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THE 'MILK QUOTAS RENT PUZZLE' IN THE EU: ECONOMIC SIGNIFICANCE, REVIEW, AND POLICY RELEVANCE

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Abstract

In the so-called Common Agricultural Policy (CAP) 'Health Check' the European Commission has recently proposed gradual transitional measures to allow a 'soft landing' of the milk sector to quota expiry. The aim of this paper is to support policy makers to get better insights in the implications of some of the most important economic assumptions and empirical choices made in partial equilibrium models focusing on dairy. Three partial equilibrium models are considered: the Agricultural Member states MODeling (AGMEMOD) model, the Common Agricultural Policy SIMulation (CAPSIM) model, and the European Dairy Industry Model (EDIM). The paper analyzes how the most important economic supply components, as they are part of the three key dairy models, affect milk production projections. A main conclusion is that the evaluation of the contribution of a study should not be based on one single characteristic (such as quota rents, supply responses). One isolated characteristic is not able to explain finally obtained model outcomes. Quota rents, supply responses, shifters and the demand side have to be integrated with each other.

Key Words: milk quota rents, supply response, shifters, dairy policy, equilibrium models.

JEL code: C01; C02; Q12; Q13.

Introduction

Milk quotas were introduced in the European Union (EU) on April 1st 1984[1]. Despite several critiques on the consequences of milk quotas[2], the Council decided under the Luxembourg agreement to extend the milk levy until March 31, 2015. In the so-called Common Agricultural Policy (CAP) 'Health Check' (HC) the European Commission has recently proposed gradual transitional measures to allow a 'soft landing' of the milk sector to quota expiry (Commission of the European Community, 2008). It is likely that the milk quotas' abolition will be accompanied, *ceteris paribus*, by lower domestic prices. However, this will also depend on the development of further cuts on trade instruments and consumption subsidies.

When modelling dairy policies, several important sources of information are required. First is the marginal cost of milk production (or shadow price of milk)[3]. Low marginal costs (or alternatively high quota rents) signal competitiveness and increase the probability of a positive output response. Second are the milk supply elasticities, which determine the slope of the supply function and therewith the change in output due to a change in the price. Third are the supply shifters which are affecting the position of the supply curve and its movement over time. The final supply response will most likely consist of a combined change along the supply curve and shift of the supply curve. Lastly, the final quantity will also be codetermined by the interaction with the demand for dairy products.

The aim of this paper is to support policy makers to get better insights in the implications of some of the most important economic assumptions and empirical choices made in partial equilibrium models focusing on dairy. Three partial equilibrium models are considered: the Agricultural Member states MODeling (AGMEMOD) model (see for further details Chantreuil, *et al*., 2008), the Common Agricultural Policy SIMulation (CAPSIM) model (see for further details Witzke and Tonini, 2008), and the European Dairy Industry Model (EDIM) (see for further details Bouamra-Mechemache *et al*., 2008). All three models are focusing on the upcoming evaluation of the dairy CAP evaluation as considered by the ongoing HC. AGMEMOD and CAPSIM are agricultural multi-product partial equilibrium model whereas EDIM is a dairy partial equilibrium model.

The paper analyzes how the most important economic supply components, as they are part of the three key dairy models, affect milk production projections. We have a threefold objective. First objective is to examine the economic significance of milk quotas from a (micro) economic perspective. Second, milk quota rents used in the three models are reviewed along with several considerations for equilibrium models. Third, it is analyzed how milk

[1] The objectives of milk quotas were to curb production, limit budget pressure, maintain market price support and ensure revenue stability for dairy farmers. For an historical overview on milk quotas, see Bianchi, (2004).
[2] Notably: protections of inefficient dairy farms, capitalisation of milk quotas into land and support in the farm assets.
[3] Note that when we assume the system to be 'in equilibrium' marginal cost is likely to coincide with the minimum locus of the average cost curve (no profits).

quota rents and supply elasticities are likely to affect the final outcomes. For this a comparative static framework is developed, including a stylized raw milk partial equilibrium framework. Two main assumptions are taken with respect the expected price decline consequent to quota expiry such as: an exogenous price decline or an endogenous price decline. This analysis is expected to provide more insights into the expected supply response in case of quota enlargement and/or quota abolition and be relevant for HC purposes. Moreover, it indicates what the relative importance of various factors is (magnitude of quota rents, responsiveness to price). Finally, it helps to disentangle and understand the contribution of the different economic drivers on the relative position of member states.

