Nordic Journal of Political Economy

Volume 31 2005 Pages 77-97

Efficiency Losses in milk marketing boards - the importance of exports

Rolf Jens Brunstad Ivar Gaasland

Erling Vårdal

Rolf Jens Brunstad*, Ivar Gaasland** and Erling Vårdal***

Efficiency losses in milk marketing boards – the importance of exports****

A milk marketing board (MMB) is a well known instrument for regulating the markets for dairy products. MMBs are based on price discrimination, and receipts from sales are pooled so that the farmers receive a single price adjusted for composition and quality. Using a numerical model, we find that the economic welfare cost of the Norwegian MMB, is as much as 26.3% of the milk production value. This computed cost is far larger than for the other countries with MMBs. The main reasons are that exports are a major ingredient of the Norwegian system, and that production costs are very high.
Keywords: Milk marketing boards, Norwegian dairy policy, price discrimination, deregulation, numerical model. **JEL classification:** D58,L52,Q13

Following Veeman (1987), a *milk marketing board* (MMB) is a legislatively specified compulsory marketing institution that conducts price discrimination. Since price discrimination leads to unequal profitability between products, receipts from sales are pooled and farmers are paid a single price adjusted for composition and quality. The exact set-up of MMBs and the corresponding pooling arrangements vary between countries. The United States has a pooling arrangement involving fluid and industrial milk through the Federal Milk Marketing Order (US-MMO) system. In Canada[1] and Japan liquid

* *The Norwegian School of Economics and Business Administration, Helleveien 30, 5045 Bergen, Norway*

** *Institute for Research in Economics and Business Administration, Breiviksveien 40, 5045 Bergen, Norway*

*** *Department of Economics, University of Bergen, Herman Fossgate 6, 5007 Bergen, Norway,* e-mail: erling.vardal@econ.uib.no

**** We are indebted to Isabelle Schluep Campo, Swiss Federal Institute of Technology, Zürich, for many valuable comments on earlier versions of this paper. Thanks also go to Bjørn Sandvik, University of Bergen and Roberto Garcia, Agricultural University of Norway. Financial support from the Research Council of Norway, through the programme Living Conditions, Development and Restructuring of the Agricultural Sector, is gratefully acknowledged.

1. The Eastern Agreement on All Milk Pooling and the Western Milk Pooling Agreement. Until the spring of 2003, exports (class 5) had a common pool.

Table 1: Efficiency loss in MMBs

	Research	Production value (million)	Loss in consumers' surplus *(per cent of production value)*	Gain in producers' surplus *(per cent of production value)*	Efficiency loss *(per cent of production value)*
Existing MMBs					
Canada	Lippert (2001)	CAD 4,187[1]	-	-	4.8
United States	Cox/Chavas (2001)	USD 19,613[2]	2.6	1.9	0.7
Previous MMBs					
Australia	Freebairn (1992)				1.4-3.8[3]
United Kingdom	Anderson (1996)	Ecu 3,064[4]	12.6	2.9	9.7

1. Lippert (2001), p. 9 and p. 57
2. Cox and Chavas (2001), p. 98 and p. 102
3. Freebairn (1992), pp. 35-37
4. Anderson (1996), p. 64, p. 145 and pp. 151-152

and manufacturing milk prices are pooled regionally. Norway has a special arrangement where the pooling takes place through the Norwegian Agricultural Marketing Board (NAMB). Until 1994 the United Kingdom had MMBs that set prices on milk to the dairies according to end use, and until recently farmers in Australia had to pay a levy that was used to subsidize exports.

It is well documented that price discrimination through MMBs entails an efficiency loss to the society. In table 1 we review the most recent documentation, while appendix 1 offers a broader list of references. Based on an interregional market equilibrium model that was calibrated on U.S. data from 1995, Cox and Chavas (2001) found that eliminating the US-MMOs would lead to a decline in the producer surplus by USD 368 million, and an increase in the consumer surplus by USD 505 million. The calculated efficiency loss of the USD-MMOs (USD 137 million) amounts to 0.7 per cent of the production value of milk. Lippert (2001) reviewed the Canadian milk market and evaluated the efficiency loss by the regulation of the Canadian supply of milk to be CAD 200 million, i.e. 4.8 per cent of the production value. According to Freebairn (1992), the levy on milk in Australia generated a relatively small deadweight loss in the domestic market. However, the resulting excess production that was exported involved relatively large deadweight losses.[2] These costs were estimated to be between AUD 25 to AUD 65 million a year, depending on the size of the supply elasticity. For the United Kingdom, Anderson (1996) found that eliminating the MMBs, would give an efficiency gain of ecu 298 million. Kawaguchi, Suzuki and Kaiser (1997) studied the Japanese milk markets. According to their analysis the pooled farm price of milk would decrease by 14.7 per cent if markets were deregulated (perfect

2. The pool pricing arrangements provided farmers with price signals in excess of the export parity price in the size of 25% for New South Wales, Western Australia and Queensland, 33% for Victoria and 40% for Tasmania.

Table 2: Export share in dairy products and efficiency losses in existing MMBs

	Export share[1] *Per cent; 1999*	Efficiency loss *Per cent of production value*
Norway	15.0	
Canada	10.0	4.8
United States	3.9	0.7
Japan	0.0	

1. International Dairy Federation (2002), country reports pp.22-44 and table 21
2. OECD (1996)

competition). Unfortunately, they did not report any welfare effects.

From table 1 we read that the efficiency loss from the US-MMOs and from the Australian levy-system seems to be small. The loss from the Canadian MMB is larger. Based on the research of Anderson (1996), the loss from the now abolished British MMBs was more substantial. However, one should be careful when interpreting the results from the various studies. First, the MMBs in the various countries differ both in type and strength. Second, the assumed elasticities of demand and supply affect the results. For example, one reason for the large difference between the loss in consumer surplus from upholding the US-MMOs and the UK-MMBs (2.6% versus 12.6%) is that the demand for dairy products is assumed to be more elastic in the US compared to the UK study.

In this paper we focus on another reason for efficiency losses to differ among countries, i.e. that the propensity to export varies. As reported by Ippolito and Masson (1978) and Serck-Hansen (1979), and more recently by Bergman (1997), exporting MMBs may incur a larger efficiency loss than non-exporting MMBs. The argument is as follows. If exports are allowed, milk production can be taken out of the domestic market to elevate domestic prices. This results in a large deadweight loss because it involves a transfer of money from the home to the foreign country. There will also be a welfare loss if an MMB does not export. However, in this case the transfer goes between domestic consumers. Consequently, the welfare loss is limited to pure deadweight losses in domestic consumption. Ceteris paribus, the efficiency gain from abolishing an MMB should therefore be greater in high as compared to low exporting MMBs.

