European Dairy Industry Model

# THE EU ENLARGMENT AND THE DAIRY-BEEF SECTOR: THREE POLICY SIMULATIONS

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# THE EU ENLARGEMENT AND THE DAIRY-BEEF SECTOR: THREE POLICY SIMULATIONS

**Abstract**

A descriptive and comparative analysis is given of the dairy sectors of the eight new member states (NMS), which recently acceded to the EU. Three scenarios focusing on the NMS were developed and applied to a dairy-beef and veal simulation model, which was developed for the enlarged EU. The scenario's are the Luxembourg reform (baseline), an additional GDP increase-scenario (accession dividend), and a new WTO agreement implying further price liberalization. The results indicate that milk quotas will become almost directly binding for most NMS at the moment quotas are in effect. With quotas remaining in place the EU-25 will become a net importer in the long run. An increased GDP growth leads to an increase of the exports from the ols member states to the new ones, which will be come net importers. A new WTO agreement following the EU's Mandelson-proposal will lead to slightly higher farm milk prices, as compared to the Luxembourg reform.

*Keywords***:** EU enlargement, Central and Eastern European Countries, Luxembourg Agreement, dairy sector

*JEL codes*: C21, Q13, Q18

## 1 Introduction

The enlargement of the European Union (EU) will have a significant impact on agriculture in the new member states (NMS), since the Common Agricultural Policy

(CAP) now also applies to the NMS. Eight out of the ten NMS are Central and Eastern European Countries (CEECs), jointly producing about 20 per cent of total EU-15 milk production. Large differences exist between the eight NMS and the EU-15 in terms of prices, production methods, milk yields, product quality, farm structures, farmers' and consumers' income, etc. Due to accession, these gaps are expected to decrease over time relative to the non-accession situation. For the dairy sector, implementation of the CAP in the NMS entails the introduction of intervention prices, quotas, premiums and quality regulations.

The present study, which has an exploratory character, concentrates on the eight acceding NMS: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia. The next section gives a descriptive analysis of the dairy and beef sector in these countries, showing that they are a heterogeneous group of countries concerning the characteristics of the dairy sector mentioned above. Poland is the largest producer but has a low milk yield, while Hungary and the Czech Republic are smaller producers but with milk yields comparable to those in the EU-15. Beef production is closely linked to dairying, with specialized beef production hardly playing any role. What they do have in common as a group is the large reduction in production after the Soviet Union fell apart in 1990. Production has gradually increased since then but has not yet reached previous levels. Tough accession negotiations resulted in tight quotas to be implemented in the eight NMS on April 1, 2004. For most countries this meant limiting production to levels below those existing in 2000. Poland and Slovenia have an exemption from the super-levy in the first year (Waite and Traynor, 2004), which implies that the quota is non-effective.

The accession agreement included limited restructuring quotas for the eight NMS, which are to be released in 2006. The decision on releasing the reserve will be taken by

the European Commission following reports submitted by the member states concerned, detailing the results and trends of the actual restructuring process in the dairy sector (2004/281/EC). Following the Luxembourg Agreement, quotas in all member states (with the exception of Ireland, Italy, Spain and Greece) will be increased by 0.5 per cent per year for the first three years, starting in 2004. After that the quotas will be increased by 1 per cent per year in all member states for the following two years. The Council Decision on 22 March 2004, concerning the conditions of accession following the reform of the CAP (22 March 2004), appears to indicate that the quota increases in the Luxembourg Agreement will not apply to the CEECs (2004/281/EC). As compensation for the announced reduction in intervention prices of butter (25 per cent from 2004 - 2007) and skimmed milk powder (15 per cent from 2004 - 2006), direct payments will be phased in gradually. For the EU-15, these range from €8.15/ton in 2004 to €24.49/ton in 2006. For the CEECs, direct payments start in 2004 at 25 per cent of the EU-15 amount in 2004, and increase by 5 per cent per year until 2007 and thereafter by 10 per cent per year.

Based on these policies, and the variation in several key variables, i.e. technical progress, growth rates of gross domestic product (GDP), and population growth, a number of scenarios are formulated and subsequently analysed using a partial equilibrium simulation model. The next section provides a brief descriptive analysis of the CEEC dairy sectors. Besides milk output, also beef and veal output is taken into account. Thereafter, further details of the model and scenarios are provided. The paper continues with a section containing the simulation results and their discussion. It concludes by comparing the results of the scenarios in the model. Jointly, these scenarios provide a first insight into the likely impacts of the accession of the NMS on the EU dairy sector. Moreover, they highlight the sensitivity of the enlargement impacts

with respect to several key parameters, among which the adjustment rate of the subsistence sector.

## 2 Descriptive analysis of the dairy sector in the 8 CEECs

### *2.1 Milk and beef and veal production and farm structure*

Poland is by far the largest acceding country in terms of population, area and milk production (11.8 million ton in 2003 or 55 per cent of the total production in the eight NMS). However, the average milk yield in Poland (4.0 ton/cow in 2002) is about 500 kg below the average in the eight NMS, and about 65 per cent of the average yield in the EU-15 (6.1 ton/cow in 2003). This relatively low milk yield is probably the result of the large number of very small non-specialised farms in Poland, producing partly for own consumption and using mainly grasslands for feed. The two countries among the eight CEECs with the highest average yields, Czech Republic and Hungary (about the EU-15 average), are the second and third largest milk producers, respectively, in the group. In these countries there are many large collective and cooperative farms, which use more modern technologies and concentrated feedstuffs as an important part of the feed ration (Tonini and Jongeneel, 2002). According to Agra Europe (2004), 95 per cent of Hungary's milk production meets EU hygiene standards, and similar high levels are reached in the Czech Republic. Hungary and the Czech Republic are also similar in terms of area, population and the share of the population living in rural areas (around a third).

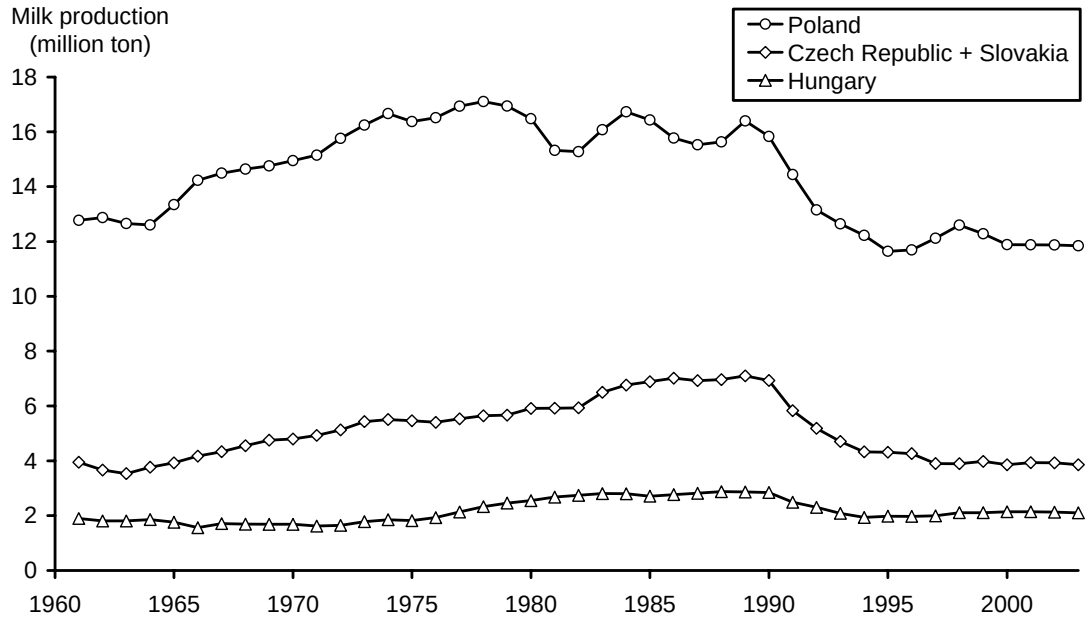


*Figure 1:* Milk production of Poland, Hungary, and Czech Republic + Slovakia between 1961 and 2003; source: FAOSTAT (2004)

The total production of the four main dairy-producing NMS (Poland, Hungary, Czech Republic and Slovakia) increased during the sixties and seventies and fluctuated at a high level during the eighties (Figure 1). In 1991, there was a large fall in milk prices and production decreased markedly, partly because of decreased yields, but mainly because of a decrease in livestock numbers. Especially for Poland, this was a large shock for dairy production. However, production and yields have been increasing steadily since the mid-1990s.

