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Agenda 2000, Dairy Policy Instruments and Farm Milk Price

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1. Introduction

In a general way the Agenda 2000 common agricultural policy (CAP) reform deepens and extends the 1992 reform through further shifts from price support to direct payments. In the case of dairy products, the EC opts for a cautious approach at this stage and discards radical solutions such as drastic price cuts or rapid abolition of the quota system. The quota system would be extended up to 2006 ; intervention prices for butter and skimmed milk powder would be reduced by 15 percent in four steps starting on 1 July 2000 ; price cuts would be compensated by the introduction of a new yearly payment for dairy cows ; and quotas would be increased by 2 percent in four steps, the increase to be shared between young farmers and producers in mountain or Nordic areas (EC, 1998).¹

Gauging the effects of Agenda 2000 proposals on producer prices is a key issue for an overall appraisal of the package. In very general terms the question is: will EU market prices follow the

¹ As far as dairy products are concerned, the 1998 EC proposals differ from the final package adopted in March 1999 as follows. The milk quota regime is extended, officially up to the year 2006, in practice up to the year 2008, and milk quotas are increased by 2.4 percent. Intervention prices for butter and skimmed milk powder will be reduced by 15 percent in three steps starting on 1 July 2005, and price cuts will be compensated by the introduction of new yearly payment on a flat rate basis per tonne of quota.

fall in intervention prices? In the case of grains, there is now ample evidence that a one unit change in the intervention price results in a smaller than unit variation in market prices. In the case of milk, the problem is that the intervention mechanism does not apply at farm level. Furthermore there are intervention purchases only for butter and skimmed milk powder.

The main objective of this paper is then to analyse the impact of changes in dairy policy instruments, i.e., butter and skimmed milk powder intervention price cuts, decreases of export subsidies for dairy products and quota level increases, on milk farm price. The vehicle for this analysis is a computable general equilibrium model of the French economy which highlights agricultural and food sectors and with special attention given to modelling of the various instruments of the CAP. In section 2 we briefly present the model and we explain how dairy policy instruments are modelled. In section 3 we present simulation results and section 4 concludes.

2. Model overview and modelling of CAP instruments

The model used in this paper is a static, single-country, multi-sector computable general equilibrium (CGE) model of the French economy benchmarked to data for 1990. The general structure of the model is underlined in Table 2.1.

2.1. Model disaggregation

The current version of the model includes 15 agricultural and food processing sectors and 25 agricultural and food products. The rather detailed level of disaggregation of the model allows us to capture the main forward and backward linkages among the various agricultural sectors on the one hand, among these agricultural sectors and their economic environment (food processing sectors and input suppliers) on the other hand.

Milk quotas are implemented at farm level. We assume that there are two representative dairy producers. The first producer is a specialised dairy farmer. In this case, beef is supposed to be a joint by-product of milk production and there are no substitution possibilities between beef and

milk (Leontief transformation function). The second producer is a mixed dairy farmer. Here, beef and milk substitute for each other through substitutable revenue function. Milk is entirely sold to the domestic dairy industry which offers two dairy products: an aggregate of butter and skimmed milk powder (B&SMP) and an aggregate of other dairy products including fat milk powder, cheese, yoghurts, ... (ODP). This modelling framework allows us to duplicate the workings of the common market organisation (CMO) of dairy products, in particular in terms of price transmission between dairy products and farm milk.