In table 2, existing MMB-countries are ranked according to the size of the export share, found in the first column. The second column repeats the efficiency losses from table 1. The United States has a low export share and a low loss, while Canada has a high export share and a moderate loss. As is discussed later, a main part of the Canadian export is outside the MMB-system. We therefore lack results on efficiency gains from abolishing MMBs in countries where the export share is large.[3] Against this background Norway may serve as a useful case. Exports of dairy products are

3. Of the previous MMB countries, Australia has a large export share (appr. 45 %), and, according to table 1, a low efficiency loss. However, the low efficiency loss is understandable since Australia is a cost effective country in production. According to the International Dairy Federation (2002), the farm gate price was only half of the level in the U.S. For England we lack information on exports.

high and are financed through the MMB system.

The next section surveys the Norwegian dairy policy in more detail. In particular we discuss the market regulation scheme set up by the NAMB. Dairies have to pay a compulsory tax on profitable products, while unprofitable products receive a subsidy. By law, this scheme has to be self-financing, i.e. the collected taxes shall equal the paid subsidies. Then, a numerical model of the Norwegian agricultural sector is used to simulate the current policy with price discrimination through the NAMB (the base solution). Thereafter, effects of deregulating the markets for dairy products are discussed. First, we assume that export subsidies are phased out. By comparing this case with the base solution, the cost of export is revealed. Thereafter, a complete deregulation is considered. Here, domestic prices on dairy products equal marginal costs. Thus, Harberger distortions in the domestic markets are eliminated. Our conclusion is that substantial efficiency gains may be achieved by deregulating the dairy sector. The potential gains are substantially higher than for other MMB-countries. The main reasons are that exports are a major ingredient of the Norwegian system, and that production costs are very high.

The Norwegian dairy policy

The Norwegian dairy market is dominated by a single farmer-owned cooperative. At the farmgate level the cooperative's market share is 98%, which means that nearly all milk farmers are members of the cooperative. The presence in the downstream industry is also strong, with a competitive fringe serving only 10% of the end market.

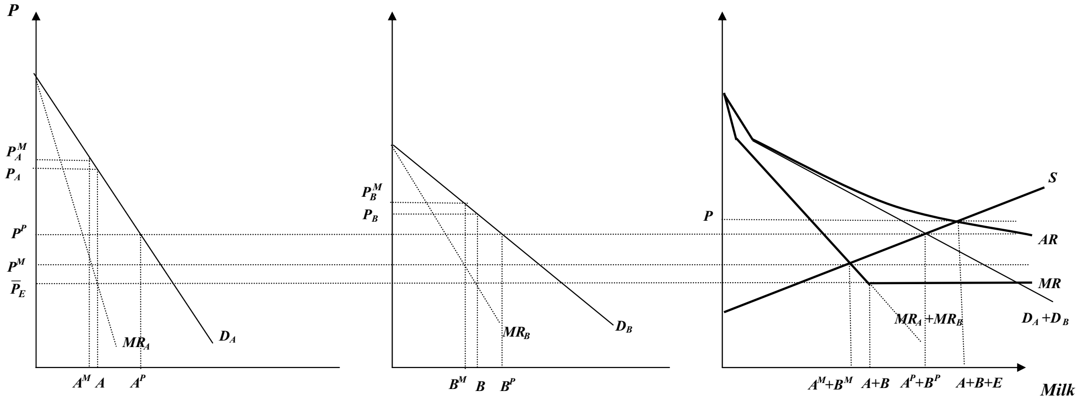
As is described carefully in the literature (see e.g. LeVay, 1983), a marketing cooperative tends to maximize the output price paid to the members, subject to a budget constraint, which says that the total payments to the members cannot exceed the net revenues from the domestic market and the export market. The constraint will always be binding. Thus, the behavior is also known as the zero surplus solution.

The zero surplus solution is a good approach to the Norwegian dairy market. To maximize the farmgate price, the cooperative price discriminates between different end uses of milk (e.g. fluid milk, cheese, butter and milk powder) and between different markets (domestic and export). Like a price discriminating monopoly would behave, the cooperative limits output in the price inelastic markets (e.g. fluid milk). However, compared to a regular vertically integrated monopoly, milk production will be higher as the net revenue is disbursed to the members as a part of the farmgate price. Naturally, a problem for the cooperative is to avoid cream skimming from entrants (private dairy companies) in the high-value segment. Initially we abstract from this, assuming that the cooperative has a monopoly in domestic markets. We also assume that the cooperative is protected from foreign competition through prohibitive tariffs.[4]

Figure 1 illustrates the zero surplus solution and compares it to: a) perfect competition, and b) the behavior of a regular vertically integrated monopoly.

4. The import tariffs, resulting from the Uruguay Round Agreement on Agriculture (GATT, 1994), are in the range of 250-400 per cent. Minimum access opportunities equal to 5 per cent of domestic consumption in the base period, are established at lower tariffs.

Figure 1.
Market structure: cooperative versus perfect competition and vertically integrated monopoly



a. Product A: Inelastic demand *b. Product B: Elastic demand* *c. Aggregate curves*

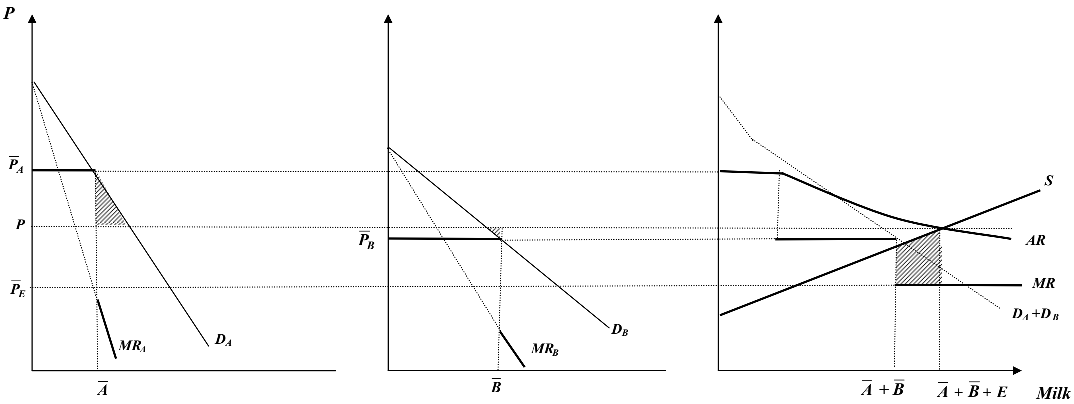
In panel a, which depicts the price inelastic market (e.g. fluid milk), the demand for milk is given by D_A. The more elastic curve D_B in panel b represents the demand for other domestic uses of milk (cheese, butter, milk powder, etc.). MR_A and MR_B are the corresponding marginal revenue curves. Aggregate curves, illustrating the price-quantity formation under different market structures, are presented in panel c. D_A+D_B is the aggregate demand for milk, while MR_A + MR_B is the horizontal sum of the marginal revenue curves in panels a and b. S is aggregate supply, which is the horizontal sum of the marginal cost curves of the individual farmers. We assume constant marginal costs in inputs other than milk, for simplicity normalized to zero. $\overline{P}_E$ is the exogenous export price, which coincides with the flat part of the marginal revenue curve, MR.