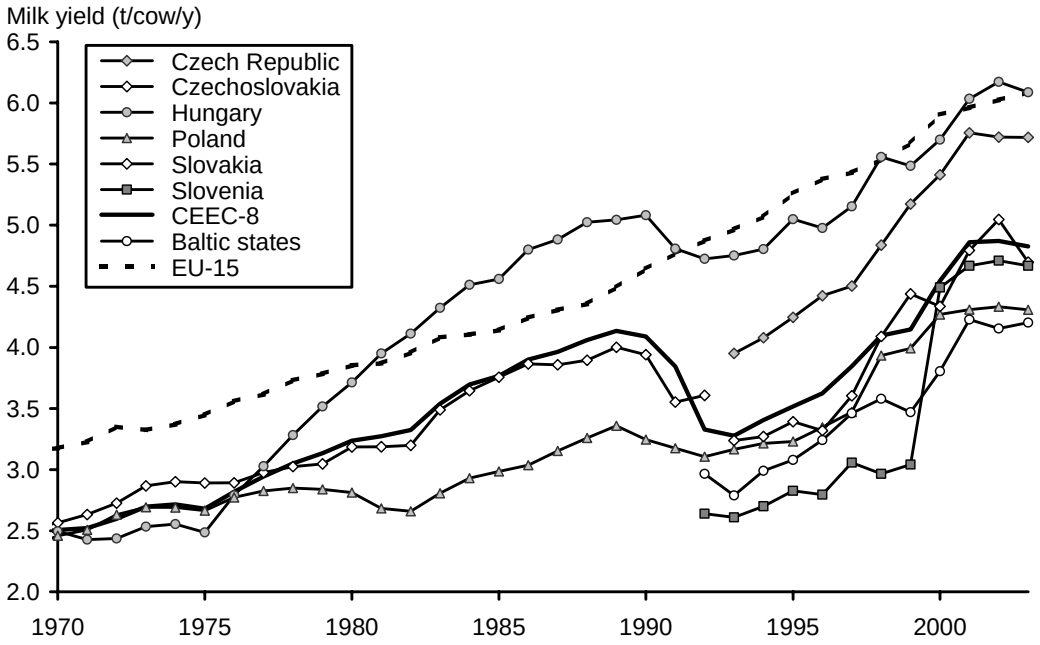


*Figure 2:* Average milk yields in the CEECs (total and individual) and the EU-15, between 1961 and 2003; source: FAOSTAT (2004)

The differences in average yields between most of the eight NMS and the EU-15 remain large (Figure 2), which suggests that a large increase in yield is still possible and expected. Apart from investments in new technologies (genetic material, machinery, feedstuffs), there is a tendency for changes in farm structure towards a more even distribution of agricultural area across producers, similar to that seen in the EU-15 (Lerman, 1999). Especially in the countries where small farm structures predominate, the pressure of the EU quality standards is thought to force the farms to either quit or expand production (Agra Europe, 2004). The price-increase in the eight NMS will be a positive incentive for the producers. However, the restrictive quotas that were allocated (see also next section) will limit expansion of production and probably influence farm size restructuring.

In EU, about two thirds of the beef production is derived from the dairy herds, which links the beef sector closely to the dairy production. Also in the NMS specialized beef

production plays only a minor role. It is therefore desirable to take into account the complementarities between milk and beef production and to model the dairy market and the beef market simultaneously.

### *2.2 Dairy market and processing industry*

A significant part of the milk production in the eight NMS is not processed in the dairy industry but either directly marketed or consumed by the farm family. In Latvia, Lithuania and Poland, only about 45 to 65 per cent of the milk production goes to dairies. Reasons for this include low quality of the raw material and high milk collecting costs (Hartmann, 2001). A large part of the production in these three countries takes place in small scale subsistence farming, which is reflected in the large share of the labour force being employed in agriculture in small scale farms (15 to 20 per cent compared to 5 to 10 per cent in the other CEECs). The share of deliveries to the dairy industry in the Czech Republic, Slovakia is almost the same as that in the EU-15, around 95 per cent of milk production. In these countries, the dairy processing industry is relatively well developed and modernised. Foreign investment has contributed to this development; foreign investors have considerably expanded the dairy industry in the eight NMS in recent years (Jongeneel and Tonini, 2002). For example, the multinational "Nutricia Dairy" is the market leader in Hungary with an 18 per cent share of milk processing. On the other hand, there are also a number of domestic investors, such as "Madeta", which is the market leader in Czech Republic with a quarter share of the milk market (Agra Europe, 2004). Foreign direct investment also plays a significant role in Poland in changing the rather fragile and small-scale dairy sector (Dries and Swinnen, 2004: 302). Compared to the developments taking place in the Czech Republic, Slovakia and Hungary, the dairy industries in Slovenia and Estonia still lag behind.

The EU enlargement in May 2004 did not lead to dramatic changes in the beef market. The increase in beef trade between old and the new member states resulted in increasing prices in the new member states. As the new states only accounts 8% of the EU-25 beef production and 6% of the consumption, the enlargement is not expected to have large impact on the EU beef market.

### *2.3 Consumption and international trade*

Consumption of milk in the NMS declined considerably in the nineties. Unlike in the other countries, where milk consumption has not yet recovered, in Slovenia and Lithuania milk consumption recovered concurrently with meat consumption. In Slovenia, increased milk consumption is probably the result of increases in incomes in the late nineties and beginning of this century. The situation in Lithuania is different; an increased number of small family farms (holding only a few cows) could explain the increased milk consumption (Abele et al., 2004). In recent years, increases in welfare in the NMS have led to an increase in demand for high value added products such as cheese. Because of a relatively low consumption levels in the NMS (cf. Table 1) the NMS have begun within the last few years to export their dairy products to the EU-15. Czech Republic, Lithuania, Slovakia and Slovenia are the most important net dairy exporters. Considered as a whole, the EU-15 is still a net importer of dairy products from the CEECs. According to ZMP (2004), net EU-15 imports of butter, cheese and SMP from the CEECs were respectively 17.0, 15.2, and 38.0 thousand tons in 2002, whereas the EU-15 was a net exporter of 34.3 thousand tons of yoghurt to the CEECs. EU imports from the CEECs increased considerably following the introduction of the 'double zero' agreement in 2000. According to Agra Europe (2004), consumption of dairy products is expected to decline further as the prices increase in the eight CEECs,

leading to even higher exports after accession. For comparison, consumption levels for dairy products in other regions of the world are added in Table 1.