The remainder of this paper is organized as follows. Section 2 discusses on the economic significance of milk quota rents. Section 3 presents milk quota rent estimates highlighting some of the most relevant issues in translating this information into equilibrium models. Supply responses, shifters and raw milk demand are also discussed. Section 4 builds on a simple case study partial equilibrium model where the previously discussed quota rents and supply elasticities are used. Section 5 closes the paper with a number of remarks

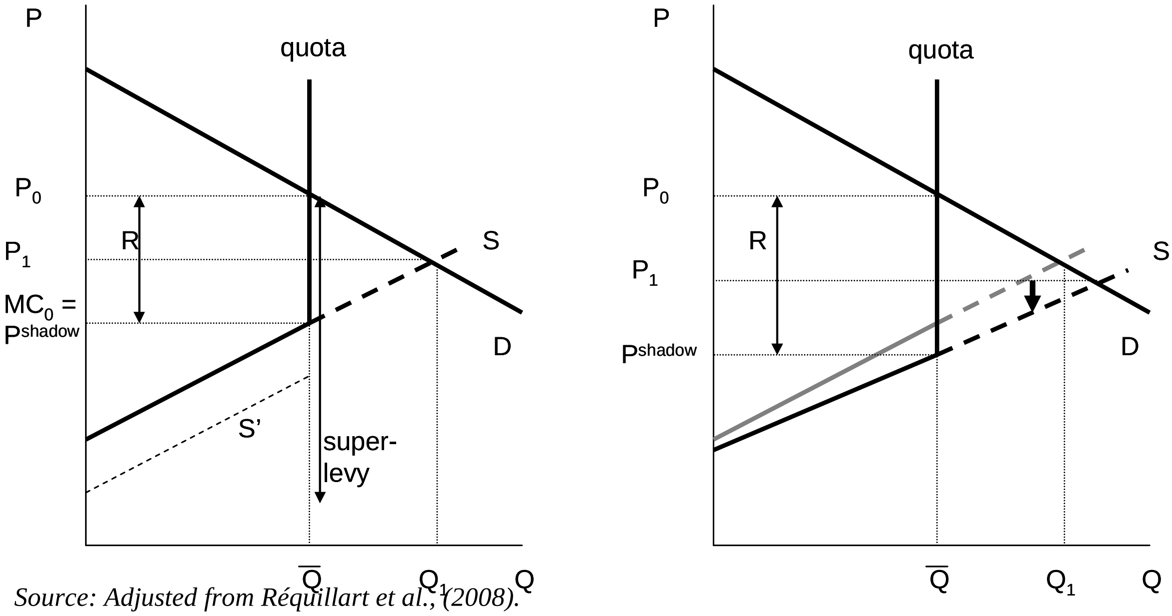
Economic significance of milk quota rents

In this section the economic significance of milk quota rents is discussed. When (binding) quotas are imposed on a market, this creates a difference between the price of the product received by farmers (P_0) and the marginal cost evaluated at the quota level (MC_0). This difference represents the 'value' of the quota, known as the quota rent $R = P_0 - P^{shadow}$. (see Figure 1, left panel). The price equivalent to the marginal cost evaluated at quota level is also known as the shadow price of milk (P^{shadow}). It is the minimum market price farmers need to get in order to supply the milk output corresponding with the quota. If the market price for raw milk is lower than P^{shadow} then the production will be lower than $\overline{Q}$ and the quota is not binding. In case the market price is higher than P^{shadow} production will be equal to the quota $\overline{Q}$ with the quota constraint being binding.

When removing the quota constraint a new equilibrium will establish where demand equals supply (see the allocation denoted by P_1, Q_1). As Figure 1 shows in this case this will lead to an increase in milk production. The main reason is that although the milk price goes down the effective price for farmers (i.e. the shadow price, which now equals the market price) still shown an increase from P_0^{shadow} to P_1 which induces output to increase from $\overline{Q}$ to Q_1. Note that the quota rent has now vanished. As regards the supply side, further note that the magnitude of the farm milk price decrease depends on the one hand on the magnitude of the quota rent and on the other hand on the slope of the supply curve (related to price elasticity of supply). With respect to the demand side, its slope is an additional important factor explaining the new equilibrium. Summarizing, the increase in production due to abolition of the quota is larger because of: i) the higher the quota rent, ii) the more elastic the supply curve, and iii) the more elastic the demand curve.