With perfect competition, the equilibrium solution is at the intersection of the aggregate demand and supply curves. The quantity A^P+B^P is produced, to a farmgate price P^P, of which A^P and B^P are sold in the two domestic markets, respectively. Since the marginal costs in inputs other than milk are normalized to zero, the price on both processed goods will, in this case, be equal to the farmgate price, P^P.

If, on the other hand, the milk farmers and the dairy sector behaved like a regular vertically integrated monopoly, they would supply the quantity A^M + B^M that follows from the intersection of the aggregate marginal cost curve, S, and the aggregate marginal revenue curve, MR. This quantity would be distributed among the markets so as to equate the marginal revenues in each market and the farmgate price P^M. Thus, the price and quantity combinations would be (P^M_A, A^M) and (P^M_B, B^M), respectively, in the two end markets. This would leave the cooperative with a substantial profit, which would have to be distributed to the members somehow, without affecting the quantities supplied (lump sum).

Unable to distribute profits in a lump sum fashion, the practice has been to raise the farmgate price until the net profit in the domestic markets is just as large as the loss in the export market. In other words, the farmers are paid a price equal to the average revenue (AR), which is a weighted average of the price

Figure 2.
Cooperative facing price caps



a. Product A: Inelastic demand *b. Product B: Elastic demand* *c. Aggregate curves*

obtained in different markets. Referring to figure 1, this principle results in a farmgate price, P, and a milk production, $A + B + E$, given by the intersection of the farmers' supply curve, S, and the solid curve, AR, defined as:

$$AR = \alpha_A P_A + \alpha_B P_B + (1 - \alpha_A - \alpha_B)\,\bar{P}_E,$$

where α_i, $i = A,B$, is the share of total production sold in the i^{th} domestic market. The price and quantity combinations in the domestic markets, which follow from the intersection of the marginal revenue curves and the exogeneously given export price ($MR_A = MR_B = \bar{P}_E$), are now (P_A, A) and (P_B, B). The export price, $\bar{P}_E$, is below the marginal costs in production.

As figure 1 illustrates, total milk production is higher under a cooperative regime than in a competitive market ($A+B+E > A^P+B^P$), but domestically sold quantities are lower ($A < A^P; B < B^P$). Obviously, since the export, E, takes place at a price below marginal costs, economic welfare is highest in the competitive solution. However, the milk farmers find the cooperative regime more attractive since it offers a higher farmgate price ($P > P^P$), as well as a higher activity level.

Compared to the regular monopoly solution, the cooperative supplies higher quantities in the domestic markets ($A > A^M; B > B^M$). Nevertheless, economic welfare and producer's surplus are lower because the rent from price discrimination is shifted from domestic producers to foreign consumers. So, the producers would prefer a regular monopoly if they were able to distribute revenue without affecting production.

So far we have considered a cooperative that unilaterally has power to set domestic prices. In actual fact, this power is restricted by price caps set in annual negotiations between the farmers' organisations and the government. The larger the farmers' bargaining strength, the closer the price caps are to the unregulated prices. We are taking these price caps into consideration in figure 2.

Assume that the cooperative faces price caps $\bar{P}_A$ and $\bar{P}_B$ that are below the unregulated prices. The cooperative will then supply $\bar{A}$ and $\bar{B}$ units in the domestic markets. In panel c of figure 2 the stepwise curve labeled MR is the (constrained) aggregate marginal revenue curve. The AR curve will now be defined by:

$$AR = \alpha_A \overline{P}_A + \alpha_B \overline{P}_B + (1-\alpha_A-\alpha_B)\ \overline{P}_E$$

where a_i, $i = A,B$, as before, is the share of total production sold in the i^{th} domestic market.

With AR pricing, production will be $\overline{A} + \overline{B} + E$. Again, the export, E, takes place at a price below marginal costs in production, leading to a deadweight loss equal to the hatched area in panel c.[5] There are also deadweight losses in the domestic markets due to price discrimination, equal to the hatched triangles in panels a and b.

Price discrimination, exploiting differences in demand elasticities between different end products, means unequal profitability between different lines and local dairies. *AR* pricing is a way of pooling revenues and costs. Obviously, this method is equivalent to a system of cross-subsidization. As will be shown later, domestic products like milk powder and goat cheese are cross-subsidized by fluid milk, while foreign consumers are cross-subsidized by domestic consumers.

A system based on cross-subsidization is threatened by cream skimming from entrants (private dairy companies) preferring to supply the most profitable products or markets and leaving the incumbent (the cooperative) to supply the less profitable products. Until 1997, cream skimming from private dairies was avoided by different kinds of institutional entry barriers.[6] In June 1997 most of the institutional entry barriers were removed.[7] However, at the same time NAMB introduced a milk price equalization scheme (MPES). Dairies (including the cooperative) are now obliged to pay a tax for profitable products, and for unprofitable products they receive a subsidy. By law the scheme is self-financing, i.e. a zero surplus solution where the total taxes collected equal the paid subsidies. Let us use figure 2 to illustrate the main principle in the milk price equalization scheme. Drinking milk is now taxed by $(\overline{P}_A - P)$, milk for other domestic uses is subsidized by $(P - \overline{P}_B)$, while exports are subsidized by $(P - \overline{P}_E)$. Since all dairies are treated on an equal basis, cream skimming is avoided.

The main objective of the MPES is to strengthen competition in the dairy sector by removing institutional entry restrictions. As such, the scheme is a response to the general criticism that monopolies tend to have low efficiency, and also a response to results of economic research that suggest that co-operatives are less efficient than other organization forms (Porter and Scully, pp.