*Table 1:* Consumption of butter and ghee, cheese, cream, whey, skimmed milk, whole milk, and milk excluding butter in kg per capita in 2002

| | **Butter, Ghee** | **Cheese** | **Cream** | **Whey** | **Milk, Skimmed** | **Milk, Whole** | **Milk – Ex. Butter** |
|---|---|---|---|---|---|---|---|
| | kg per capita | | | | | | |
| Czech Republic | 4.7 | 13.6 | 1.6 | 41 | 110 | 264 | 239 |
| Estonia | 2.8 | 8.5 | 1.5 | 61 | 72 | 367 | 303 |
| Hungary | 1.3 | 11.2 | 7.3 | 85 | 41 | 205 | 203 |
| Latvia | 2.6 | 4.7 | 7.7 | 28 | 82 | 352 | 346 |
| Lithuania | 2.7 | 5.8 | 4.8 | 102 | 114 | 505 | 386 |
| Poland | 4.5 | 13.1 | 5.5 | 96 | 112 | 281 | 280 |
| Slovakia | 3.4 | 9.3 | 3.2 | 53 | 91 | 219 | 200 |
| Slovenia | 1.4 | 10.7 | 10.2 | 10 | 98 | 330 | 313 |
| Bulgaria | 0.4 | 3.9 | 0.0 | 29 | 12 | 191 | 196 |
| Romania | 0.3 | 1.5 | 0.0 | 9 | 7 | 221 | 222 |
| EU-15 | 4.5 | 17.8 | 4.4 | 97 | 121 | 323 | 312 |
| Rest of Europe | 2.6 | 4.4 | 1.9 | 21 | 52 | 256 | 250 |
| Africa | 0.4 | 1.0 | 0.0 | 4 | 8 | 37 | 41 |
| North America | 1.6 | 10.2 | 0.5 | 44 | 31 | 202 | 209 |
| Central & South America | 0.5 | 2.1 | 0.0 | 16 | 12 | 129 | 129 |
| Asia | 1.0 | 0.4 | 0.0 | 2 | 18 | 49 | 51 |
| Oceania | 2.9 | 9.5 | 0.1 | 109 | 97 | 618 | 281 |

Source: FAO (2005)

## 3 Description of the model

### *3.1 Theory*

The impacts of the accession of the eight CEECs to the EU can be analysed with a simple partial equilibrium model, which is graphically illustrated in Figure 3. The pre-accession dairy market in the CEECs is characterised by a domestic demand and supply equation, which are at equilibrium at $(q^0_{CEEC}, p^0_{CEEC})$ (see Figure 3, left panel). The average pre-accession price level in the concerned CEECs is higher than the world market price due to support measures introduced after the initial liberalisation of the

early 1990s to compensate for the difficult market conditions (Kaspersson et al., 2002: 26). In the graph this is reflected by tariff (and export subsidy) $t^0$. It is assumed, for the ease of exposition, that before the accession the CEECs are a net exporter to the world market, thereby influencing the excess demand curve faced by the EU-15 (see right panel $ED^0_{ROW+CEEC}$). The main direct impacts for the NMS of accession are the introduction of milk quota and the milk price increase, and inclusion of the NMS in the EU. The milk quota restricts milk output at a level below the pre-accession production level (cf. Table 2 and Table 3). In Figure 3, the milk quota is represented by a vertical line at $\bar{q}$. With the accession the milk price increases from $p^0_{CEEC}$ to the EU price level $p^0_{EU}$. As a consequence CEEC milk demand will decrease by $\Delta q^d$. If the quota restricts milk output to a level lower than the profit maximising level, then marginal costs are no longer equal to marginal revenue. The marginal cost of production at the quota level is given by the intersection of the curve $\boldsymbol{S_{CEEC}}$ with the quota level $\bar{q}$ in the left panel of Figure 3. This would be the price that would induce producers to produce the quota level in the absence of restrictions. The marginal cost is termed the shadow price, $P^{shadow}_{CEEC}$. The difference between the market price and the shadow price is the quota rent ($p^1_{EU} - p^{shadow}_{CEEC}$).

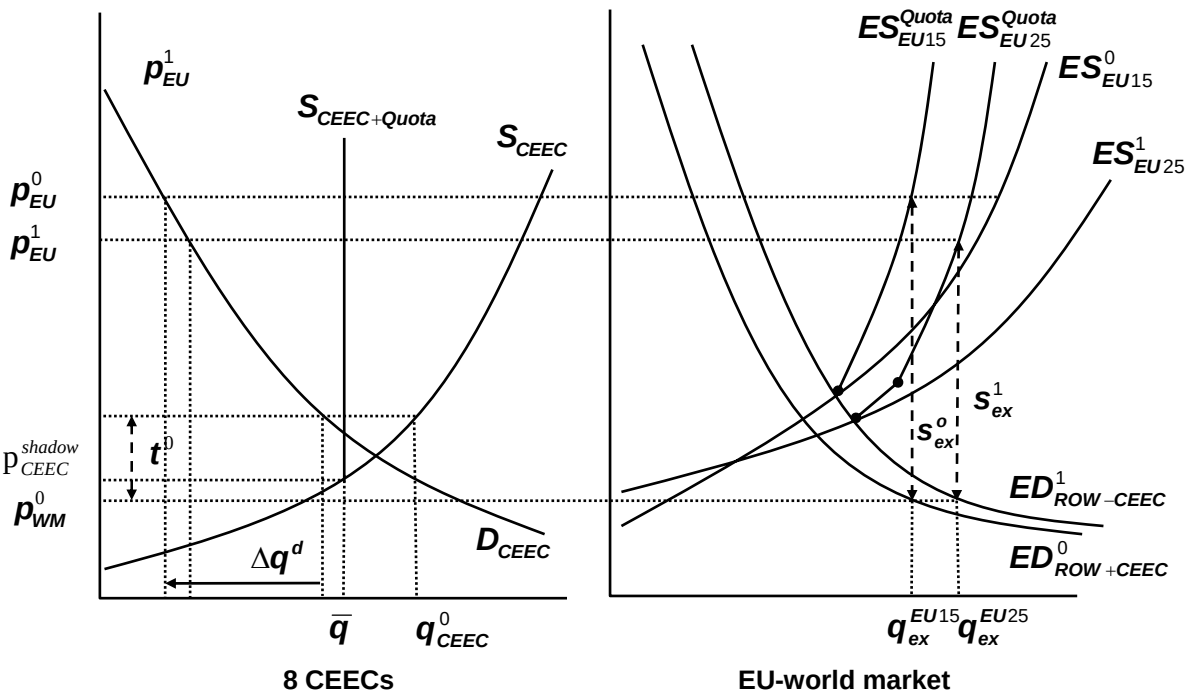


*Figure 3:* Simplified representation of the supply and demand curves of the 8 CEECs (left panel) and the EU-world market (right panel) (for explanation of the symbols, see text)

The impact of the EU enlargement on the world dairy market is illustrated in the right panel of Figure 3. This panel shows the excess milk supply of the EU (difference of $S_{EU15}$ and $D_{EU15}$), as well as the excess demand of the rest of the world, which initially includes the (negative) net excess demand of the NMS (see $ED^0_{ROW+CEEC}$). Since a quota scheme already exists in the EU-15, the relevant excess supply curve is $ES^{Quota}_{EU15}$. As a consequence of the enlargement both the EU's excess supply as well as the rest of the world's excess demand change. Following accession, the new relevant excess supply curve includes the NMS and is represented by $ES^{Quota}_{EU25}$, which is the sum of the excess supply curves of both the EU-15 and the NMS (see shift from $ES^{Quota}_{EU15}$ to $ES^{Quota}_{EU25}$)[1]. Since the NMS are now part of the EU market they have to be removed from the initial excess demand curve, and the excess demand curve at the world market shifts slightly to the right (see $ED^1_{ROW-CEEC}$).

