STRUCTURAL CHANGE IN THE EU DAIRY SECTOR

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Abstract
The aim of this paper to determine how structure and governance in the dairy sector in four different regions in the European Union alter as a result of the change in EU's dairy policy. For this purpose two models of structural change are developed and interviews are held. Results differ between the regions depending on whether or not they are export oriented, their growth in farm size and farm exit rates.

Keywords
Structural change, dairy policy, governance

1. Introduction

Fresh milk is a highly perishable product and is therefore, because of high transport cost, processed in the region of production. Processed products can be divided into two groups. First, products that are produced and consumed locally. This is because of relatively high transport cost of fresh products (e.g. drinking milk) and local tastes. Second, processed products as butter and skimmed milk powder and certain types of cheeses that are internationally traded because of relatively low transport cost. Looking at demand and supply, we can also observe two types of production regions. First, regions where supply is focussed on meeting local demand. Second, regions that produce a surplus of processed products that is transported over longer distances or exported. These differences can create a price wedge for milk between regions (e.g. Parliament of Australia, 2010). Trading cost including transport cost lead in a region that is not exporting to a higher milk price than in a region that is exporting. This price difference can be offset by differences in regional production and processing cost.

With the yearly increase in milk quotas and the abolishment of the milk quotas in the European Union (EU) in 2015, the dairy sector (both dairy farming and milk processing industry) is approaching a new more liberalised market situation. It is expected that milk prices will fluctuate more and the average milk price level will be lower than in the last decade (Bouamra-Mechemache et al., 2008). Because of the lower price and the increased opportunities for farmers to expand production, a restructuring of the EU's dairy sector is likely. The number of dairy farms will decrease relatively fast and farms will increase in size to exploit scale economies (Jongeneel and Tonini, 2007). However, regional differences can be expected. In

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exporting regions an increase in milk production might take place. In less productive regions milk production might decrease and in some more isolated regions where production tends to fall below local demand it is likely that milk processors or supermarkets will give extra support to dairy farms to guarantee supply of fresh processed products or prevent a complete production stop. The latter can be for instance seen in a liberalised market as the Australian (e.g. Parliament of Australia, 2010) but also in Eastern Europe where milk processors provide technical services to dairy farms to secure supply and improve milk quality (Dries, et al., 2009). This also shows that the governance structure between farmers and processors is influenced by the demand and supply situation in a region (van Bekkum and Nilsen, 2002; Tacken, et al., 2009). So structure and governance in the dairy sector are expected to alter as a result of changes in EU's dairy policy where structure is defined as the number and size of dairy farms. Until now the causes of regional heterogeneity in structural development have been largely ignored.

The aim of this paper to determine how the structure and governance in the dairy sector in four different regions in the European Union: North-Holland (the Netherlands), Centre (France), Bulgaria and Scotland alter as a result of the change in EU's dairy policy.

To answer the research question we develop and apply a model of structural change and make use of interviews with stakeholders to see whether or not they confirm the model results. Taken into account regional differences will increase insight in the factors that shape the future structure of the dairy sector in the EU.

In section 2 we provide a description of the study regions. Section 3 presents the model. Section 4 discusses the followed methodology with respect to the interviews. Section 5 presents the model results and the interviews. Section 6 provides some conclusions and discussion.

2. Description regions

To get insight in regional differences within the EU, a literature research is conducted on the structure of the dairy sector in four case study regions taken up by the CAP-IRE project, namely: namely: the Netherlands (more specific the province North-Holland, North East Scotland (UK), South East Planning Region (Bulgaria) and Centre (France). Table 1 provides some information of the case study regions. Table 2 gives an overview of the production and export of dairy products per country.
The countries were selected because of characteristics of the dairy sector. In the Netherlands, the dairy farms are capital intensive, land intensive, and relatively large (FADN, 2009). The Netherlands is export oriented. Cheese is the main product. There is a limited number of processors. More than 90% of all milk is processed by cooperatives (PZ, 2009). Dairy farmers are clearly constrained by the milk quotas. It is expected that for the Netherlands farmers will expand their milk production after quota abolition.