5. In 1998 approximately 16% of the Norwegian milk production was exported at a loss (today this share is 12%). As a means to limit the surplus production of milk, a production quota system applies at the farm level, but the system is highly inefficient as the total production level still exceeds by far the quantity necessary to supply the domestic market. It is therefore not considered in the model.
6. It was almost impossible for entrants to get milk supplies from farmers since all the existing milk farmers were members of the cooperative and legally unable to change dairy company. Milk supplies from new farmers were also ruled out as a result of a closed quota system. Potential entrants in the dairy sector were therefore obliged to buy milk from the cooperative, which would be their rival in the end market. Another severe barrier to competition was the cooperative's dual role as competitor in the market place on one hand, and as administrator of the pool system on the other hand.
7. By repealing the law, which made it difficult for farmers to change dairy company and by introducing tradable production quotas at the farm level, the new scheme makes it easier for entrants to receive supplies from the farmers. The scheme also facilitates competition by moving the administrative responsibility for the pool system from the cooperative to the NAMB.

Table 3: Production processes in the dairy sector

Product	*Process*					
	Fluid milk	*Cheese dom.*	*Cheese export*	*Whey cheese*	*Goat cheese*	*Milk powder*
Cow milk (litre)	-1.031	-10.061	-11.122	-12.260		-12.340
Goat milk (litre)					-8.690	
Fluid milk (litre)	1.000					
Cheese, domestic (kg)		1.000		1.000		
Cheese, export (kg)			1.000			
Whey cheese (kg)				0.529		
Goat cheese (kg)					1.000	
Milk powder (kg)						1.000
Butter (kg)	0.006	0.194	0.177			0.586
Processing costs[1] (NOK)	3.07	19.50	20.43	18.50	15.88	14.71

1. These costs are scaled to balance total revenues and costs. The scaling factor constitutes 1.5% of the input value (25 million NOK) of farm milk. This factor can be interpreted as the costs which are left out at the process level, like administration costs in the milk price equalization scheme.

511-12, 1987). While this may have led to some improvement in efficiency in the dairy industry, the MPES implies no major change in the practice of cross-subsidizing export and some domestic products by imposing a levy on other domestic products, especially drinking milk. Hence, the issue of welfare losses due to price discrimination and cross-subsidization is just as relevant as before the reform.

Simulation of the current policy

Model description

In order to estimate the efficiency loss due to the Norwegian market policy for dairy products, we use a price endogenous, partial equilibrium model that includes the most important products and factors in the Norwegian agricultural sector. It is a partial equilibrium model in the sense that input prices as well as export prices are determined outside the model and treated as given. However, domestic linear demand functions for the main agricultural products are included, hence the term price endogenous (see McCarl and Spreen, 1980).

In this section we focus on some important details regarding the model's representation of the dairy sector. A fuller description of the model is given in appendix 2.[8] Eight dairy products or aggregates are modeled: Cow milk, goat milk, fluid milk, cheese, whey cheese[9], goat cheese, butter and milk powder. Cow milk and goat milk are delivered from milk farms to dairies.[10] The remaining products are aggregates delivered from dairies to wholesale or retail dealers. Cow and goat milk are converted into dairy products by six different dairy processes or model dairies. The

8. The model is designed to perform policy analyses, and has as such been used by the Norwegian Ministry of Finance and the Norwegian Ministry of Agriculture. A detailed description of an earlier version of the model is given in Brunstad et al. (1995a). For a description of the current version, see Gaasland et al. (2001).
9. Whey cheese is a traditional Norwegian product made by boiling down milk and whey.
10. At the farm level, milk production is represented by about 75 model farms of varying size (from 6 to 200 cows) and location (9 production regions), each characterized by fixed input and output coefficients.

Table 4: Tax (+) and subsidies (-) in the Norwegian MMB

Process	*Tax/Subsidy (NOK per process unit)*	*% of production value*
Fluid milk	1.70	20.6%
Cheese, domestic	-2.44	4.8%
Cheese, export	-31.99	131.2%
Whey cheese	10.72	15.1%
Goat cheese	-1.63	3.3%
Milk powder	-18.39	48.1%
Butter, export *)	-10.90	80.7%

*) NOK per product unit

model dairies are characterized by fixed conversion coefficients for milk into each product. The conversion coefficients and processing costs for each model dairy are presented in table 3. Note that four of the model dairies have butter as a by-product.

The domestic demand functions are linearized to go through the price/quantity combination of the base year (1998) using the following demand elasticities: cheese and whey cheese (0.5), butter (1.0), milk powder (1.0) and fluid milk (0.3). These elasticities correspond to the common assumption that the demand for fluid milk is less elastic than the demand for butter, milk powder and cheese, and are roughly in line with several existing studies.[11] Cross-price effects are neglected as we use broad product aggregates which hardly are close substitutes in consumption, except for cheese and whey cheese.

The base solution: The milk price equalization scheme (MPES)

Using the model, we have simulated the agricultural policy in Norway by implementing the actual system of subsidies and import barriers in the base year 1998,[12] as well as the MPES. As earlier explained, the MPES means price discrimination between different uses of milk and between different markets. The taxes and subsidies in the scheme are listed in table 4. We see that the "price-inelastic-processes" (fluid milk and whey cheese) are heavily taxed, while the "price-elastic-processes" (milk powder and export of cheese) are heavily subsidized.

The results from this simulation, which is called the base solution, are presented in the first column of table 5. Production (P) and net imports (I) figures are given. Consumption is the difference between these magnitudes. Numbers in brackets are percentage of the actual situation.

11. See Gustavsen et al. (1998).
12. At the farm level, the Norwegian agricultural policy is based on different kinds of subsidies. First, there are substantial budget transfers in the form of deficiency payments (general and regionally differentiated), acreage and headage payments, disaster payments, transport subsidies, structural adjustment measures etc. Second, support is also given in the form of import tariffs. Third, a system of tradable production quotas for milk gives regional protection. It should also be noted that the subsidies in general favor small farms in scarcely populated areas. Consequently, the Norwegian agricultural policy is to a large extent directed at rural employment and protection of the family farm. For a recent description of the Norwegian agricultural policy, see OECD (pp. 182-187, 2003).