As a consequence of the Agenda 2000 and the Luxembourg Agreement of 2003, the milk price will decline over time (see Introduction). This is reflected in Figure 3 by a decrease in the milk price from $p_{EU}^{0}$ to $p_{EU}^{1}$. This price decline has a positive effect on domestic dairy consumption in the EU and will lead to reduced excess supply. The net result of the enlargement and price decline is an increase of EU net exports from $q_{ex}^{EU15}$ to $q_{ex}^{EU25}$. The world market will only take up this export if an export subsidy bridging the gap between EU and world market price levels is available. As a consequence of the reduced price support in the EU the export subsidy can be lowered from $s_{ex}^{0} = (p_{EU}^{0} - p_{wm}^{0})$ to $s_{ex}^{1} = (p_{EU}^{1} - p_{wm}^{0})$. In the graph the world market price does not change as a consequence of the enlargement and EU dairy policy reform. Of course depending on the quota restrictions and EU price support level the world market price might shift in either a downward or upward direction.

Other, dynamic, effects, not considered in Figure 3 which will affect demand and supply arise due to income increases and population growth on the demand side and technological progress and milk yield increase on the supply side. In terms of Figure 3 (right panel), the consumer demand increase can be interpreted as an inward shift of the excess supply curve. The supply side shifters will move the supply curve to the right (see Figure 3, left panel) and will as such drive the NMS shadow price down over time, therewith increasing the value of the quota rents (with rent equal to $p_{EU}^{1} - p_{CEEC}^{shadow}$).

A final issue not considered in Figure 3 regards the dual structure of the dairy sector (subsistence and commercial production) in a number of NMS (cf. Abele and Frohberg, 2003, for a general discussion). Since the milk quota are defined in terms of milk delivered to dairies and direct sales milk produced in the subsistence sector is excluded. Production shifts from the subsistence sector to the commercial sector may influence the

period in which the milk quota will become binding. Moreover, given the low price sensitivity of subsistence production, a shift of production from subsistence to commercial will increase the price responsiveness of aggregate supply (see Annex A for further details).

### *3.2 Model specification, data & calibration*

The model consists of a set of milk and beef supply and demand equations[2] (where dairy product demand is measured in milk equivalents). Commercial supply is specified to be a function of the price of milk, the price of beef, land, and a trend variable, capturing technical progress Supply of the subsistence sector is specified to be a function of income growth and an autonomous trend. Demand for dairy products is a function of the price of milk, income, and population growth. Demand for beef and veal is specified in a similar manner. All functions follow a constant elasticity specification. Details of the elasticities and exogenous shifts (yield growth, income growth and population growth) are provided in Tables 2 and 3. Changes in subsistence production are assumed not to affect the total commercial demand for dairy products.

Data availability for the new member states is limited, and data over longer time frames are either not available or cover a period with so much structural change that underlying relationships are unrecoverable with traditional econometric techniques. The estimates for these countries are, however, empirically-based, using a mixed generalized maximum entropy procedure (Jongeneel and Tonini, 2006). The estimates for the old EU-15 member states come from Burrell and Jongeneel (2002), who used a classical mixed GLS estimator.

In the simulations for this paper, several simplifications to the model described above were implemented. Simplifications to the model included: the dairy and beef and veal

demand, which were calibrated rather than estimated, feed demand was not explicitly considered and feed prices were assumed to follow cereals prices, and cow stock was not included in the supply function (or shadow price function)[3].

The year 2002 was used as the base year for the model. Table 3 gives the most important base year data, including growth rates and trends. Data were taken from FAOSTAT (2005), Eurostat (2005), ZMP (2004), and IMF (2005). As Table 3 shows, there is considerable variation in milk prices, with a production weighted average milk price for the CEECs of about €0.22 per kg[4]. Gross Domestic Product (GDP) per capita was taken from the IMF in U.S. dollars (constant prices). Income growth is the average of the yearly GDP growth rates between 1992 and 2002. Population growth is the average of the annual growth rates between 1961 and 2002. Technological progress estimates for the CEECs and the EU-15 (kilogram milk yield increase per cow per annum) are based on regression analysis over the period 1993 to 2001 and exclude the impact of milk and feed prices on yields (all estimates were statistically significant). Estimates for the other regions of the world are based on Zhu et al. (1998).

*Table 2:* Base year data (2002)

| | CZ | HU | EE | LV | LT | PL | SK | SI | EU15 |
|---|---|---|---|---|---|---|---|---|---|
| Total milk supply | 2804 | 2068 | 611 | 812 | 1765 | 11873 | 1162 | 686 | 121231 |
| Commercial milk sup | 2663 | 2068 | 583 | 612 | 1362 | 7900 | 1025 | 576 | 118893 |
| Subsistence milk | 141 | 0 | 28 | 200 | 403 | 3973 | 137 | 110 | 2338 |
| Milk price (€/100kg) | 261 | 297 | 178 | 170 | 155 | 199 | 154 | 290 | 310 |
| Relative quality | 0.92 | 0.82 | 0.6 | 0.47 | 0.64 | 0.55 | 0.81 | 0.68 | 1 |
| Cow stock (1000) | 464 | 338 | 116 | 205 | 443 | 2935 | 230 | 140 | 19551 |
| Milk yield (kg/cow) | 6043 | 6119 | 5285 | 3969 | 3981 | 4046 | 5048 | 4901 | 6201 |
| Yield growth | 2.057 | 1.314 | 2.558 | 1.8 | 1.481 | 1.164 | 1.67 | 2.814 | 1.29 |
| Land (mill ha) | 839 | 1063 | 67 | 610 | 1203 | 3562 | 799 | 307 | 40720 |
| Milk demand (mill ton) | 2337 | 2048 | 605 | 829 | 1261 | 11527 | 1010 | 536 | 111307 |
| Beef&veal supply (1000t) | 109 | 54 | 17 | 16 | 38 | 281 | 38 | 43 | 7401 |
| Beef &veal demand | 101 | 55 | 18 | 19 | 41 | 224 | 38 | 38 | 7220 |
| Beef price (€/100kg) | 229 | 165 | 155 | 122 | 128 | 144 | 218 | 225 | 222 |
| GDP ($/cap) | 6843 | 6450 | 4536 | 3606 | 3658 | 4898 | 4388 | 10682 | 22724 |
| GDP growth (%) | 2.43 | 4.09 | 6.21 | 6.3 | 4.51 | 4.09 | 4.00 | 3.92 | 2.52 |
| Population (1000) | 10246 | 9923 | 1338 | 2329 | 3465 | 38622 | 5398 | 1986 | 378829 |
| Population growth (%) | -0.12 | -0.41 | -1.09 | -0.98 | -0.40 | 0.01 | 0.09 | -0.04 | 0.35 |