The quota redistribution mechanism among member states is also likely to play a role. The effects of quota and its tradability on asset value has been analysed in Burrell, (1989), Dawson, (1991), Boots, (1999) and Colman, (2000), among others. Reallocation mechanism might enhance competitive milk production (i.e. freely tradable quota), or freeze milk production in non-competitive areas (i.e. regional restrictions on quota trade). As far as milk quotas artificially keep production in non-competitive regions or member states, changes in their administration might lead to significant shifts in production. Therefore it is not only the total amount of quota and the associated rent that are relevant, but also the way they are administered. For example when removing milk quota another effect might be that the supply curve will shift in downward direction (see Figure 1, right panel).

Figure 1 - Impact of quotas on market equilibrium



Source: Adjusted from Réquillart et al., (2008).

The reason for this is that potential inefficiencies generated by the quota system (such as milk not produced by the most efficient farms but rather by a mixture of efficient and inefficient farms) now vanish (see also Section 1). The magnitude of this efficiency-effect will depend on the way in which quota are tradable, the kind of restrictions imposed on quota exchange (regional trade restrictions, siphon, etc.), or, if not tradable, the nature of the administrative redistribution system. Quota trade might be restricted in order to maintain producers in less competitive areas in activity, with the quota instrument thus used as 'rural development' policy tool. This may even lead to a situation where within one country you have regions where farmers face binding quotas and other regions where quotas are non-binding. In case quotas are tradable, efficient farms can already buy out inefficient ones, and there will be no efficiency impacts. In case other (e.g. administrative) quota distribution and reallocation rules are followed, inefficiencies are expected to play a role. Thus, when removing a quota system, the proper supply curve for determining the new market equilibrium is not the original one but rather the one taking into account the increased efficiency impact.

In terms of implementation, milk production quotas are imposed through the payment of a fine (the so-called super-levy) as soon as a farmer's production exceeds the quota (Council Regulation, 2003). If this rule is applied at the farm level, it means that the producer gets the market price in the limit of his quota and for the excess production he will not receive the market price, but the market price less the fine. Usually the fine is that large that the net return for a kilogram of surplus milk will by far not cover costs. However, as can be recalled from Figure 1, (left panel) if the farmer would have a quota rent R that is larger than the super-levy it would be rational to produce in excess of his quota. If he overproduces, then the total quantity he will produce is such that the marginal cost of production (evaluated at this level of production) is equal to the market price minus the fine. In order to well-understand why systematic excess production is observed in some EU countries it is important to also exactly know how this system is applied. For example it needs to be known whether producers really pay the fine or only a part of the fine because this will determine at the farm level the incentive to produce over the quota or not. If he overproduces, then the total quantity he will produce is such that the marginal cost of production (evaluated at this level of production) is equal to the market price minus the fine.

Quota rent estimates and related issues

In this section the main available options to compute milk quota rents are discussed. This is followed by a review of the estimates used in the three partial equilibrium models considered. In addition a set of estimates used by the Global Trade Analysis Project (GTAP) model (Lips and Rieder, 2005) is also included.

First, 'micro-econometric approaches' mostly estimate marginal cost functions by relying on market prices from the farm accountancy data network (FADN). Milk quota rent estimates are then derived by subtracting marginal cost from market milk prices. Some of the most recent studies following this approach can be found in Bouamra-Mechemache *et al*., (2002), INRA-Wageningen Consortium, (2002), Colman, (2002), Moro *et al*., (2005), Cathagne *et al*., (2006), Wieck and Heckelei (2007a,b). Micro-econometric approaches may suffer from aggregation issues. Two main types of aggregation can be followed during the estimation. The first estimates one equation for each country under analysis capturing farm heterogeneity (see Cathagne *et al*., 2006). The second estimates one equation for each sub-sample of farms classified according to size, location, etc. (see Moro *et al*., 2005 among others). The former takes the estimated total cost curve and then derives marginal cost curves by plugging in sample mean for each variable (i.e. outputs, milk quotas, fixed inputs, prices). This may cause problems for interpretation because it would not consider the position of farms on their marginal cost curve. The latter requires estimating marginal cost curves for each representative farm plugging in the observed value for the variable of that farm (i.e. outputs, milk quotas, fixed inputs, and prices) and then averaging among all specific values to each farm[4]. This method allows understanding how marginal costs vary in the sample due to different farm characteristics. Both approaches are likely to produce different results.