Table 2.1. General characteristics of the model

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1. Single-country, multi-sector, static CGE model applied to France, benchmarked to data for 1990, focused on agricultural and food processing sectors.
 2. 22 multi-product activity sectors and 30 products: 9 agricultural sectors producing 14 agricultural products ; 6 food processing industries producing 11 food products ; 2 retailing sectors and 5 mono-product activity sectors for the rest of the economy.
 3. Two foreign markets: the Rest of the European Union (RoEU) and the Rest of the World (Row).
 4. Four primary production factors: labour, capital, land and production rights.
 5. Three institutional sectors: a single representative consumer, the French “government” and the FEOGA.
 6. Multi-stage, multi-product, constant-returns-to-scale production technologies with substitution between inputs, including intermediate inputs.
 7. Multi-stage budgeting process for the single representative consumer and allocation of its disposal income on the basis of linear expenditure systems (LES).
 8. Imperfect substitution between domestic and foreign commodities on both the import side and the export side (except for some “regulated” products). Armington specification.
 9. Small country assumption on both the import side and the export side with respect to the RoW, except for some agricultural and food products (including dairy products) on the export side.
 10. Explicit modelling of public policy instruments with special attention given to CAP instruments: intervention price mechanism, export subsidies, import tariffs, production quotas, direct payments, set aside, ...
 11. Imperfect mobility of primary production factors across activity sectors on the basis of nested CET (constant elasticity of transformation) functions.
 12. Competitive markets and neoclassical macro-economic closure.
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2.1. Model disaggregation

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2.2. Production technology specification

As regards the production technology of the dairy industry, we assume that this sector uses all the milk produced by the two agricultural dairy producers in fixed proportions. The allocation of milk between the two dairy products is the result of revenue maximisation subject to a constant elasticity of transformation (CET) function. The curvature of the CET reflects substitution possibilities between B&SMP and ODP. As the elasticity of transformation of the CET increases, substitution possibilities increase. We will show that the value of this parameter is a key factor which largely determines the final impact of a B&SMP intervention price cut on milk farm price. The sensitivity of simulation results to the value of this parameter will be investigated in the next section.

The maximisation programme of the dairy industry may be written as:

$$(1) \max_{y_1, y_2, l, x} \pi = p_1 \cdot y_1 + p_2 \cdot y_2 - w_l \cdot l - w_x \cdot x \quad \text{s. t.} \quad \min(l, x) = CET(y_1, y_2)$$

where y_1 is the quantity of B&SMP and p_1 the corresponding producer price ; y_2 is the quantity of ODP and p_2 the corresponding producer price ; l is the quantity of milk used by the dairy industry and w_l the corresponding price ; and x is the quantity vector of other inputs used by the dairy industry and w_x the corresponding vector price. In order to simplify the presentation, we assume in this section that all inputs, including primary production factors, are variable. As a result, the vector x represents all production factors, but milk, used by the dairy industry.

Optimisation proceeds as a two-stage process. The first stage corresponding to revenue maximisation subject to the CET function defines the supply function of B&SMP, the supply function of ODP and the revenue function for a given milk demand and for a given factor x demand. In the second stage milk and factor x demands are obtained from Shephard's lemma, i.e., by taking partial derivatives of the cost function with respect to the relevant factor price. Note that x is defined as a constant elasticity of substitution (CES) function of labour and capital while intermediate inputs are used in fixed proportions.

Under the assumption of constant returns to scale, there is no profit and total revenue equals total cost. It results that we can define an equilibrium relationship between the milk price w_l on the one hand, the prices p_1 and p_2 of the two dairy products and the price w_x of inputs x on the other hand:

$$(2) w_l = f(p_1, p_2) - w_x \quad \text{with} \quad \partial f / \partial p_i \geq 0$$

Equation (2) shows that the price of milk depends positively on the prices of the two dairy products and negatively on input x price. Furthermore one can show that each price p_i is a decreasing function of quota level (other things being equal).

2.3. Agricultural policy instrument modelling

It is now well recognised that the representation of agricultural support programmes in partial or general equilibrium models can have a substantial bearing upon the model predictions and outcomes (see, e.g., Whalley and Wigle, 1990). One important feature of our model is that main CAP instruments are explicitly modelled.

The first principle underlying the common dairy policy is the management of the markets for dairy products in order to secure product prices that permit milk producers to obtain the target price for milk. This mainly involves the annual fixing of a target price for milk, the annual fixing of an intervention price for butter and skimmed milk powder, the imposition of tariffs on imports for dairy products, the payment of subsidies on exports for dairy products and the payment of aids for disposal of some dairy products on domestic market. Faced with the problem of achieving a better balance between supply and demand, and the derived problem of an increasing budgetary cost, the EU introduced the milk quota system in 1984. Originally with a five-year life, the system was extended until 2000 as part of the CAP reform package in 1992. It would be extended at least until 2006 under Agenda 2000. The various dairy policy instruments mentioned above are explicitly modelled using a mixed-complementarity approach.