*Table 3 continued*

| | BU | RO | ROE | AFR | NAM | SAM | ASI | OCE |
|---|---|---|---|---|---|---|---|---|
| Total milk supply | 1509 | 4905 | 62903 | 28651 | 98763 | 46393 | 180491 | 25767 |
| Commercial milk sup | 905 | 1472 | 44032 | 14325 | 88887 | 32475 | 90245 | 24478 |
| Subsistence milk | 603 | 3434 | 18871 | 14325 | 9876 | 13918 | 90245 | 1288 |
| Milk price (€/100kg) | 170 | 159 | 200 | 222 | 293 | 173 | 270 | 200 |
| Relative quality | 0.5 | 0.5 | 0.7 | 0.5 | 0.9 | 0.7 | 0.7 | 0.9 |
| Cow stock (1000) | 367 | 1684 | 21520 | 43588 | 21287 | 32641 | 80031 | 5925 |
| Milk yield (kg/cow) | 4107 | 2912 | 2923 | 657 | 4640 | 1421 | 2255 | 4349 |
| Yield growth | 0.7 | 2.5 | 0.15 | 2.15 | 1.5 | 2.25 | 4 | 2.5 |
| Land (mill ha) | 1742 | 4938 | 111921 | 895324 | 262795 | 614151 | 1079030 | 412956 |
| Milk demand (mill ton) | 1523 | 4941 | 62433 | 28904 | 85235 | 62066 | 181342 | 19667 |
| Beef&veal supply (1000t) | 54 | 156 | 3375 | 4281 | 13583 | 14532 | 14199 | 2622 |
| Beef&veal demand | 82 | 165 | 3868 | 4472 | 13616 | 13603 | 15496 | 896 |
| Beef price (€/100kg) | 129 | 250 | 201 | 194 | 295 | 243 | 297 | 179 |
| GDP ($/cap) | 2038 | 1913 | 3895 | 672 | 34667 | 3190 | 2077 | 15067 |
| GDP growth (%) | 2.51 | 2.41 | 1.00 | 1.15 | 1.44 | 0.65 | 2.61 | 0.39 |
| Population (1000) | 7965 | 22387 | 243846 | 830557 | 322309 | 531542 | 3742567 | 31205 |
| Population growth (%) | -0.77 | -0.26 | 0.40 | 2.60 | 1.40 | 2.10 | 1.90 | 1.60 |

Source: Eurostat (2005), FAO (2005), IMF (2005)

*Table 4:* Elasticity data for the CEECs, EU-15, the Rest of Europe (ROE), Africa (AFR), North America (NAM), South & Central America (SAM), Asia (ASI) and Oceania (OCE)

| | CEECs | EU-15 | ROE | AFR | NAM | SAM | ASI | OCE |
|---|---|---|---|---|---|---|---|---|
| *Milk supply(commercial)* | | | | | | | | |
| Milk price | 0.25 | 0.45 | 0.30 | 0.45 | 0.40 | 0.39 | 0.30 | 0.50 |
| *Beef supply* | | | | | | | | |
| Beef price | 0.47 | 0.08 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| *Milk demand* | | | | | | | | |
| Milk price | -0.35 | -0.30 | -0.35 | -0.35 | -0.50 | -0.70 | -0.60 | -0.50 |
| Income per capita | 0.60 | 0.25 | 0.40 | 0.80 | 0.30 | 0.60 | 0.70 | 0.20 |
| *Beef demand* | | | | | | | | |
| Beef price | -1.00 | -0.40 | -0.40 | -0.40 | -0.40 | -0.40 | -0.40 | -0.40 |
| Income per capita | 0.40 | 0.25 | 0.40 | 0.80 | 0.30 | 0.60 | 0.70 | 0.20 |

| | CZ | HU | EE | LV | LT | PL | SK | SI |
|---|---|---|---|---|---|---|---|---|
| *Milk supply(commercial)* | | | | | | | | |
| Milk price | 0.33 | 0.33 | 0.28 | 0.28 | 0.28 | 0.18 | 0.34 | 0.28 |
| *Subsistence sector* | | | | | | | | |
| GDP/capita | -2.99 | -0.83 | -0.33 | -0.61 | 0.00 | -0.21 | -0.89 | -0.36 |
| *Beef supply* | | | | | | | | |
| beef price | 0.51 | 0.45 | 0.47 | 0.39 | 0.38 | 0.48 | 0.49 | 0.49 |

Table 4 gives the elasticity values used for the CEECs, the EU-15, the Rest of Europe (ROE), Africa, North America (NAM), South and Central America (SAM), Asia (ASI) and Oceania (OCE). For the all eight NMS, milk supply models were estimated using data based on period 1990-2002. A mixed information generalized entropy estimator was used, which in addition to the sample information took also non-sample prior

information (derived from economic theory, previous empirical economic research and agronomic information) into account (see Jongeneel and Tonini, 2006 for further details). The obtained results are comparable to the supply elasticity for the CEECs used in Gardiner et al. (1989) and Zhu et al. (1998). The supply elasticity estimates for the old EU-15 member states were econometrically estimated and based on simulated medium-term elasticities (see Burrell and Jongeneel, 2001 for further details). The average supply elasticity for the old member states was 0.45 whereas the average quota rent was 53% of the milk price. This implies that marginal costs were 47% of the milk price. Most other milk supply and demand elasticities are estimates based on Gardiner et al. (1989) and Zhu et al. (1998).

Following a relationship suggested in Von Braun and Lohlein (2003: 54), the estimates for the subsistence sector are based on regressions with subsistence production regressed on a GDP/capita indicator (estimation period 1993-2003)[5]. The responsiveness of output in the subsistence sector to the milk price, which is known to be rather low, was set equal to zero (Abele and Frohberg, 2003: II). When the estimated GDP/capita-coefficient was not significant the elasticity was set equal to zero.

### *3.3 Scenarios*

Three scenarios are analysed, with the base scenario following the EU dairy policy as defined in the Luxembourg Agreement. The second scenario follows the Luxembourg Agreement, but then with an additional increase in GDP in the NMS (+2% GDP growth per annum). The third scenario represents a new WTO agreement.

Each scenario includes the settings as defined in the base scenario, unless otherwise specified. Table 4 presents the milk quotas as used in the base scenario.

*Table 4:* Milk quotas in each of the 8 CEECs and in the EU-15 between 2003 and 2015

| Member states | 2004/5 | 2005/6 | 2006/7 | 2007/8 | 2008/15 | Restructuring quota[1] |
|---|---|---|---|---|---|---|
| | | | Quotas in million tonnes | | | |
| Czech Republic | 2682 | 2682 | 2682 | 2738 | 2738 | 56 |
| Estonia | 624 | 624 | 624 | 646 | 646 | 22 |
| Latvia | 695 | 695 | 695 | 729 | 729 | 33 |
| Lithuania | 1647 | 1647 | 1647 | 1705 | 1705 | 58 |
| Hungary | 1947 | 1947 | 1947 | 1990 | 1990 | 43 |
| Poland[2] | 8964 | 8964 | 8964 | 9380 | 9380 | 416 |
| Slovenia[2] | 560 | 560 | 560 | 577 | 577 | 16 |
| Slovakia | 1013 | 1013 | 1013 | 1041 | 1041 | 27 |
| Total CEEC-8 | 18134 | 18134 | 18134 | 18805 | 18805 | |
| Total EU-15 | 118893 | 118893 | 119374 | 119854 | 120335 | |

1: restructuring quotas are added in 2006/7.
2: Poland and Slovenia were exempted from the super levy in the first year. To reflect this in the model, quotas in Poland and Slovenia do not become active until 2005/2006.
Source: EC, No.281, 2004 (OJ L93);