French farms mainly are diversified and extensive. The French dairy sector had a relatively low restructuring rate (Perrot et al., 2009). The milk processing industry is characterized by the production of diversified products by many processors.

Approximately 45% of all milk is collected by cooperatives while 34% is processed by cooperatives (Orlait, 2005). Just as in the Netherlands French farmers in Centre are constrained by the milk quotas.

Bulgaria has more than 150,000 small farmers with in general 1-2 dairy cows (MAF, 2007). Only 20% of the produced milk is delivered to processors. This milk mainly is produced by larger farms. The remaining 80% is produced for self consumption or for the local market. There are many small scale local processors present and a few international large scale processors (Dries et al., 2008). There are no Bulgarian cooperatives processing milk. Milk quotas do not form a restriction. Production is much more restricted by the low milk quality.

In 2007, North East Scotland as NUTS 3 region build up from the NUTS 2 regions Aberdeen, Aberdeenshire and North East Murrey only had 70 farms specialised in dairy production (Scottish government, 2008). In Scotland in total there were 1,429 dairy farms. The number of dairy farms and dairy cows has declined rapidly in the last years. This is probably the result of the introduction of new alternatives to dairy farming such as the production of biofuel crops and the low profitability of the sector (Scottish government, 2008). The number of dairy farms in the whole of Scotland decreased by 8.9% in the period 2004-2007 while during that period, the number of dairy farms in the North East Scotland decreased by 17.6% (Scottish Government, 2007). Production is processed and consumed locally. In Scotland milk quotas are not filled.

[Table 1 here]

Table 2 shows production and exports of processed products (not per region). For Scotland we do not have reliable data. In some cases exports are higher than production which can be explained by a reduction in stocks and re-exports. Data show that the Netherlands is very export oriented but also France and Bulgaria are exporters.

[Table 2 here]

3. Theoretical model

From the previous section it follows that the regions differ with respect to the structure of dairy farming and market situation. In this section we develop a model to analyse the structure in the dairy sector in these regions. Structure is defined as the number and size of farms. Structure is by definition changing if the number of farms changes through exit and farms growing in size. Structure is assumed to be determined by:

- Personal characteristics of the farmers. In this group of explanatory variables we have age, education and presence of a successor. With more alternative opportunities to dairy farming farmers are expected to stop earlier just as it is the case with older and more educated farmers and farmers with a successor.
- Relative profitability of dairy farming. Factors that determine this relative profitability are milk price, prices of other outputs and variable inputs and supply

- Growth in farm size. In this group of explanatory variables we have productivity growth but also investment costs. An increase in productivity implies that with the same production factors more milk can be produced. This leads to an increase in milk production.
- Market size. Supply quotas and local consumer demand are expected to influence structure. With supply quotas an increase in production per farm automatically will lead to less farms. If production becomes less than local consumer demand processors can stimulate production to avoid excess capacity. Finally, new government policy could be aimed at maintaining production a certain level in a region, e.g. to secure joint production of dairy and wildlife and landscape.

Below we present two simple models of structural change. For simplicity we assume that farms are of the same size. Moreover, the models are recursive dynamic, so no optimisation over time takes place.

Model I: Total production is variable

The production of a farm is given by equation (1). We assume that production per farm grows per year with a fixed growth rate r e.g. as a result of productivity growth. Moreover, we assume that production is determined by relative profitability. Profit equals revenues minus variables costs. If profit of dairy farming increases relative to the profit of its alternatives production will increase. The model assumes that a 1% change in relative profitability leads to a 1% change in production per farm. We assume production per farm to be equal for all farms.