2.3.1. Milk quotas

Milk quotas are represented by means of an additional primary factor of production which ensures that the zero profit condition holds for both the specialised dairy farmer and the mixed dairy farmer (Hertel and Tsigas, 1991 ; Peerlings, 1993).

We assume that one unit of quota rights is necessary to produce one unit of milk. As a result, the maximisation programme of a dairy producer (specialised or mixed) may be written as:

$$(3) \max_y \pi = p \cdot y - C(y, w) \quad s.t. \quad y \leq \bar{y}$$

where p is the producer price of milk, y is the quantity of milk, $C(y, w)$ is the cost function of milk production and \bar{y} is the quota level of the considered producer. In order to simplify the

presentation, we do not take into account beef production in this paragraph. First-order conditions associated with programme (3) are:

$$(4) \quad p - \partial C / \partial y - \lambda \leq 0, \quad y \geq 0, \quad y.(p - \partial C / \partial y - \lambda) = 0$$

$$(5) \quad y - \bar{y} \leq 0, \quad \lambda \geq 0, \quad \lambda.(y - \bar{y}) = 0$$

where λ is the multiplier associated with the quota constraint. In our case, λ is simply the price of quota rights. It depends on the type of dairy farmer, specialised or mixed.

Equations (4) show that milk production is positive when marginal profits equal the price of quota rights and that milk production is null when marginal profits are lower than the price of quota rights. Equations (5) show that the level of milk production is equal to (respectively lower than) the quota level when the (shadow) price of quota rights is positive (respectively null). In the second case, the quota is not constraining for the considered producer.

Equations (4) and (5) are used in our model in order to imitate the workings of the quota mechanism. They represent a set of simultaneous equations that are a mix of strict equalities and inequalities, with each inequality linked to a bounded variable in a complementary-slackness condition (Rutherford, 1995). This approach has already been used in agricultural CGE models (see, e.g., Löfgren and Robinson, 1997). However, to our knowledge, it is the first time it is used to represent the dairy quota system in the EU. The main advantage of this modelling strategy is that the status of the quota (i.e., constraining or not constraining) is endogenously determined as part of the model solution.

2.3.2. Intervention price mechanism

The mixed-complementarity approach is also used to model the intervention price mechanism prevailing for butter and skimmed milk powder. In order to simplify the presentation, we assume in this paragraph that total imports of B&SMP are fixed at level \bar{m} . Furthermore we assume that the domestic demand and the demand from the RoEU can be defined as a single demand.

With no public intervention, the market clears at price p :

$$(6) \quad y(p) + \bar{m} = d(p) + e(p)$$

where $y(p)$ is the domestic supply function, $d(p)$ is the “domestic” demand function (i.e., including the RoEU) and $e(p)$ is the export demand function from the RoW.

In practice, the EU intervenes on the considered market by engaging in three kinds of intervention activities. The first of these activities consists of consumption subsidies in order to favour domestic use.² The second of these activities is the public purchase of goods for storage and the third of these activities is the provision of export subsidies to dispose of domestic excess supply on RoW markets. Note that goods that are initially purchased for storage are likely to be exported with the help of export subsidies in a second step.

In our model we assume that the unit export subsidy s is the endogenous equilibrium variable which ensures that the market clears when the market price p is equal to the intervention price \bar{p} . In that case, the unit export subsidy s is implicitly defined by:³

$$(7) \quad y(\bar{p}) + \bar{m} = d(\bar{p}) + e(\bar{p} \cdot (1 - s))$$

To accommodate the competitive price regime (equation 6) and the intervention price regime (equation 7) simultaneously, we use the mixed-complementarity approach as follows:

$$(8) \quad y(p) + \bar{m} = d(p) + e(p \cdot (1 - s))$$

$$(9) \quad p \geq \bar{p}, \quad S \cdot (p - \bar{p}) = 0 \quad \text{with} \quad S = p \cdot s \cdot e$$

Equations (8) and (9) show that the price regime is endogenously determined. When total export subsidies S are positive, the domestic market price is equal to the intervention price. The latter is then greater than the RoW price and the unit export subsidy covers the difference between the domestic price and the world price. When total export subsidies S are null, the domestic market price is greater than the intervention price. This can arise when the unit export subsidy equals zero (in such a case, EU and RoW market prices are equal) or when exports to the RoW equal zero.