Table 5: Production, trade, support, economic surplus and main input levels in the Norwegian agriculture

	Base solution		No export		Internal deregulation	
Production (P) and net imports (I): (million kilos)	P	I	P	I	P	I
Cow milk *)	1671.5 (100)		1379.1		1308.1	
Fluid milk *)	635.4 (100)		635.4		677.1	
Cheese	75.7 (103)	-25.1	50.7		50.4	
Whey cheese	11.8 (100)	-3.3	8.5		10.9	
Milk powder	14.5 (94)		14.5		4.7	
Butter	22.3 (147)	-10.2	19.0		12.6	
Goat milk *)	22.2 (99)		22.2		21.8	
Goat cheese	2.6 (100)		2.6		2.5	
Meat	233.0 (94)	1.0	233.5	1.0	233.6	1.0
Coarse grains	1021.3 (101)	135.0	928.1	135.0	904.7	135.0
Wheat	210.5 (105)	263.0	209.9	263.7	209.3	264.3
Potatoes	298.0 (96)		299.1		299.0	
Eggs	43.8 (99)	0.7	43.8	0.7	43.8	0.7
Employment:						
(1000 man-years)	59.7 (73)		56.4		55.1	
Remote areas	40.1		36.3		35.1	
Central area	19.6		20.1		20.0	
Land use: (million hectares)	0.85 (86)		0.79		0.78	
Economic surplus:						
(billion NOK)	14.4		15.4		15.9	
+ Consumers' surplus	21.9		21.9		23.2	
+ Producers' surplus	0.8		0.3		0.6	
+ Surplus MPES	0.0		1.2		0.0	
+ Tariff revenues	0.3		0.3		0.3	
- Taxpayers' expenses	8.6		8.3		8.2	
Support: (billion NOK)	15.2 (77)		15.0		13.8	
Budget support	8.6 (71)		8.3		8.2	
Border measures	6.6 (86)		6.7		5.6	

*) Million litres

For most products there is a good correspondence between the model results and the actual situation. An exception is butter, which is a by-product of most dairy processes. For employment and land use, there is a substantial deviation between the base solution and the actual situation. The reason for this is threefold: First, the model does not cover products such as fruit and vegetables. Second, extreme small-scale farming is not included. Third, since the available data on the production processes are based on better than average farms, the model farms tend to be too efficient in the use of labor.

As is seen from the base solution, the level of support given to Norwegian agriculture is extremely high (NOK 15.2 billion or USD 2.0 billion).[13] Since Norwegian agriculture employs about 60,000 man years, the support per man year is about NOK 250,000 (USD 32,500). Apart from grain, Norway is self-sufficient or has a surplus in agricultural products. In particular, there are large exports of both cheese and butter.

Deregulation

In two steps we now analyze the effects of deregulating the markets for dairy products. First, we assume that export subsidies are abolished. By comparing this case with the base solution, the cost of export is revealed. Thereafter, a complete deregulation is assumed by setting all MPES-rates to zero. By doing so, we are also able to deduce the efficiency losses caused by Harberger distortions in the domestic markets.

No export subsidies

While abolishing export subsidies, other MPES-rates are set such that prices on domestic dairy products are unchanged. By holding domestic prices and consumption unchanged, we are able to isolate export costs.

Since export prices are way below production costs, in spite of substantial subsidies at the farm level,[14] the dumping of dairy products stops, as shown in column 2 in table 5. The 292.4 million litres (17.5%) decline in milk production, compared to the base solution, is solely due to the elimination of exports.

This leads to a surplus in the MPES-system of NOK 1.2 billion. If this surplus is allocated to the milk producers, producer surplus will increase by NOK 0.7 billion (1.5-0.8=0.7) compared to the base solution. The overall increase in economic surplus is NOK 1.0 billion, of which NOK 0.7 billion is due to higher producer surplus, while NOK 0.3 billion can be explained by lower budget support, mainly because of lower milk production and fewer farms. In 1998 the production value of milk was NOK 5.7 billion. Consequently, the NOK 1 billion efficiency gain amounts to 17.5 per cent of the production value.[15]

In a similar experiment for the Canadian dairy sector, Schluep (1999) found that elimination of export subsidies leads to an increase in economic surplus of 0.7 per cent of the production value.[16] The reason for this small efficiency loss is twofold: First, a major part of the Canadian export is excluded from the Canadian pooling arrangements.[17] Second, the cost of marginal milk production is substantially lower in Canada than in Norway.

Internal deregulation

In addition to export costs, there are efficiency losses caused by Harberger distortions in the domestic markets. To highlight these costs, we assume a complete deregulation, i.e. all MPES-rates are set to zero. Consequently, we obtain prices which equal marginal costs. Import restrictions are maintained, which means that the focus is on internal deregula-

13. The actual agricultural support in 1998 was approximately NOK 20 billion (USD 2.6 billion).
14. For example, the average revenue from the cheese export process is NOK 24.40, while the costs are NOK 58.25 (not reported). The cost–number can be inferred by using table 3: Processing costs for export of cheese is NOK 20.43. The market price of milk is NOK 3.40 (not reported). The milk requirement is 11.122. Using this information and adding up, NOK 58.25 is the result.
15. This percentage equals the percentage decrease in the milk production. However, this is an arbitrarily coincidence.
16. Schluep (1999), p. 105.
17. Class Ve is not included.

Table 6: Wholesale prices (NOK per kg or litre)

	Base solution	*Internal deregulation*	*Percentage change*
Fluid milk	8.14	6.53	- 19.8%
Cheese	46.60	47.37	+ 1.6%
Whey cheese	45.95	20.12	- 56.2%
Goat cheese	49.36	51.13	+ 3.5%
Milk powder	24.18	40.83	+68.9%
Butter	24.04	23.32	- 3.0%

tion. The farm level subsidies are unaltered. The exact framing and accomplishment of the deregulation is beyond the scope of this paper, but removal of the MPES is a basic condition.

The results of this experiment are presented in column 3 in table 5 and in table 6. As we observe from table 6, not only export is cross-subsidized in the base solution but in particular also domestically sold milk powder. The deregulation means an increase in the domestic price of this product by as much as 68.9%. Furthermore, in the base solution whey cheese and fluid milk are substantially overpriced. Therefore, the consumption of whey cheese and fluid milk increases as a result of the transition to cost-based pricing, while the consumption of milk powder decreases. The substantial drop in the consumption of milk powder should be seen in the light of the assumed unitary price elasticity.[18]

As a result of the deregulation, economic surplus increases by NOK 1.5 billion compared to the base solution, i.e. 26.3% of the production value of milk. Consumers and taxpayers are the main gainers. As a result of lower domestic prices on fluid milk and whey cheese, and despite higher prices on milk powder, the consumer surplus increases by 1.3 billion NOK (23.2% of production value). Due to lower milk production, and thereby less subsidies to milk farmers, the taxpayers gain NOK 0.4 billion. The producer surplus decreases by NOK 0.2 billion because of the decline in milk production.

