayers, and on the other hand for processors and consumers, at least for the rates of direct payment assumed in the study.

ANNEX I : Main characteristics of the models used

The objective of this study is to perform *ex ante* quantitative assessments of alternative dairy policies for the EU. The study is based on two linked models that represent the dairy sector in the 15 EU member states. In each member state, farm milk supply, milk processing and the markets for 14 different final products are modelled. At the farm level, the interaction between beef and dairy is taken into account as well as the dynamics of production due to lagged stock adjustment. All policy instruments at each stage in the production and marketing chain are represented. The models are used to simulate the impact on markets and revenues of alternative dairy policies.

The first model, developed at Wageningen University, is designed to simulate the impact of dairy and beef policy instruments on outcomes in the inter-related dairy and beef sectors. It is specified at member state level.

The model is dynamic in order to depict adjustment processes over time. Milk and beef outputs are determined in the current period, as a function of current prices (or prices and milk quota levels when quotas are in force). However, the adjustment of the quasi-fixed factors, dairy cows, suckler cows and land, begin their adjustment with a one-year lag, and take several periods to adjust fully to a price or policy change. Thus, the full impact of a price or policy change takes a number of periods to complete.

The model is based on equations that represent short-run and long-run responses of milk and beef production to policy changes. Three equations (profit function, beef and veal output and feed input) form a mutually consistent set of equations describing short-run profit maximisation. A shadow price equation determines the marginal cost of milk production (when quotas are in force), or milk output supply (if there are no quotas). Finally, a set of adjustment equations, for dairy cows, suckler cows and land use, are dynamic, and embed the long-run expressions consistent with short-run profit maximisation.

As milk output equation is not directly observable from past behaviour (due to the existence of quotas since 1984) a specific study was carried out by INRA-Rennes to estimate the quota rents in each member state. Rents are calculated based on restricted cost functions estimated using FADN data (see Table 2 for the results).

In addition to the above behavioural equations of the supply model, there are a number of accounting identities that are used to calculate direct payments, dairy producer surplus and net revenue (dairy and livestock revenue minus feed costs) with and without direct payments.

The supply model can simulate in two different policy settings: with milk supply constrained by quota, and without any quota restrictions *on* milk supply. When milk supply is constrained by quota, it is assumed that milk production in each member state equals the quota limit in that member state and milk price is exogenously determined. In this case, the prices generated by a demand model (given exogenous supply) are used to calculate producer surplus and net revenue.

When milk is not constrained by quota, the shadow milk supply functions determine milk production in each member state *in conjunction with* price, which is now endogenous. To solve for milk supply and milk price jointly when the model is run independently, the shadow milk supply functions of each member state are aggregated to form an EU total milk supply function, which interacts with a demand function at EU level.

In this study, in order to solve jointly for price and quantity in the non-quota scenarios, the supply model is run in conjunction with the Toulouse demand model (described below), which depicts demand for raw milk in each member state as derived from internal and export demands for the full range of individual dairy products. For each year sequentially, the solutions for milk price and quantity are found by iterating between the two models until convergence is obtained.

For each year of analysis, the main outputs of the supply model are the following:

- Milk market: production, price (member state level) (as described above)

- Other inputs and outputs: beef output, purchased feed use, dairy and suckler cow stocks, forage and grazing land used for dairy and beef production (member state level)

- Direct payments: dairy and beef producers (by member state and type of payment)

- Surpluses: dairy producer surplus (decomposed into the elements quota rent, non-rent surplus and revenue from dairy culls), and net revenue (member state level).

The second model, developed at INRA-Toulouse, is designed to simulate the impact of dairy policy instruments on milk and dairy product markets. Thus, the dairy sector is modelled as a vertical structure that includes the supply of milk, the processing of milk into final products and the demand for dairy products. It is specified at member state level.

Supply of milk is considered as follows: when quotas are in force, a simplified milk supply equation is used. When quotas are removed (or when some extra production above the quota is allowed) milk supply comes from the Wageningen supply model (as explained above).

Then, the processing and demand model breaks total milk supplies down into fat and protein components. Market demands for milk products drive the derived demands for the milk components, which are reconstituted into dairy products at market level. This procedure ensures that product supplies are consistent with raw milk supplies. The technology of processing milk into final dairy products is explicitly modelled. Technical coefficients of processing milk into final products were derived from technical studies and the composition of products. In order to have a good representation of processing technologies, the model considers 14 final dairy products (fluid milk, fresh products, butter, cream, SMP, WMP, condensed milk, casein, soft cheese, blue cheese, semi-hard cheese, hard cheese, fresh cheese, processed cheese, whey powder).

Demand is split between domestic demand, subsidised and non-subsidised demand, and demand from the rest of the world. Trade policy is important in the dairy sector. The EU can export dairy products to four different non-EU regions (CEC, Independent State Countries, USA, other regions) and imports from an aggregate rest of the world.

Dynamics in the model mainly comes from autonomous trend in demand components (both domestic demand and export demand). Intervention stocks (if any) are an additional element in the dynamics. The model is solved year by year using an optimisation algorithm. Both quantities and prices on all markets are endogenous variables. External modules are also developed to calculate accounting identities.