The number of farms in a year changes compared to the previous year with a (negative) growth rate (equation 2). This growth rate reflects the personal characteristics leading to an autonomous reduction in the number of farms. We assume a fixed yearly percentage reduction.

Total production equals the production per farm times the number of farms (equation 3).

$$y_t^d = y_{t-1}^d \times (1+r) \times \frac{\pi_t^d}{\pi_t^o} \qquad (1)$$

$$N_t = N_{t-1} \times (1+i) \qquad (2)$$

$$Y_t = y_t^d \times N_t \qquad (3)$$

Where

y_t^d: average farm production with exogenous profit in year t

π_t^d: profit in dairy farming in year t

π_t^o: profit of alternative production in year t

r: productivity growth rate

N_t: actual number of farms in year t

Y_t : total production in year t

i : autonomic growth rate in number of farms.

In this model production and the number of farms do not influence each other. Total production can grow or shrink without any restriction. If for example profitability falls, production falls (also in future years) but the number of farms is not affected.

Model II: total production is fixed

In comparison to model I we now assume that total production is fixed, e.g. because of the size of the local consumer market or because of supply quotas. In the model the fixed total production or market size will influence both production per farm and the number of farms.

Production is given by equation (4) or (5). Just as in model I we assume that production per farm grows yearly with a fixed percentage. Moreover, we assume that production is determined by relative profitability. If profit of dairy farming increases relative to the profit of alternatives production will increase.

The number of farms is by definition equal to the total production or market size divided by the production per farm (equations 8). If total production in a region is fixed the number of farms and production per farm are variable. There are two possibilities. First, it could be that the number of farms determines production. The number of farms is on an autonomic trend (equation 10) and is determined by the number of farms in the previous year times the (negative) growth rate. Production in this case is given by equation (5). Second, if relative profit is exogenous production is determined by equation (4). This production determines the optimal number of farms. The first possibility is relevant if the number of farms as determined by the autonomic trend is lower than the number of farms in option 2 (equation 9). This is because the number cannot be larger than the autonomic trend (we assume there is no entry). In case the number of farms is determined by the autonomic trend the production is larger than if it is not. In the model this is possible if profit of dairy farming goes up. This extra profit could be the premium processors pay to farmers to stimulate production to fill their production capacity. Given that this extra profit is positive it also implies that $y_t^e \geq y_t^d$ so equation (6) applies.

$$y_t^d = y_{t-1} \times (1+r) \times \frac{\pi_t^d}{\pi_t^o} \tag{4}$$

$$y_t^e = y_{t-1} \times (1+r) \times \frac{\pi_t^e}{\pi_t^o} \tag{5}$$

$$y_t = \max(y_t^d, y_t^e) \tag{6}$$

$$\pi_t^d = \pi_t^e + e_t \tag{7}$$

$$N_t^d = \frac{\overline{Y}_t}{y_t^d} \quad N_t^{trend} = \frac{\overline{Y}_t}{y_t^e} \tag{8}$$

$$N_t = \min(N_t^d, N_t^{trend}) \tag{9}$$

$$N_t^{trend} = N_{t-1} \times (1+i) \tag{10}$$

Where

y_t^e: average farm production with exogenous profit in year t

π_t^e: exogenous profit in dairy farming in year t

e_t: extra profit in dairy farming in year t

π_t^o: profit in alternative production in year t

$\bar{Y}_t$: fixed total production in year t

N_t^{trend}: number of farms according to trend in year t.

To illustrate the model suppose profitability falls in dairy farming, e.g. because of the dairy policy reform. In that case production per farm goes down and the number of farms increases or falls less given the total fixed production. There are two possibilities. First, the number of farms is (still) below the autonomic trend. Profit is still exogenous and total production equals the markets size. Second, the number of farms is above the autonomic trend. This is however not possible and therefore the actual number of farms is set equal to the number given by the autonomic trend. To increase production per farm, and therefore lower the number of farms, farmers need an incentive e_t. This could be an extra payment made by milk processers to ensure milk supply.