Another important aspect is the relationship between marginal cost and average cost. Farms are conventionally assumed to be on the rising part of their shadow supply function above and to the right of the minimum of the average cost curve. Under this assumption expansion along this supply curve provides an answer when simulating milk production developments when quotas are phased out. However in several cases dairy farms may be on the left of the minimum of the average cost curve and in the downward sloping part of their

[4] This approach consists in estimating a set of cost curves characterized by similar shape but different positions.

shadow marginal costs function[5] (see for further details Guyomard *et al*., 2004). One possible explanation for farms with decreasing marginal costs is that milk quotas freeze the possibility to exploit scale economies. Empirical findings suggest that marginal costs are almost constant and farms display elastic supply responses (Moro *et al*., 2005). One of the main issues is whether to include or to not to include during estimation those farms that do not behave according to standard microeconomic theory. One way could be to at least identify the extent to which farms deviate from this assumption. For example what would happen in case quotas are phased out for farms on the downward sloping part of their marginal cost curve? Those farms may still be viable after quota abolition if they are able to expand to the minimum of their average cost curve. However this may not be always a feasible option because of the investment required in terms of land. Direct payments become relevant in this context given that they can act as a 'safety net' while having a loss making farm. This may also allow farmers to adjust to the most profitable regions where scale economies allow reducing average production costs through scale expansion.

Micro-econometric approaches, although grasped on micro data, are frequently based on sample data that do not reflect the most recent market developments. Therefore those estimates need in several cases adjustments. In addition micro-econometric approaches require defining the length of run or the degree to which dynamic adjustments in quasi-fixed factors are accounted for. This latter issue also brings in the time lag in the supply response whenever it is specified. In the short-run the quasi-fixed production factors are unlikely to adjust, but in the medium and long-run they will do. This also requires using the most plausible and consistent estimates in terms of length of run into the equilibrium model used.

Second, 'quota market approaches' can be followed when the milk quota price is available in terms of rent or lease prices. In this case, marginal costs are estimated by the difference of milk price less the rental/lease price. Quota market approaches are in reality not without complications. For example in a number of cases the milk quota market does not exist. In case it exists, several factors have to be accounted for, before being able to obtain a reasonable quota rent (or marginal cost) estimate. Other factors influencing the quota price formation are fiscal treatment (tax credits or exemptions), the connectedness of milk production rights to land, as well as other institutional constraints (siphons, minimum transfer amounts, etc.). In case lease prices are used, one should for example be careful with respect to the time: just before the expiration of the quota year they may be subject to incidental shocks or circumstances and not provide a realistic picture of the structural position of the sector. In addition the expectations of farmers play a role (among others with respect to the survival of the quota system). For example, recently quota price declines were observed in several member states in the exchange of milk quotas due to negative expectation on the milk quotas survival. Moreover, if buy and sell prices have to be used (which present an estimate of the net present value of the market access right associated with the quota) a number of

[5] For several EU countries the number of farms in the decreasing region of marginal costs frequently out passes the number of farms in the increasing region of marginal costs.

assumptions (choice of discount rate and time horizon) are necessary to derive an estimate of the annual quota rent value. In principle this approach has the advantage that it implicitly takes into account the aggregation issue resulting from the equilibrium price as compared to 'micro-econometric approaches'.

Finally, a third 'synthetic approach' consists of guesstimating the potentially occurring quota rents at Member State level. This approach lacks empirical estimation but synthesises quota rent levels based on various sources of information such as previous studies and recent market developments. Synthetic approaches suffer of a lack of empirics and they suffer often from 'ad-hocery' and a degree of arbitrariness. They are frequently the results of exchanges with information coming from the market and experts. However this approach is better capable to take recent market developments and institutional changes into account than micro-econometric approaches, which rely on past time series information. Options for estimating milk quota rents are also discussed in Grinsted and Nielsen, (2004). This section continues with an overview on the milk quota rents used by AGMEMOD, CAPSIM, EDIM and GTAP. From Table 1 it appear that the weighted average of milk quota rents used by AGMEMOD, CAPSIM and GTAP are very similar whereas EDIM is using on average larger estimates.