More specifically the following assumptions with respect to the scenario's are made:

A) Here, quotas are imposed in six NMS in 2004 and in Poland and Slovakia in 2005 (Poland and Slovakia were exempt from the super levy in 2004/2005, which implies a non-effective quota (Waite and Traynor, 2004 and 2004/281/EC)). The quotas are increased in most EU-15[6] countries, based on the Luxembourg Agreement (0.5 per cent per year between 2005 and 2007, and 1 per cent in 2008 and 2009). These rates of increase are not applied to the NMS (see Council Decision 2004/281/EC), and quotas remain fixed with the exception of the restructuring quotas. It is assumed, however, that the restructuring quotas are not implemented in 2006 in the CEECs (2004/281/EC). The quantities of the restructuring quotas were fixed by the European Commission for each CEEC, based on analysis of the milk sector in each country. Given their limited magnitude the choice to ignore them will hardly effect the simulation results. Intervention prices are gradually decreased by 25 per cent between 2004 and 2007 for butter (7 percent in 2004, 2005 and 2006 and 4 per cent in 2007) and 15 per cent between 2004 and 2006 for skimmed milk powder (SMP).

B) Scenario B is similar to scenario A but focuses on demand. An additional 2 per cent per annum GDP growth rate is assumed for all CEECs. The additional GDP growth can be interpreted as an estimate of the macro-economic dividend from accession.

C) Scenario C corresponds to a new WTO agreement, roughly following the EU's offer as expressed in the Mandelson-proposal. This proposal is interpreted as implying a 50% reduction of the tariff rates for milk and beef. Moreover, this proposal contains a reciprocity clause, which is here assumed to imply that the US reduces its tariffs on dairy products with 25%, with no changes imposed for other countries or regions. The agreement is imposed over a 5 year period starting in 2008.

## 4 Results & discussion

### *4.1 Results*

Table 5 presents a number of key results of the model simulation for the three scenarios developed. Milk supply in the CEECs results are reported as an index relative to 2002. Net exports for the EU-25 and CEECs are provided. The average milk prices in the EU-25 and CEECs are reported alongside the shadow prices. The difference between the market price and the shadow price represents the quota rent and also indicates whether quotas are binding. The lower part of the Table provides information on beef supply, demand, price, and trade, al measured at EU-25 level.

*Base scenario – Scenario A*

In the base scenario, milk quota become binding immediately following accession for the Czech Republic, Hungary and Slovakia and one year after accession for Poland, Slovenia, Latvia and Estonia. In contrast, for Lithuania quota will not be binding for several years following accession. So for most countries and for more than 95% of the

milk production the quota become directly binding. Net exports in the EU-25 decrease and the EU-25 would become a net importer in 2015. When looking to the details at country level (not reported in Table 5), the Czech Republic remains a net exporter throughout the period of analysis while Hungary becomes a net importer as soon as the quotas are binding. Poland is mostly a net importer but fluctuates between net exporter and net importer in the period 2002-2010. The average milk price in the CEECs remains below the price in the EU-25, with the exception of the years 2013 and 2014. Shadow prices decrease over time.

Table 5: Simulation results for scenarios

| | Scenario | | | Scenario | | |
|---|---|---|---|---|---|---|
| | **A** | **B** | **C** | **A** | **B** | **C** |
| | **Milk supply NMS** | | | **Milk demand NMS** | | |
| 2002 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 2006 | 103.1 | 103.1 | 103.1 | 108.9 | 113.8 | 108.9 |
| 2010 | 108.1 | 108.1 | 108.1 | 110.2 | 120.5 | 109.9 |
| 2014 | 108.1 | 108.1 | 108.1 | 114.2 | 130.5 | 113.8 |
| | **Net export EU-25 (million t)** | | | **Net export CEECs (million t)** | | |
| 2002 | 4853 | 4853 | 4853 | 1611 | 1611 | 1611 |
| 2006 | -4114 | -5100 | -4114 | 120 | -962 | 120 |
| 2010 | -5202 | -7263 | -4819 | 484 | -1769 | 551 |
| 2014 | -7735 | -10973 | -7191 | -509 | -4029 | -418 |
| | **Milk price EU-25 (€/100kg)** | | | **Milk price CEECs (€/kg)** | | |
| 2002 | 297.9 | 297.9 | 297.9 | 215.5 | 215.5 | 215.5 |
| 2006 | 267.2 | 267.9 | 267.2 | 215.7 | 216.7 | 215.7 |
| 2010 | 283.4 | 284.8 | 285.7 | 265.4 | 267.1 | 267.7 |
| 2014 | 305.5 | 307.9 | 309.0 | 306.9 | 310.8 | 310.4 |
| | **Shadow price EU-25 (€/kg)** | | | **Shadow price CEECs (€/kg)** | | |
| 2002 | 227.5 | 227.5 | 227.5 | 215.6 | 215.6 | 215.6 |
| 2006 | 205.8 | 205.9 | 205.8 | 194.6 | 194.6 | 194.6 |
| 2010 | 190.3 | 190.3 | 190.3 | 193.8 | 193.8 | 193.8 |
| 2014 | 170.4 | 170.4 | 170.4 | 163.3 | 163.3 | 163.3 |
| | **Beef supply EU-25** | | | **Beef demand EU-25** | | |
| 2002 | 7996 | 7996 | 7996 | 7758 | 7758 | 7758 |
| 2006 | 8501 | 8501 | 8501 | 8068 | 8085 | 8068 |
| 2010 | 9035 | 9035 | 9036 | 8353 | 8389 | 8351 |
| 2014 | 9576 | 9576 | 9461 | 8635 | 8690 | 8957 |
| | **Beef price EU-25 (€/100kg)** | | | **Net beef exports EU-25** | | |
| 2002 | 201.2 | 201.2 | 201.2 | 238 | 238 | 238 |
| 2006 | 205.2 | 205.2 | 205.2 | 433 | 416 | 433 |
| 2010 | 211.5 | 211.5 | 211.6 | 682 | 646 | 686 |
| 2014 | 217.8 | 217.8 | 220.1 | 940 | 886 | 504 |

[1]: A: Luxembourg reform (baseline); B: 2% additional GDP growth in NMS; C: New WTO Agreement with 50% EU dairy and beef tariff reduction.

Whereas commercial milk supply is fixed, the milk supply generated by the subsistence sector shows a tendency to decline over time (it declines from 4.993 million tons in 2002 tot 4.389 million tons in 2014 (-12%)). This decline is driven be GDP growth rather than by milk price, and does not show much variation over scenario's. The impact of the decline of the subsistence on the moment in which the milk quota will become binding is negligible.

With respect to beef supply exceeds demand for the EU-25, with net exports increasing from 238 thousand tons in 2002 to 940 thousand tons in 2014 (+295%). The beef price increases, but with less than 1% per annum.

*Increase in demand in the NMS – Scenario B*

Assuming 2 per cent extra growth in GDP for the CEECs, dairy demand in the CEECs will increase by 46 per cent over the period 2002-2018, compared to about 22 per cent in Scenario A. Additional GDP growth will increase net dairy exports from the old EU-15 to the CEECs and the total EU-25 will already become a net importer in the year 2011. The net imports of the new member states will be 7 times higher than in scenario A. The CEECs become already net importers in 2006 rather than in 2013. With the increase in demand for milk products, milk prices in the EU-25 are marginally higher than in the base scenario. Shadow prices for scenario's B and A are equal to each other since nothing changes with respect to the supply side (quota remain binding). Quota rents (difference between market price and shadow price) will be slightly higher in scenario B as compared to A.