² These consumption subsidies are modelled by means of fixed ad-valorem subsidies.

³ In equation (7), we assume that there are no domestic consumption subsidies.

Equations (8) and (9) are used to imitate the workings of the intervention mechanism applied to butter and skimmed milk powder. For other dairy products, the domestic market price is not regulated by an intervention mechanism. Prices adjust to ensure market equilibrium and the unit export subsidy is an exogenous political variable.

3. Simulation results

3.1. First set of scenarios: impact of a - 15 % intervention price cut of B&SMP

The first scenario corresponds to a - 15 % intervention price cut of B&SMP, other things being equal. In particular we assume that other dairy policy instruments are maintained unchanged at base period levels. The central elasticity scenario presents the results with our “best” guess of the elasticity of transformation between B&SMP and ODP ($\sigma = 0.5$). In order to analyse the sensitivity of results, this scenario is rerun with a very low and a very high elasticity of transformation (0.1 and 0.9, respectively).

Let us first consider the central elasticity case ($\sigma = 0.5$). In that case, a - 15 % reduction in the intervention price of B&SMP corresponds to a - 15 % decrease in the market price of this aggregate and to a - 5.5 % decrease in domestic supply. Intervention and domestic producer prices of B&SMP are equal, and export subsidies are still necessary to dispose of domestic excess supply of B&SMP on RoW markets. Domestic final demand increases very slightly (+ 0.2 %). Exports of B&SMP to the RoW decrease by a very large percentage (- 80.8 %) as a result of a decreased domestic supply and an increased domestic demand. At this stage, it is important to note that French exports of B&SMP to the RoEU and domestic demand of B&SMP follow the same pattern of evolution.⁴

⁴ In order to save place, simulation impacts on exports to the RoEU are not reported. They are available upon request.

Table 3.1. Effects of a - 15 % decrease in the B&SMP intervention price (results in % with respect to the base)

	Benchmark	$\sigma=0.1$	$\sigma=0.5$	$\sigma=0.9$
<i>Farm milk</i>				
Producer price	1	-7.40	-9.26	-10.10
Domestic production	52 295	0	0	0
Price of quota rights				
Specialised dairy farmer	0.25	-28.33	-35.77	-39.24
Mixed dairy farmer	0.20	-35.28	-44.98	-48.94
<i>Butter and skimmed milk powder</i>				
Producer price	1	-15.00	-15.00	-14.01
Domestic production	24 685	-1.24	-5.55	-8.43
Domestic final demand	12 849	+0.21	+0.16	+0.12
Exports to the RoW	3 156	-47.81	-80.76	-100
<i>Other dairy products</i>				
Producer price	1	-0.40	-1.75	-2.67
Domestic production	82 261	+0.34	+1.55	+2.38
Domestic final demand	65 578	+0.10	+0.69	+1.11
Exports to the RoW	3 336	+5.20	+19.04	+28.38
<i>Welfare change</i> (million of French francs)	-	+1 548	+2 685	+3 385

The first effect of a cut in the intervention price of B&SMP is to increase the price ratio between ODP and B&SMP, other things being equal. This substitution effect leads to a decrease in B&SMP domestic supply and to an increase in ODP domestic supply. In the final situation ODP domestic supply increases by + 1.6 % and the corresponding producer price decreases by - 1.8 %. This price decrease leads to a small increase in domestic demand (+ 0.7 %) and to a substantial increase in exports to the RoW (+ 19.0 %). It is important to recall that unit subsidies on ODP exports to the RoW are supposed unchanged in this scenario.