An objection to our model simulation is that deregulation will hardly lead to perfect competition and cost-based pricing. Although institutional entry barriers have been removed, there are many kinds of technical and strategic entry barriers, which may continue to hamper competition, such as economies of scale, sunk costs and transport costs.[19] The industry norm is, as noted by Sexton (1990) and Tennbakk (1995), that cooperatives coexist with other firms in markets that are structural oligopolies or oligopsonies. Thus, the estimate in this section should be interpreted as the maximum gain by deregulating the dairy sector.

18. Milk powder is mainly demanded by the processing industry, used as an input in the production of for example chocolate and ice cream. The assumed elasticity for milk powder is derived from these products.
19. Since the introduction of the MPES, three private dairies have expanded their production rapidly. However, they still have low market shares, especially at the farm gate level (about 2%). The highest market share is in the wholesale market for cheese (about 10%). Other entrants have tried to enter the market, but have failed.

Concluding remarks

A marketing board is a well known instrument for regulating the markets for dairy products. Since it is based on price discrimination, it causes economic losses. Our findings suggest that a deregulation of the Norwegian dairy industry could increase the economic surplus by as much as 26.3% of the milk production value. This computed gain is far larger than for the other countries reviewed in table 1 and 2. The main reasons are that exports are a main ingredient of the Norwegian MMB, and that production costs of milk are very high in Norway. In addition, there is some evidence that the Norwegian MMB-regulation is stronger than in other countries, based on the following reasoning: The strength of a country's regulation may be estimated by the effect on the price of fluid milk, since fluid milk is regarded as the most inelastic product and therefore most exposed for taxation. For the U.S. this indicator is 13.9% (Cox and Chavas (2001), p. 101), compared to 19.8% for Norway (table 6).

The literature offers many arguments in favour of MMBs or marketing cooperations. In a recent article by Bouamra-Mechemache et al. (2001), the possibility of introducing an MMB in the EU is discussed. Their argument is that, as long as the total milk production is kept unchanged by the quota system, an MMB is an effective way of transferring money from consumers to farmers. The reason is according to Bouamra-Mechemache et al. (2001, p. 9) that "the welfare cost of price discrimination policy could be as low as, or lower than fully decoupled payments when the opportunity cost of public funds is taken into considerations." However, this argument is not valid if transfers are used to promote exports.

When evaluating the regulations, there is always the question whether there are social benefits to outweigh the substantial costs of the current policies. There are several alleged benefits of regulation, spanning from the original objectives in the 1930s, namely to raise and stabilize milk prices and offset monopsony power, to current objectives related to rural employment and farm incomes. However, under the present market conditions it is hardly probable that these benefits justify government interventions of the magnitude we have described for Norway. The regulations may have been relevant at the time when they were passed, i.e. during the depression in the 1930s, but they are now out of date due to technological development and structural change. For example, farmers' bargaining power towards dairy companies has increased due to lower transportation costs and better conservation methods. The rationale for price stabilizing interventions in the market is also weakened, partly because farm level production has become more predictable, and partly because technology makes it easier to deliver milk products in time (storage) and space (trade). Regarding rural employment, it might be argued that deregulation will have a negative effect on agricultural employment in rural areas, estimated to be 4,000 man-years (-10.2%).[20] However, it is well established that the most efficient way to achieve rural employment is by means of general income support to all inhabitants or general wage subsidies to all industries in a particular region (see e.g. Winters 1989-1990), and not by support confined to a single industry. If the authorities still want to pay specific support to agriculture, production neutral support is definitely more efficient than export subsidies

20. See Brunstad, Gaasland and Vårdal (1995b) for a more detailed discussion of issues regarding rural employment.

and price support of the kind used in the Norwegian dairy sector.

So why does an arrangement that is not desirable neither for economic nor for social reasons continue to exist? One answer is that MMBs serve as a useful instrument for farmers, and through lobbying they have been able to maintain this institution. However, discrimination between foreign and domestic products is a violation of basic WTO-principles. In the Uruguay Round it was agreed that by the end of the year 2000 export subsidies should be reduced by 36% as of the situation in 1992. In the ongoing Doha round in WTO, it is agreed to eliminate export subsidies with 2013 as a deadline. The harm from MMB arrangements such as the Norwegian NAMB will thus be reduced.

References

Anderson, J. D. (1996): *The Economics of Adjustment in Food Markets with Special Reference to the United Kindom Dairy Secor,* A Thesis submitted for the Degree of Doctor in Philosophy, Queens University of Belfast.

Bergman, M.A. (1997): "Antitrust, Marketing Cooperatives, and Market Power," *European Journal of Law and Economics*, 4: 73-92.

Bouamra-Mechemache, Z, J.-P. Chavas, T. Cox and V. Réquillart (2001): "Price Discrimination and EU Dairy Policy: An Economic Evaluation of Policy Options," INRA ESR Tolouse Cahier de Recherche, 2001-11.

Brunstad, R. J, I. Gaasland and E. Vårdal (1995a): "A Model for the Agricultural Sector in Norway," SNF Working Paper no. 25/95, Foundation for Research in Economics and Business Administration, Bergen.

Brunstad, R. J, I. Gaasland and E. Vårdal (1995b): "Agriculture as a Provider of Public Goods: A Case Study for Norway," *Agricultural Economics,* 13, 39-49.

Cox, T.L. and J.P. Chavas (2001): "An Interregional Analysis of Price Discrimination and Domestic Policy Reform in the U.S. Dairy Sector," *American Journal of Agricultural Economics*, 83(1), 89-106.

Dardis, R. and B. Bedore (1990): "Consumer and Welfare Losses from Milk Marketing Orders," *Journal of Consumers Affairs,* 24 (2), 366-80.

Freebairn, J. (1992): "Dairy Industry Policy," *Review of Marketing and Agricultural Economics*, 60 (1), 23-41.

GATT (1994): *Results of the Uruguay Round of Multilateral Negotiations: The Legal Text,* Geneva.

Gaasland, I, K. Mittenzwei, G. Nese and A. Senhaji (2001): "Dokumentasjon av JORDMOD," SNF Report no. 17/01, Foundation for Research in Economics and Business Administration, Bergen.