The additional demand growth hardly affects the beef market. Supply is similar to supply in scenario A, reflecting the joint production character of beef in combination

with the binding milk quota. This not only freezes milk output, but indirectly also beef output. The increased domestic demand for beef in the EU-23 leads to a decline of its net beef exports (in 2014 they are 6% below the net exports under the baseline scenario A). The low impact on beef prices whereas there is an impact on milk prices has to do with the share of the NMS in EU-25 ‘s total consumption: in 2002 for dairy this is about 15%, while for beef this is around 7%.

*A new WTO agreement – Scenario C*

A bit surprisingly, the further trade liberalization implied in Scenario C does hardly affect the milk price: the milk price is even slightly higher than in scenario A. The quota will thus remain binding as in scenario A. Until 2008 scenario C does not really differ from scenario A. In 2008 and later things are different, because than the tariff reductions are phased in. Initially not much will change because there is a lot of water in the tariffs of milk and beef, in particular for the EU. Ultimately the 50% tariff reductions in the EU will affect market protection and lead to an adjustment. However, the reciprocity clause implies that also the tariffs in the US will be reduced, although with a lower rate (-25%). This will increase market access to the US market as well as the EU market. The net effect on the world market is that the milk and beef prices both slightly increase as compared to scenario A. The EU net imports for dairy decrease, although the EU still remains a net importer.

Beef supply still exceeds beef demand, although net exports decline as compared to scenario A (in 2014 net exports in Scenario C are about 7% lower than in baseline scenario A. The milk price-beef price ratio marginally increases. This relative price change induces a small substitution effect, leading to a slight reduction in beef output (beef output in 2014 is 1.2% lower than beef output in scenario A). Although beef

demand also declines, it turns out that net exports in 2014 in scenario C are 437 thousand tons lower than in Scenario A.

### *4.2 Discussion*

The results from scenarios A, B and C that the EU-25 will become a net importer for dairy products. This also holds for the NMS as a subgroup, although the time frame differs over scenarios. Somewhat surprisingly the results obtained in the new WTO agreement scenario are rather similar to the Luxembourg Reform baseline (cf. Figure 4). Factors explaining this limited impact are the still high official tariff rates for dairy and beef and veal in the EU. Because the actual prevailing tariff rates are already significantly below these official rates, even a 50% official tariff rate reduction has only a limited impact. Moreover, the reciprocity condition, although not symmetric (the US reduces its official tariff only with 25%) has a positive impact on world market prices. Also in the WTO-scenario the EU-25 becomes a net importer for dairy products.

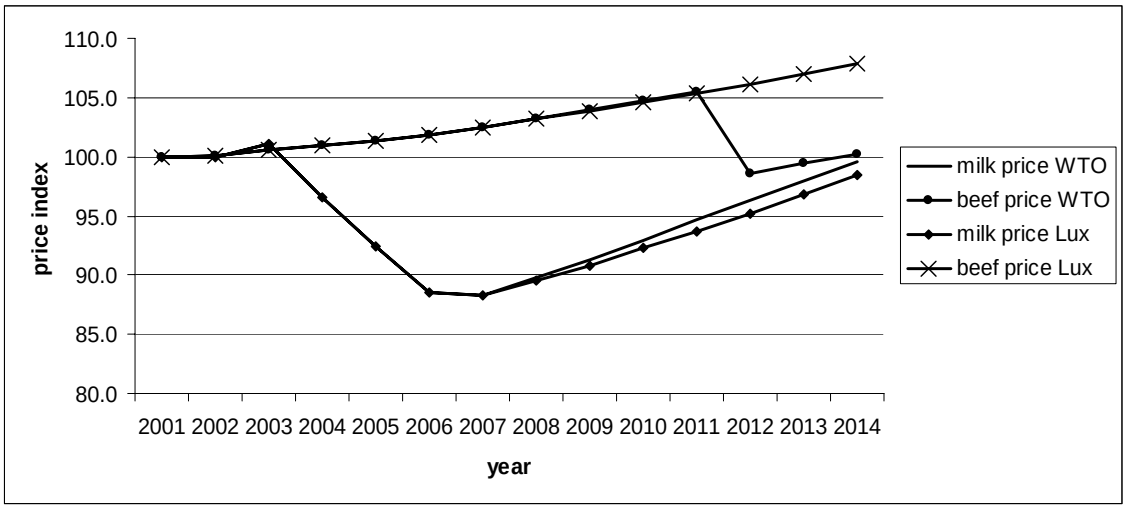


Figure 4 Evolution of milk and beef prices under Luxembourg reform and WTO scenario

Following the relaxation in quotas (Luxembourg Agreement), milk prices in the EU-25 initially decrease in all three scenarios, and begin to increase in 2006/07 for the first three scenarios and a year later for the liberalisation scenario (cf. Figure 4). The milk price decline of 10% as compared to 2002 fits in with results obtained in other studies for the impact of the Luxembourg agreement. Boamra-Mechemache and Requillart (2003), for example, found a 15% milk price decrease as compared to baseline 2000. However, they have not yet included the EU enlargement in their calculations. The average milk price in the EU-25 shows only small variance across scenarios, but this seems reasonable given that differences in the scenarios all occur for the CEECs. In terms of both the world market and the EU-25 market, the CEECs are relatively small, jointly producing only 20 per cent of total EU-15 production. Table 1 also illustrates that consumption levels per capita are generally lower in the CEECs than the EU-15 for most dairy products.

It is expected that the shadow prices (marginal costs) will decrease over time, driven by technological improvements (particularly in milk yield). However, in a binding quota situation, milk supply remains the same and increases in milk yield imply decreases in the cow stock. This provides an effective 'bound' on the decreases in shadow prices due to technological change. Due to difficulties experienced in incorporating this effect, we modelled it using an artificial bound on the shadow price function of 2 per cent (see endnote 3 for further details). The shadow prices were very sensitive to the price elasticity of supply and the uncertainty that exists regarding the elasticities has implications for the shadow prices. Low shadow prices suggest room for significant supply increases in case of quota abolition. However, since low shadow prices often go with low supply elasticities, a small increase in output already substantially drives up the shadow price. This implies that the output expansion effect will then be limited.

Due to the uncertainties outlined above, shadow prices are most meaningful when compared across scenarios. In the EU-25, shadow prices decrease over time for the three 'with quota' scenarios. Quota rents are smaller in scenario B relative to the base scenario and the same in scenario C. In the CEECs shadow prices stay the same for all three scenario's. This is because of the unchanged and binding quota.

In the simulations, feed was assumed to follow the projected cereals price (following the projection as made by Commission, 2002). Sensitivity analysis with respect to feed indicated that the results presented here are rather stable.

Following Burrell and Jongeneel (2001) in the analysis the jointness in production and possibilities for substitution between dairy cows and beef cows was taken into account. It appeared that the milk quota in an indirect way to a large extent also freeze beef and veal supply. There is some space for substitution when relative milk and beef prices change, but its impact on domestic supply and demand in the EU is rather limited.

In scenario C demand for dairy products substantially increases, which is mainly due to the high income elasticity for dairy products in the CEECs. There still exists uncertainty with respect to the exact values of this parameter. However, Abele et al. (2004) emphasise the importance of the income effect on dairy demand in the CEECs. Whereas Agra Europe (2004) expects the milk price increase in the CEECs to lead to an increase in their net exports, our findings indicate that the (positive) income effect dominates the (negative) price effect, causing nearly all CEECs to become or remain net importers of dairy products. This holds in all scenarios, although it does not exclude that some individual CEECs will be net exporters. A limitation of the current simulation model is that it treats demand in terms of milk equivalents and not in terms of differentiated dairy products.