The model explicitly integrates the policy instruments used in dairy sector (milk quota, intervention prices for SMP and butter, public intervention including ceiling quantities for public intervention, domestic consumption subsidies for SMP and butter, production subsidies for casein, export refunds, import tariffs and quotas). The model can also represent the WTO commitments on subsidised exports and imports.
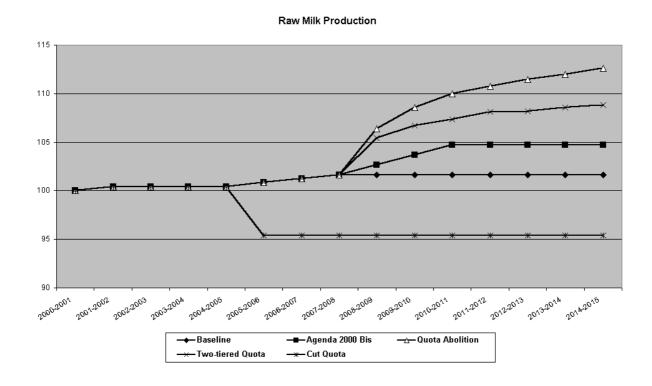
For each year of analysis, the main outputs of the demand model are the following:

- Milk market: production, price (member state level) (as described above)

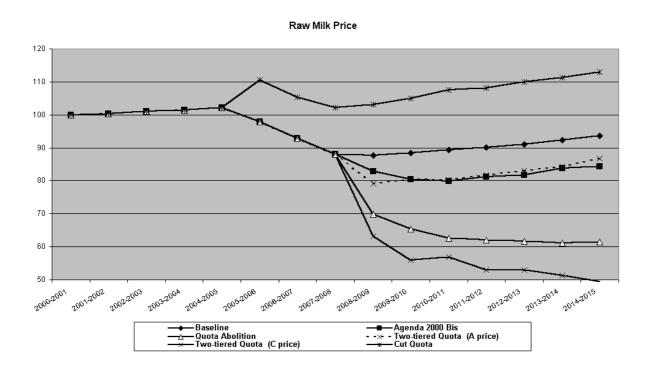- Intermediate products: fat and protein prices (member state level)

- Dairy product markets: production, price, subsidised and unsubsidised consumption (member state level)

- Trade: imports, subsidised exports, unsubsidised exports (EU level)

- Surpluses : Consumer surplus, processing sector surplus, taxpayer cost (EU level).
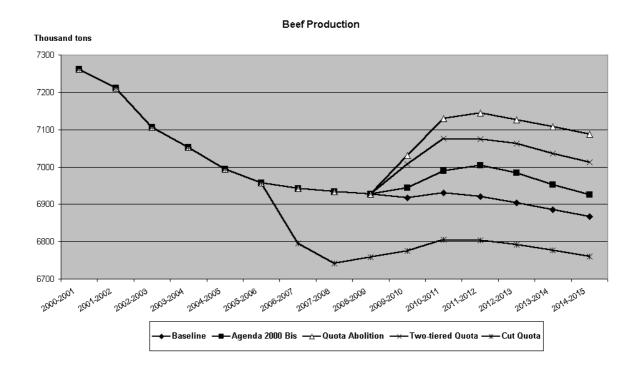
ANNEX II - Figures

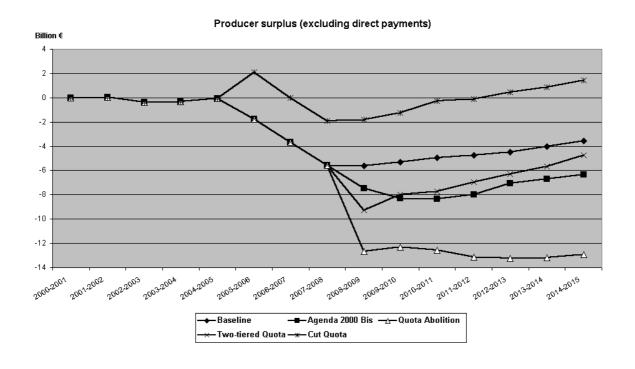## Graph 1: Estimated impact on EU raw milk production of different options, 100=2000/01

Raw Milk Production

Graph 2: Estimated impact on EU raw milk price of different options, 100=2000/01

Raw Milk Price

Graph 3: Estimated impact on EU beef production of different options

Beef Production

Graph 4   **Change in dairy producer surplus excluding direct payments relative to 2000/01**

Producer surplus (excluding direct payments)

Graph 5: Change in dairy producer surplus including direct payments relative to 2000/01

Producer surplus (including direct payments)

Billion €

Baseline — Agenda 2000 Bis — Quota Abolition — Two-tiered Quota — Cut Quota

Graph 6: Estimated impact on EU budget of different options

Taxpayer cost

Billion €

Baseline — Agenda 2000 bis — Quota Abolition — A+C Quota — Cut Quota