Table 1 - Milk quota rents used into several equilibrium models (% milk prices)

Countries	AGMEMOD 2008	CAPSIM 2008	EDIM 2008	GTAP 2005
BE	34.3	30.3	46.7	20.0
DK	8.8	15.1	31.5	26.0
DE	20.2	10.3	45.4	20.0
GR	12.7	9.1	34.3	0.0
ES	29.5	42.1	40.9	24.0
FR	15.1	19.4	36.4	22.0
IE	35.0	27.6	36.0	31.0
IT	9.7	27.9	33.3	23.0
NL	36.0	48.2	43.6	23.0
AT	33.4	30.6	37.1	17.0
PT	8.6	14.1	19.9	0.0
FI	4.0	6.9	40.7	15.0
SE	15.0	0.0	0.0	10.0
UK	15.8	0.0	0.0	27.0
CZ	3.0	0.0	0.0	
EE	0.0	0.0	0.0	
HU	3.0	0.0	0.0	
LT	0.0	0.0	0.0	
LV	8.9	0.0	0.0	
PL	8.0	0.0	0.0	
SL	0.0	0.0	0.0	
SK	0.0	0.0	0.0	
BG	0.0	0.0	0.0	
RO	0.0	0.0	0.0	
EU15		20.1	21.0	22.0
EU25		16.3		
EU27		15.1		
EU27 weighted	17.66	16.61	28.73	18.73

Note: Quota rents equal to zero indicate that milk quotas are not considered to be binding.
Source: Own table.

AGMEMOD (see for further details Chantreuil, *et al*., 2008) calculates EU15 member state milk quota rents as a difference from the actual fat content producer (raw) milk price from NewCronos (Eurostat) and the marginal milk production costs as estimated in Réquillart *et al*., (2008). For the EU12 new member states milk quota rents are approximated by taking

10 percent of the quota lease price (as provided by Réquillart *et al*., 2008) and dividing it by the producer milk price. From the quota rents and milk prices in 2000, milk production costs are retrieved and projected into the future in order to give an annual milk cost index. The production cost index is assumed to change following changes in feed costs and the other input costs. CAPSIM (see for further details Witzke and Tonini, 2008) uses as default assumption the quota rent used by Réquillart *et al*., (2008) that are calculated from milk prices and marginal costs for the starting point of the recent simulation (i.e. 2008). This was done in order to reflect the current situation while removing short run impacts such as the quota over-run for a given year. The simulated quota rent for 2008 used in EDIM are thus a more suitable starting point for a comparative static model like CAPSIM than, for example, the historical marginal costs and quota rents in 2005. ESIM (see for further details Bouamra-Mechemache *et al*., 2008) uses the set of long run quota rents estimated by Moro *et al*., (2005). These estimates are for the EU15 and based on a detailed micro-analysis using FADN data, consistently applying the same methodology to each EU member states. In the aforementioned models adjustments are often made for those countries where milk quotas are no longer binding (e.g. Sweden and United Kingdom). Adjustments are made in order to reflect quota rents equal to zero or equivalently marginal costs being equal to the base year's milk price.

In the GTAP computable general equilibrium model instead of using a consistent set of estimated quota rents, Lips and Rieder, (2005) prefer to rely on mixed sources. In so doing, they obtain estimates for the ratio between milk market price and milk shadow prices for Austria and Germany from national experts. They then rely on Kleinhanss *et al*., (2001), who provide an aggregate EU raw milk quota rent of 7.9 billion Euros in order to get an aggregate residual quota rent for all EU-15, with the exception of Austria, Germany, Greece, and Portugal[6]. The authors then use information on raw milk prices and quota quantities at the member state level in order to disaggregate the residual quota rent for each EU nation. They also do this relying on quota rent estimates from the INRA-Wageningen Consortium, (2002). For consistency, the obtained quota rents are downsized in order to meet the constraint of the guesstimated residual quota rent.

When considering the aforementioned studies it appears that the INRA-Wageningen Consortium, (2002) and its follow up in EDIM (Bouamra-Mechemache *et al*., 2008) play a central role. Other studies use it as a reference. A common element across the different studies is that none of them fully rely on 'micro-econometric approaches'. Micro-econometric estimates are usually taken as initial source which is then confronted with expert information in order to reflect recent market development. In practice a mixture of empirical estimates, 'quota market approaches' and 'synthetic approaches' is used.

[6] The last two countries listed have no quota rents since their quotas are not binding for the base year. Therefore, they are exempt from any quota rent calculations.