## 5 Conclusions

The results of the model described in this exploratory paper demonstrate that under the present EU policies for the dairy sector in the enlarged EU, demand for milk and dairy products in the CEECs will increase, even though prices will rise considerably. In all cases where quotas remain in place, and even more in the case with income growth in the CEECs being higher than the current trend, the enlarged EU will in the long run become a net importer of dairy products. As such, a prudent quota expansion policy will help the EU to satisfy WTO constraints on subsidised dairy exports.

An aim of this paper is to provide some further insight into the milk-beef interaction analysing a few scenario's out of the set analysed with the EDIM model. It showed that beef and veal output is closely linked to milk output. This implies that a quota constraint on milk output will also constrain the output of beef, although there are some opportunities for substitution. In general the beef demand growth in the EU 25 outpaced milk demand growth, generating steadily increasing prices for beef in the EU.

Another aim of this study was to explore whether taking the subsistence sector explicitly into account would affect the market situation. It turned out not to be the case, although the decline in the subsistence sector could have slightly contributed to making the milk quota earlier binding than otherwise would have been the case. However, the effects are negligible.

A number of qualifications and suggestions for further research apply. First, it should be realised that in particular the demand side was modelled in a rough way by aggregating all dairy products in terms of milk equivalents, thereby losing a lot of detail on the demand side. Moreover, both beef and veal demands were calibrated rather than empirically estimated.

With respect to future research further analysis of the functioning of the quota system (in particular with respect to the 'direct sales'-milk not delivered to dairies) is required. Moreover, more attention should be paid to the dual structure of the dairy sector in a number of CEECs and the impact this has on sectoral adjustment dynamics. A further refinement is the accurate modelling of the impacts of technological change on the shadow price and supply functions.

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**Endnotes**

[1] The kinks in the aggregate supply curves can be multiple and arise from the discontinuities in the supply curves of individual member states caused by the moment quota constraints become binding.

[2] Details about the model structure, which roughly follows a constant elasticity approach, are available from the authors upon request.

[3] The commercial supply function was initially specified as a function of the price of milk, the price of beef, land, *cow stock*, and a trend variable capturing technical progress. Cow stock was defined as the supply of milk divided by the milk yield, where yield was a function of the relative price of milk compared to the price of feed and a genetic or technological trend coefficient. Using this specification, both the shadow price and supply functions were extremely sensitive to the elasticity of changes in supply to changes in cow stock. Due to uncertainty over the parameter value for this elasticity and the un-reasonable results that the model produced with this specification, it was decided to take a simpler approach and model the effects of including cow stock

on the shadow price by using a bounded approach to the shadow price function. If quota were binding (and the quota level remained unchanged from the previous level), the shadow price could not increase and the maximum decrease was 2 per cent (estimate based on Carthagne et al 2005). If these conditions did not hold, then the shadow price could adjust freely.

[4] In the simulation the price differentials are assumed to be a function of the self-sufficiency rate and transport costs on the one hand and of the raw milk quality level on the other hand. The milk quality is assumed to converge to minimum EU standard quality over time:

$$P_{c,t} = P_{EU,t} + \left(\left(1-f_{q,t}\right)/\left(1-f_{q,2000}\right)\right)\cdot\left(P_{c,2000}-P_{EU,2000}\right)$$

Where: P=price; c=country; t=time; fq= share of milk delivered to dairies over the share of milk delivered to dairies in the EU. The share of milk delivered to dairies is an indicator for milk quality. It is increased from 2004 onwards by 0.01 in Czech Republic, Slovakia and Hungary, 0.02 in Estonia, Lithuania, Poland, and Slovenia, and 0.025 in Latvia, which results in values for fq between 0.8 and 1 in the year 2016.

[5] Also other specifications including the unemployment rate and a trend variable were tried. Given the limited number of observations it was difficult to get significant estimates and a very simple specification and pragmatic specification was chosen. Note that a lot of uncertainty remains. For example, the estimation period does not include any year in which the EU accession was a reality. So its impact might be poorly captured by our estimates. For Lithuania a non-significant positive relationship between GDP/capita and the subsistence supply was found. Since it is very unlikely that increasing income levels will lead to a larger subsistence sector, the coefficient for Lithuania was set equal to zero.

[6] With the exception of Ireland, Italy, Spain and Greece.

[7] Adjustments in other dairy policy instruments (aimed at stimulating domestic dairy consumption) are ignored.

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**Annex A**

Figure 4 represents a dairy sector composed of subsistence production and commercial producers. The initial supply of the subsistence sector is given by $S^0_{subs}$ and does not respond to price changes. The supply by the commercial sector is price responsive and represented by the upward sloping supply curve $S^0_{com}$. Total milk supply is equal to the aggregated supply of both sectors and given by $S^0_{aggr}$. The milk quotas are represented by the brace beneath the q-axis. Since this quota is larger than commercial supply at the prevailing prices, the quotas are initially not binding. After accession the milk price is assumed to increase. Moreover, assuming the subsistence sector decreases its output (supply shifts from $S^0_{subs}$ to $S^1_{subs}$), resources and production factors are shifted to the commercial sector. The production share of the commercial sector in total milk supply increases. Therefore, the price responsiveness of the aggregate supply also increases (see $S^1_{aggr}$). As is shown in the figure, due to the shift the quotas become binding.

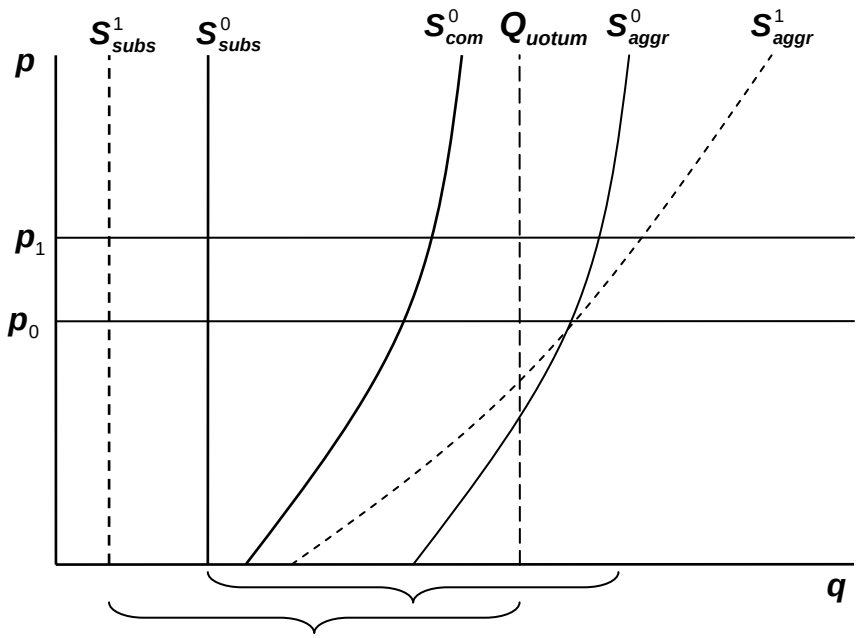


Figure A-1: Producer price responsiveness of milk production in the subsistence and commercial sectors.