Note that all these changes in the dairy industry output and price structure are obtained for a given derived demand of milk since quotas are maintained unchanged at base period levels. According to equation (2), and given the fact that price variations of production factors x are negligible, one verifies that price decreases of B&SMP and ODP lead to a reduction in farm milk prices. In this central scenario the decrease of farm milk prices is equal to - 9.3 % with respect to the base. Output of both the specialised dairy farmer and the mixed dairy farmer is

unchanged at quota level, but these producers suffer from the milk price decline. This can be observed by noting that the unit price of quota rights decreases by - 35.8 % for the specialised dairy farmer and by - 45.0 % for the mixed dairy farmer.

We do not comment the effects of this scenario on other sectors and markets. However, it is important to note that this scenario leads to a significant welfare gain for the French economy (+ 2.6 billion French francs with respect to the base).

The central scenario corresponds to an elasticity of transformation of 0.5 between B&SMP and ODP. It clearly shows that the farm milk price fall is not as deep as the drop in B&SMP intervention prices, other things being equal. When substitution possibilities between B&SMP and ODP are lowered, the effect of a decrease in the B&SMP intervention price on farm milk prices is reduced. For example when the elasticity of transformation is 0.1, the milk farm price decrease is 7.4 % only. With respect to the central scenario, changes in the dairy industry output and price structure are now smaller. In particular the producer price of ODP decreases by - 0.4 % only which results in a smaller negative impact on farm milk prices. A reverse result is obtained when substitution possibilities between B&SMP and ODP are increased, i.e., when the elasticity of transformation is higher. However it is important to note that the effects of an increase in the intervention price of B&SMP are not linear because the policy regime can endogenously change. For example when the elasticity of transformation is 0.9, the intervention mechanism does not apply. As a result, the market price decline of B&SMP is now smaller than the intervention price cut (respectively - 14.0 % and - 15 %). This result can be explained as follows, using equations (8) and (9). When substitution possibilities between B&SMP and ODP are “sufficiently” high, a - 15 % decrease in the intervention price of B&SMP leads to a strong decline in B&SMP domestic supply (- 8.4 % when $\sigma = 0.9$). Exports of B&SMP to the RoW are now equal to zero and the domestic market price of B&SMP which adjusts domestic supply to “domestic” demand is now greater than the intervention price. When the elasticity of transformation between B&SMP and ODP is 0.9, a - 15 % cut in the intervention price of B&SMP leads to a - 10.1 % reduction in farm milk price.

3.2. Second set of scenarios: impact of a decrease in subsidies on ODP exports to the RoW

In addition to the – 15 % cut in the intervention price of B&SMP, we now suppose that subsidies on ODP exports to the RoW are simultaneously reduced. We consider two cases. The first scenario corresponds to a reduction of the unit export subsidy by – 15 % and the second scenario corresponds to a regime where ODP export subsidies are null. Results are reported in Table 3.2. Three main points are noteworthy.

Table 3.2. Effects of a - 15 % decrease in the B&SMP intervention price and of a simultaneous decrease in ODP unit export subsidies s ($\sigma = 0.5$; results in % with respect to the base)

	Benchmark	s=-0 %	s=-15 %	s=-100%
<i>Farm milk</i>				
Producer price	1	-9.26	-11.49	-20.30
Domestic production	52 295	0	0	-0.19
Price of quota rights				
Specialised dairy farmer	0.25	-35.77	-44.75	-80.08
Mixed dairy farmer	0.20	-44.98	-55.82	-100
<i>Butter and skimmed milk powder</i>				
Producer price	1	-15.00	-15.00	-15.00
Domestic production	24 685	-5.55	-4.96	-2.72
Exports to the RoW	3 156	-80.76	-76.03	-57.76
<i>Other dairy products</i>				
Producer price	1	-1.75	-3.25	-9.20
Domestic production	82 261	+1.55	+1.40	+0.55
Exports to the RoW	3 336	+19.04	-2.91	-100
<i>Welfare change</i> (million of French francs)	-	+2 685	+3 944	+ 8 765

Firstly when ODP export subsidies are simultaneously decreased, the final impact of a – 15 % cut in the intervention price of B&SMP on milk farm prices is more important. For example when the unit export subsidy is reduced by – 15 %, farm milk prices decline by - 11.5 % to compared with a decrease of – 9.3 % when the unit export subsidy is maintained unchanged at base period level. This is due to the fact that the domestic market price of ODP also decreases by a larger percentage (respectively - 3.3 % and – 1.8 %). The higher the cut in the ODP unit export

subsidy, the higher the milk farm price decrease (under the condition that the intervention price mechanism for B&SMP continues to apply). This first result clearly shows that the final impact of Agenda 2000 dairy reforms on farm milk price is closely linked to the EC management of export subsidies (on dairy products).