As regards the supply, all studies use aggregate supply functions at member state level, but none of them discusses the aggregation issue. the supply responses, AGMEMOD and EDIM use empirical estimates, whereas CAPSIM bases itself on other studies. EDIM has a dynamic supply side structure, with the supply elasticity being different for different lengths of run. All models have inelastic supply responses, which roughly range from 0.3 to 0.7. No study really takes into account inefficiencies in the current structure of the dairy sector due to the institutional characteristics of the quota system, although the EDIM study discusses the effect at a conceptual level.

Other aspects, likely to affect milk supply, which could not be directly taken into account in the comparative analysis in the following section because of a lack of sufficient information are: supply shifters and farm restructuring information. Increase in efficiency over time caused by technical change, genetic progress, increased farmer skills and improved farming practices is also an important aspect in determining the position of the supply curve. These shifts are usually embedded in the so-called supply shifters. Apart from technical change also changes in other prices (than the milk price) can in principle lead to a shift in the supply curve, which can be in either downward or upward direction, depending on the specific price changes (increased feed prices, for example, will induce an upward shift of the supply curve). Farm size (re)structuring is related to the milk supply response at sector level by Tonini and Jongeneel, (2008) in a specific case study for Poland.

An in-depth comparative analysis

In this section the key economic variables (quota rents prices responses) are taken into account and put in a stylized comparative static framework. A common base year for 2005 (derived from the EDIM study) is selected to analyze cow milk projected output changes under various assumptions. The demand side is taken into account in a simplified way because the focus is on the supply side. Two alternatives are considered. First, the price decline associated with quota abolition after 2015 is considered exogenous using value taken from the EDIM model (see their scenario QR09) as a best estimate[7]. Given this projected price decline a comparative static projection is made using the base year assumptions and the key economic variables. Second, a linear aggregate EU derived demand for raw milk is specified (i.e. endogenous milk price decline). A demand price elasticity of -0.4, and a demand shift of 1 percent per annum are assumed (Soregaroli *et al*., 2005). In addition, it is assumed that the considered milk reform takes place over a period of 7 years. This latter price projection results from the interaction of the supply module of each of the considered models with a similar aggregate EU demand curve for raw milk.

Table 2 provides an overview of the (production share) weighted average quota rent and supply responses as well as the aggregate model outcomes. As can be seen the (weighted) milk supply elasticity is lowest for CAPSIM, highest for AGMEMOD, with EDIM taking an

[7] This corresponds to an 11 percent price decline.

intermediate position. As regards the marginal costs CAPSIM and AGMEMOD are quite similar, with EDIM's estimate being about 15 percent lower. Equivalently, the (weighted average) quota rent estimate for EDIM (29% of the milk price) is significantly higher than that for CAPSIM (17%) and AGMEMOD (18%) (See Table 2). In principle, multiplying the effective price change (column 3) with the milk price elasticity (column 1) should give the projected milk supply increase (column 4). Here it is not exactly the case, due to the weighting procedure used. What the top of Table 2 makes clear is that the very similar and relatively low quota rent assumption in CAPSIM and AGMEMOD plays an important role in explaining the limited supply increase result of these models. Therefore it is mostly the difference in milk supply elasticities which explains the difference in outcome between CAPSIM and AGMEMOD. Taking into account the dynamics in the supply side, the medium to long-run milk supply elasticities of EDIM and AGMEMOD seems to lie in a similar range, with the CAPSIM model having relative inelastic milk supply responses.

Table 2 (bottom part) also shows the projected results change when taking into account the interaction with a demand curve, rather than considering an exogenous price decline. A relatively low marginal cost (e.g. EDIM), and/or a relatively elastic supply response (e.g. AGMEMOD) generate a relatively high supply increase. However, at the same time the expansion pressure from the supply side, when confronted with the demand curve, drives prices down. This relatively strong price decline dampens the final milk supply increase. In case of CAPSIM, with a relatively low quota rent and relatively inelastic supply response the induced price decline is much less. This causes the projected supply increase to be about 7 percent (more than double of what was found in the upper past of Table 2). In case of the endogenous price simulation, the projected output increases for EDIM and AGMEMOD are rather similar, although the strongly differ with respect to their supply elasticity estimates (see also Table A1). So the interaction with demand matters: it contributes to a certain kind of convergence of the models with respect to the projected milk supply increase at the cost of a divergence with respect to the projected milk price declines. Moreover, it downgrades the role of differences in supply elasticities on the final output volume. With an inelastic demand for raw milk, the possibilities to expand production are limited: the price will quickly decline and curb the expansion of output. Disaggregated results are available in Annex I.