Gustavsen, G.W, K. Rickertsen and A. Sørensen (1998): "En modell for scenarioanalyse etter etterspørselen etter meieriprodukter," NILF Report no 8/98, Norsk institutt for landbruksøkonomisk forskning, Oslo.

Helmberger, P.G. and Y. Chen (1994): "Economic Effects of U.S. Dairy Programs," *Journal of Agricultural and Resource Economics,* 19, 225-38.

International Dairy Federation (2002): "World Dairy Situation," Bulletin N°378/2002.

Ippolito, R. A. and R. T. Masson (1978): "The Social Cost of Government Regulation of Milk." *Journal of Law and Economics,* 21, 33-65.

Kawaguchi T, N. Suzuki and H.M. Kaiser (1997): "A Spatial Equilibrium Model for Imperfectly Competitive Milk Markets," *American Journal of Agricultural Economics,* 79, 851-859.

LeVay, C. (1983): "Agricultural Co-operative Theory: A Review," *Journal of Agricultural Economics*, 34 (1), 1-44.

Lippert, O. (2001): *The perfect food in a perfect mess: The cost of milk in Canada*, Public Policy Sources, The Fraser Institute, Vancouver, B.C.

McCarl, B. A. and T. H. Spreen (1980): "Price Endogenous Mathematical Programming as a Tool for Sector Analysis," *American Journal of Agricultural Economics,* 62, 87-107.

OECD (1996): *Reforming Dairy Policy,* Organisation for economic co-operation and development, Paris.

OECD (2003): *Agricultural Policy in OECD Countries. Monitoring and Evaluation*, Organisation for economic co-operation and development, Paris.

Omsetningsrådet (1998): Årsmelding og Regnskap 1998.

Omsetningsrådets Sekretariat (1998): Årsrapport 1998.

Porter, P. K. and G. W. Scully (1987): "Economic Efficiency in Cooperatives," *Journal of Law and Economics,* 30, 489-512.

Schluep, I. (1999): *The Law and Economics of "Consumer Only" Financed Export Subsidies: A Context for the WTO Panel on Canadian Dairy Pricing Policy,"* A Thesis presented to the Faculty of the Graduate

School of Cornell University.
Schmitz, A. (1983): "Supply Management in Canadian Agriculture: An Assessment of the Economic Effects," *Canadian Journal of Agricultural Economics*, 31, 135-152.
Serck-Hansen, J. (1979): *Strategiske typer i norsk næringsliv*, Universitetsforlaget, Oslo.
Sexton, R. J. (1990): "Imperfect Competition in Agricultural Markets and the Role of Cooperatives: A Spatial Analysis," *American Journal of Agricultural Economics* ,72, 709-20.
Tennbakk, B. (1995): "Marketing Cooperatives in Mixed Duopolies," *Journal of Agricultural Economics,* 46 (1), 33-45.
Veeman, M.M. (1987): "Marketing Boards: The Canadian Experience," *American Journal of Agricultural Economics*, 35, 992-1000.
Winters, L. A. (1989-1990): *The So-Called "Non-Economic" Objectives of Agricultural Support,* OECD Econ. Stud, 13:237-266.

Appendix 1. Efficiency loss in MMBs

Country	*Description*	*Welfare Loss*
(i) Canada		
Schmitz (Barichello)	Abolishing fluid and industrial milk regulation	CAD 214 million annual welfare gain CAD 955 million annual loss in producer surplus CAD 980 million annual gain in consumer surplus CAD 303 million annual gain for taxpayers
Lippert	Abolishing fluid and industrial milk regulation	CAD 200 million annual welfare gain CAD 987 million annual transfer from consumer to producers
(ii) USA		
Dardis/Bedore	Eliminating MMO 1985	USD 343-608 million annual welfare gain
Helmberger/Chen	Long run impact of eliminating MMO 1990	USD 444 million annual loss in producer surplus USD 1 billion annual gain in consumer surplus for fluid milk USD 648 million annual loss in consumer surplus for manufactured milk
Cox/Chavas	Eliminating MMO 1995	USD 137 million annual welfare gain USD 368 million (2.3%) decrease in producer surplus USD 505 million (0.9%) increase in consumer surplus
(iii) Japan		
Kawaguchi et al.	Deregulation	14.7 % decrease in the milk price
(iv) Australia		
Freebairn	Abolishing the levy system 1988/1989	AUD 25-65 million in estimated welfare gain
(v) United Kingdom		
Anderson	Eliminating MMB 1994	Ecu 89 mill. (2.54%) decrease in producer surplus Ecu 387 mill. (2.61%) increase in consumer surplus

Appendix 2. The model

For given input costs, demand functions and support systems the model computes market clearing prices and quantities. Prices of goods produced outside the agricultural sector or abroad are taken as given. As the model assumes full mobility of labor and capital, it must be interpreted as a long run model.

The model includes the most important products produced by the Norwegian agricultural sector, in all 13 final and 8 intermediary products. Most products are aggregates. Primary inputs are: land (three different grades), labor (family members and hired), capital (machinery, buildings, livestock and ditches) and other inputs (fertilizers, fuel, seeds, etc.). The prices of inputs are determined outside the model and treated as given.

On the supply side the model has about 1000 model farms with fixed coefficients (Leontief technology), covering 19 different production activities in 6 scales and 9 regions. The regional division reflects differences in climatic conditions, support systems and available land. The products from the model farms go through processing plants before they are offered on the market. The processing plants are partly modeled as pure cost mark-ups (meat, eggs and fruit), and partly as production processes of the same type as the model farms (milk and grains). Imports take place at given world market prices inclusive of tariffs and transport costs. Domestic and foreign products are assumed to be perfect substitutes.

The domestic demand for final products is represented by linear demand functions. These demand functions are based on existing studies of demand elasticities, and are linearized to go through the observed price and quantity combination in the base year (1998). Between the meat products there are cross-price effects, while only own-price effects are considered for other products. The demand for intermediary products is derived from the demand for the final products for which they are inputs. Exports take place at given world market prices.

Domestic demand for final products is divided among 5 separate demand regions, which have their own demand functions. Each demand region consists of one or several production regions. If products are transported from one region to another, transport costs are incurred. For imports and exports, transport costs are incurred from the port of entry and to the port of shipment respectively.

In principle, restrictions can be placed on all variables in the model. The restrictions can be divided into two groups:

(1) *Scarcity restrictions:* upper limits for the endowment of each grade of land in each region.
(2) *Political restrictions:* lower limits for land use and employment in each region, for groups of regions (central regions and remote areas), or for the country as a whole; maximum or minimum quantities for domestic production, imports or exports; maximum prices.