Secondly one notes that when export subsidies on ODP export are null, then the farm milk price decrease is “sufficiently” important (-20.3 %) so that quotas are no more constraining for mixed dairy farmers. The price of quota rights for these producers is now zero and their milk supply adjusts downwards. As a result, total milk supply decreases by – 0.2 % with respect to the base. Of course, this result holds only under the condition that there is no quota transfer between the two types of producers.

Thirdly the welfare effect of a decrease in ODP export subsidies is substantial, in particular when they are equal to zero (+ 8.8 billion French francs with respect to the base).

3.3. Third set of scenarios: impact of a quota increase

We now analyse the effects of a quota increase. Results are reported in Table 3.3. As expected, a quota increase tends to increase the negative impact of the intervention price cut on farm milk price. Columns 3 and 4 of Table 3.3. suggest that a + 2 % quota increase induces a + 3 % additional decrease in farm milk price. The last column of this table shows that a –15 % decrease in B&SMP intervention prices, a + 2 % quota increase and a – 15 % reduction in unit export subsidies on ODP exports lead to a decline in farm milk price of nearly – 15 %. Finally it is important to note that a quota increase leads to a domestic welfare improvement. This result may be surprising at first sight because an increased quota means higher export subsidies of ODP, other things being equal. In fact the quota increase means also higher value added in the economy. This second effect dominates the first effect in terms of welfare.

Table 3.3. Effects of a - 15 % decrease in the B&SMP intervention price, a + 2 % quota Q increase and a decrease in ODP unit export subsidies s ($\sigma = 0.5$; results in % with respect to the base)

	Benchmark	Q=+0% s=-0%	Q=+2%, s=- 0%	Q=+2% s=-15%
<i>Farm milk</i>				
Producer price	1	-9.26	-12.35	-14.50
Domestic production	52 295	0	+2	+2
Price of quota rights				
Specialised dairy farmer	0.25	-35.77	-48.41	-57.01
Mixed dairy farmer	0.20	-44.98	-60.35	-71.11
<i>Butter and skimmed milk powder</i>				
Producer price	1	-15.00	-15.00	-15.00
Domestic production	24 685	-5.55	-2.86	-2.27
Exports to the RoW	3 156	-80.76	-61.02	-56.28
<i>Other dairy products</i>				
Producer price	1	-1.75	-3.74	-5.18
Domestic production	82 261	+1.55	+3.37	+3.22
Exports to the RoW	3 336	+19.04	+38.90	+17.07
<i>Welfare change</i> (million of French francs)	-	+2 685	+4 178	+5 422

4. Concluding remarks

The main conclusion of this paper is that it is hard to predict the final impact of the Agenda 2000 dairy reform on farm milk prices. This impact depends on the management of export subsidies on dairy products. Furthermore we have shown that it also depends on substitution possibilities between butter and skimmed milk powder on the one hand (i.e., the two dairy products regulated by the intervention mechanism), other dairy products on the other hand. These substitution possibilities are summarised in our model by the elasticity value of the constant elasticity of transformation function between B&SMP and ODP. There is a lack of estimates of this parameter. As noted by Kehoe et al. (1988), “one of the most important products of the general equilibrium modelling exercise is that it points out the important areas for future research”. This is clearly the case here.

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Abstract. The main objective of this paper is to analyse the impact of changes in Agenda 2000 dairy policy instruments, i.e., butter and skimmed milk powder intervention price cuts, decreases in export subsidies and quota level increases, on milk farm price. The vehicle for this analysis is a computable general equilibrium model of the French economy which highlights agricultural and food sectors and with special attention given to modelling of the various CAP instruments.