Table 2: The role of quota rent and supply elasticity estimates

Model	Milk price elasticity (1)	Marginal cost (€/kg) (2)	Effective %-price change (3)	Projected supply increase (%) (4)	Projected price decline (%) (5)
			Exogenous Price Decline		
AGMEMOD	0.63	0.241	9.8	7.2	-11.0
CAPSIM	0.27	0.243	10.9	3.3	-11.0
EDIM	0.40	0.205	32.1	11.4	-11.0
			Endogenous Price Decline		
AGMEMOD			10.9	8.8	-10.9
	0.63	0.241	(5.0 – 8.0)	(3.7 – 4.8)	
CAPSIM			20.9	7.0	-0.1
	0.27	0.243	(7.5)	(2.8)	
EDIM			27.8	11.4	-9.0
	0.40	0.205	(12.0)	(4.6)	

Note: In brackets price and quantity changes are reported as from the original results of these models under a quota abolition scenario. Source: Own calculations.

Several caveats have to be noted. First note that the obtained results might partly differ from the results presented in the original studies. This is because the responses to changes in non-milk prices (feed) are not taken into account in this analysis. Moreover, the role of supply shift variables (technical change and autonomous milk yield increases) is currently neglected[8]. However, when comparing our results with the ones presented in the individual studies, this gives an impression of the role played by the ignored factors. For example, our projected supply increase estimate of 11 percent, exceeds that of the EDIM study with about 5 percent. Implicitly this implies that the compensating impact of the other factors was equivalent with a 5 reduction in the milk expansion. So, although not taken into account, the role of non-milk price responses as well as the shift variables deserves some attention in comparing and explaining (differences in) model outcomes.

Table 3 shows that the models slightly differ in the importance they attribute to individual member states. All three studies converge on the importance of the Netherlands, which on average explains 33 percent of the EU's aggregate supply response. EDIM and AGMEMOD identify Germany as an important contributor (average share in EU's total milk expansion is 30%), whereas CAPSIM ranks Germany as a member state which will decline in milk production when the price decline is exogenous. CAPSIM has Spain as a second important member state expanding production under the exogenous price decline assumption whereas it shifts to the intermediate category when price decline is endogenous. As regards the member states with a declining milk production, the predicted increase of milk output by the UK and Sweden in AGMEMOD is strange, and could be traced back to the quota rent assumptions made.

[8] Unfortunately when writing the paper, it was not possible to fully recover this information, which was the main reason to exclude it from the comparison. As will be made clear with respect to the demand side an autonomous shift is taken into account, at least in one sub case.

Table 3: The role of individual member states in explaining the EU's milk supply

Model	Member states with expansion share greater or equal to 15%	Member states with expansion share between 0% and 15%	Member states with declining production
		Exogenous Price Decline	
AGMEMOD	DE, IE, **NL**	**BL**, GR, ES, FR, **AT**, SE, UK	DK, IT, PT, FI, **CZ**, EE, **HU**, **LT**, **LV**, **PL**, **SL**, **SK**, **BG**, **RO**
CAPSIM	ES, FR, IT, **NL**	**BL**, DK, IE, **AT**, PT	DE, GR, FI, SE, UK, **CZ**, EE, **HU**, **LT**, **LV**, **PL**, **SL**, **SK**, **BG**, **RO**
EDIM	DE, FR, **NL**	**BL**, DK, GR, ES, IE, IT, **AT**, PT, FI, EE	SE, UK, **CZ**, **HU**, **LT**, **LV**, **PL**, **SL**, **SK**, **BG**, **RO**
		Endogenous Price Decline	
AGMEMOD	DE, **NL**	**BL**, **DK**, **GR**, **ES**, FR, **IE**, **IT**, **AT**, SE, UK	PT, FI, **CZ**, EE, HU, LT, LV, **PL**, SL, SK, BG, RO
CAPSIM	**NL**	**BL**, **DK**, DE, **GR**, **ES**, FR, **IE**, **IT**, **AT**, PT, FI, EE, HU, LT, LV, SL, SK, BG, RO	SE, UK, **CZ**, **PL**
EDIM	DE, FR, **NL**	**BL**, **DK**, **GR**, **ES**, **IE**, **IT**, **AT**, PT, FI, EE	SE, UK, **CZ**, HU, LT, LV, **PL**, SL, SK, BG, RO

Note: In bold font are countries which are in the same expansion category across the three models.
Source: Own table.