Different types of objective functions are used, depending on the market structure. When assuming perfect competition, total economic surplus (consumer surplus, producer surplus and importer surplus) of the agricultural sector is maximized. The maximization is performed subject to demand and supply relationships and the imposed restrictions. The restrictions applied depend on the scenario. The solution to the model is found as the prices and quantities that give equilibrium in each market. No restrictions must be violated, and no model farm or processing plant that is active, must be run at a loss.

The model reports figures like production, use of inputs, domestic consumption and prices, import and export, support and economic surplus measured as the sum of consumer, producer and importer surplus. A more technical description of the model is given in Brunstad et al. (1995a).

Appendix 3. Subsidies and taxes given by the NAMB

The taxes and subsidies in table 4 equal the difference between revenues and costs of the various dairy processes in table 3. In principle, these rates equal the official rates given by the NAMB. However, there are some differences. First, the rates of NAMB are tied to products rather than processes. Second, NAMB uses more disaggregated products and markets than in our model. Third, transportation costs are rebated separately. Fourth, the rates are measured at a higher level of the vertical chain than in the model. In this appendix we compare the official rates with the rates reported in table 4.

NAMB comprises two arrangements:

First, the milk price equalization scheme (MPES) taxes some products and gives subsidies to others. Furthermore, MPES grants subsidies for transportation of milk from farms to dairies and from dairies to retailers.

Second, a marketing fee is collected on all milk delivered to dairies. In 1998 this fee was

Table A.1: The rates in the MPES

	Rate (R) *NOK per liter raw milk*	Conversion (C) *Liter raw milk per product unit*	Share (S)	RxSx *NOK per product unit*
Fluid milk aggregate				
Yoghurt	0.958	0.895	0.043	0.0369
Drinking milk	1.602	1.098	0.820	1.4424
Chokomilk	-0.036	1.168	0.022	-0.0009
Milk for industrial use	-0.914	1.142	0.058	-0.0605
Full cream	7.732[1]	1.036	0.057	0.4566
				1.8745
Cheese aggregate, domestic				
Cottage cheese	0.093[2]	6.379	0.22	0.1305
Cheese for consumption	-0.097	11.122	0.53	-0.5718
Cheese for industrial use	-0.389	11.040	0.25	-1.0736
				-1.5149
Whey cheese	2.631[3]	7.87[4]		**20.706**
Goat cheese	0.284	8.690		**2.47**
Milk powder	-0.854	12.340		**-10.5384**
Butter	-8.591[5]	2.238[6]		**-19.2267**
Export of cheese				
Brand name (MPES)	-1.333	11.122	0.607	-9.000
Bulk				
(i) MPES	-0.389	11.040	} 0.393	-1.688
(ii) Marketing fee	-2.223			-9.645
				-20.333
Export of butter (Marketing fee)				**-6.15**

1. NOK per liter cream
2. Average of the rates for consumption and industrial use
3. NOK per liter whey
4. Liter whey per kilo whey cheese
5. NOK per liter cream
6. Liter cream per kilo butter

Sources:
Gaasland et al. (2001), pp. 22-25.
Omsetningsrådet (1998), p. 10.
Omsetningsrådets Sekretariat (1998), p. 14 and p. 34.

Table A.2: Subsidy and tax rates in the MPES. Process level

	MPES-gross rates *NOK per process unit*	Transport,a.s.o. *NOK per process unit*	MPES-net rates *NOK per process unit*
Processes:			
Fluid milk	1.76	-0.60	1.16
Cheese, domestic	-5.25	-2.01	-7.26
Whey cheese	9.44	-2.45	6.99
Goat cheese	2.47	-2.47	0.00
Milk powder	-21.81	-2.72	-24.53
Cheese, export	-23.73	-1.98	-25.71

Sources: Gaasland et al. (2001), pp. 22-25

NOK 0.23 per liter farm milk, and it was used to finance exports of cheese and butter, to subsidize transportation, to cover administrative expenses and to finance a program for school milk.

Official tax and subsidy rates

In table A.1 the MPES-rates are adapted to our level of aggregation. The first column reports the official tax and subsidy rates given by the MPES. A negative entry means a subsidy. The second column reports how much farm milk is needed to produce one unit of the product. Then, weighted by the commodity shares in the third column, the fourth column gives the tax and subsidy rate for the various products in the model.

In the table there are altogether eight product aggregates. The first six refer to domestic sales, while the last two are for exports. Notice that exports are financed both through the MPES and the marketing fee.

Multiplying the bold marked product rates in table A.1 with the coefficients in table 3, we obtain tax and subsidy rates on a process level, reported in the first column of table A.2. Transportation subsidies are written into the second column, and net rates are found in the third column.

Table A.3: The MPES rates used in the model

	MPES-net rates	Marketing fee and deficit	Adjusted MPES-rates	Model rates
Domestic Sale				
Milk process	1.16	0.50	1.66	1.70
Cheese process	-7.26	4.96	-2.30	-2.44
Whey cheese process	6.99	6.04	13.03	10.72
Goat cheese process	0.00	2.63	2.63	-1.63
Milk powder process	-24.53	6.08	-18.45	-18.39
Export				
Cheese process	-25.71	4.28	-21.43	-31.99
Butter	-6.15		-6.15	-10.90

The tax and subsidy rates used in the model

The official MPES rates are based on a farm gate price of NOK 3.893 per liter.[21] In reality, the farm gate price is lower (NOK 3.40 per liter). The wedge is due to:

(i) the milk marketing fee,
(ii) the loss in the dairy sector which is passed on to the farmers, and
(iii) additional costs covered by the farmers.

In 1998 the marketing fee was NOK 0.23 per litre farm milk. The remaining NOK 0.263 is costs attributable to (ii) and (iii). To take account of the wedge, the MPES rates are adjusted by multiplying NOK 0.493 with the respective farm milk requirement of each process, given in the first line of table 3. For the milk process this amounts to NOK 0.493x1.013 = NOK 0.50. This adjustment is written into the second column of table A.3. The third column gives the adjusted MPES rates.

We also have to make some individual corrections. As for exports the MPES-rates are based on prices at a higher level of the vertical chain than in our model. With regard to goat cheese the MPES-rates are based on the farm gate price of goat milk, while our model treats goat milk as a separate product. Finally, whey cheese is based on a separate arrangement for subsidizing whey. When taking this into account, we obtain the model rates in the last column.

21. See Omsetningsrådets Sekretariat (1998), p. 34.