As regards the role of the shifters no precise analysis could be made. However, when comparing the projected supply increases with those reported in the studies, it turns out that they are rather similar. This implies that in general the net impact of the shifters on the supply side has been rather 'neutral'. Or, alternatively, the impact from positive shifters (technical change, genetic progress) and negative shifters (increased feed prices) more or less balances.

Conclusion

The paper analyzed how the different economic supply components, as they are part of the three key dairy models, affect milk production projections. The aim was to support policy makers to get better insights in the implications of some of the most important economic assumptions and empirical choices made in partial equilibrium models focusing on dairy. First, the economic significance of milk quotas from a microeconomic perspective showed that it is difficult to estimate these rents. Several approaches are possible, but the obtained estimates will remain object of debate and subject to be confronted with recent market developments and expert information. Second, the review on milk quota rents used in the three models along with several considerations highlighted that there is some convergence in applied modelling. Several studies use the quota rent estimates from the Wageningen-INRA consortium and later on its follow-up in the EDIM project as a reference. These estimates are based on an extensive empirical analysis. Other studies add their own adjustments to these estimates. Third, the impacts of milk quota rents and supply elasticity on the final outcomes of the three models considered through a comparative static framework showed that the key factors (milk quota rents and supply elasticities) should be considered not in an isolated but rather an integrated way. This also implies that only focusing on the quota rent issue is short-sighted. It is good to realize that the quota rents are only one factor explaining the final result. Unfortunately the supply side dynamics (shifters) could not be well-addressed. Its importance might easily outweigh other factors and need therefore careful treatment (farm structural adjustments).

A main conclusion is that the evaluation of the contribution of a study should not be based on one single characteristic (such as quota rents or supply responses). One isolated characteristic is not able to explain finally obtained model outcomes. Quota rents, supply responses, shifters and the demand side have to be integrated with each other.

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Appendix I

Table A1: Overview on the effective price change and projected quantity response

ɔuntries	BL	DK	DE	GR	ES	FR	IE	IT	NL	AT	PT	FI	SE	UK	CZ	EE	HU	LT	LV	PL	SL	SK	BG	RO
	Effective Price Change																							
ƷMEMOD	35	-2	12	2	26	5	37	-1	39	34	-3	-7	5	6	-8	-11	-8	-11	-2	-3	-11	-11	-11	-11
CAPSIM	28	5	-1	-2	54	10	23	23	72	28	4	-4	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11
EDIM	67	30	63	35	50	40	39	33	58	42	11	50	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11
	Projected Quantity Response																							
ƷMEMOD	906	-59	1974	8	1124	665	1502	-132	3293	693	-27	-91	89	492	-35	-30	-76	-70	-8	-160	-26	-55	-49	-69
CAPSIM	328	66	-46	-5	1066	701	423	760	2111	178	21	-35	-84	-440	-74	-21	-43	-39	-16	-236	-16	-17	-26	-41
EDIM	631	558	6383	84	865	3173	829	1241	2758	334	88	517	-161	-612	-164	0	-121	-81	-40	-651	-30	-63	-17	-22
	Effective Price Change																							
ƷMEMOD	39	1	15	5	28	8	39	2	43	36	-1	-4	9	7	-8	-12	-8	-12	-3	-5	-12	-12	-12	-12
CAPSIM	43	18	11	10	72	24	38	39	93	44	16	7	0	0	0	0	0	0	0	0	0	0	0	0
EDIM	68	32	64	37	49	41	38	36	60	41	11	53	-9	-12	-13	-14	-13	-14	-14	-15	-14	-14	-14	-14
	Projected Quantity Response																							
ƷMEMOD	990	19	2515	22	1204	1038	1582	190	3659	751	-6	-49	169	578	-32	-33	-70	-75	-11	-227	-28	-59	-52	-74
CAPSIM	512	242	673	21	1438	1609	699	1248	2728	276	95	58	-1	-6	-1	0	-1	-1	0	-4	0	0	0	-1
EDIM	636	591	6517	88	843	3229	804	1326	2846	333	88	545	-131	-685	-187	0	-137	-105	-52	-879	-38	-82	-22	-28

Source: Own calculations.