Governance

Both models do not describe the coordination mechanisms or governance in the dairy sector. Government policy can influence the relative profitability of dairy farming. Model I assumes that production can grow or shrink without any restrictions. Moreover, it is implicitly assumed that the milk processors process the extra milk produced or process less milk if needed. Model II assumes that relative profitability has to increase if production tends to fall below the fixed total production level. There are two possible cases. First, in case fixed production is determined by the size of the local consumer market it will be milk processors or supermarkets that pay a higher price or provide market and technical services to dairy farms that also increase relative profitability of dairy farming. This is what actually happens already in many markets, e.g. in Eastern and Central Europe (Dries et al., 2009) and some regions in Australia (e.g. Parliament of Australia, 2010). Second, in case fixed production is a government target the government has an incentive to take action. This could be through directly or indirectly subsidising dairy farming in a region. Notice that in case of a supply quota and production falling below the quota level there is no market mechanism available that to prevent this. In case supply tends to be higher than the quota level there has to be an extra reduction in the number of farms. In practice in countries with tradable milk quotas (e.g. the Netherlands) this takes place by selling quota rights by less efficient producers to more efficient producers.

4. Interviews

Interviews with experts and stakeholders of the dairy sector in the case studies were used to get insight in their expectations about the structure and governance in the dairy sector as a result of the EU's dairy policy reform. 20 semi-structured interviews were held in France and the Netherlands. In Bulgaria, 1 semi structured interview and

14 surveys with open questions were hold. The explanation on the survey questions took place during a short presentation given to the respondents. Table 3 gives an overview of the interviewed persons, in this paper further referred as ‘respondents’. The interviews were analysed by coding the findings from the interviews systematically into the core categories that together hold a coherent framework using the grounded theory as described in Neergaard and Ulhøi (2007). In the first phase, open coding, categories were named and their properties and dimensions determined. In the second phase, axial coding, categories were linked at the level of dimensions and properties. In the third phase, selective coding, the core categories were refined to integrate them into a coherent framework. No distinct differences were found in perception of specific interviewed subgroups on the core categories.

[Table 3 here]

5. Results

5.1 Model

Before the models can be used the growth rates of farm production and farm exit have to be determined. Moreover, the production per farm, the number of farms in a region and total production in a region have to be known. We use the data for 2003 and 2007 given in Table 1 and choose the growth rates of farm production and farm exit such that the model exactly reproduces the actual change in production per farm, total production and farm numbers from 2003 to 2007. We have here to make the assumption that relative profitability of dairy farming does not change in this period. Next we use 2007 as the base year and simulate the model over a 10 year period assuming that the values of the growth rate of farm production and farm exit remain constant and are equal to their average values in the period 2003-2007. Because in the EU’s dairy policy reform supply quotas are gradually increased just as intervention prices and export subsidies will be decreased we assume that as from 2008 on relative profitability of dairy farming drops by 10% in all four regions (Bouamra-Mechemache et al., 2008).

So we have two scenarios:

- Base scenario: relative profitability of dairy farming does not change.
- Scenario I: relative profitability of dairy farming decreases by 10% in 2008.

In the Netherlands model I is relevant because we expect total production to increase as a result of quota abolition. In France it is to be expected that the government wants to maintain regional milk production at the present quota level in regions less suitable for milk production. Centre is such a region. This makes that model II is relevant for France. In Bulgaria quotas are not binding so quota abolition is not expected to lead a constraint on total production, so model I seems relevant. In Scotland we expect that a further reduction in profitability would lead to a decrease in production. However, we assume that this will not happen because milk processors and retailers want to maintain milk production at the present level. This makes model II relevant. Table 4 summarises the model inputs and also shows the effect on the number of farms and production in case of both scenarios. As mentioned before we perform the simulations for a ten year period starting in 2007.

[Table 4 here]

The results for the Netherlands (model I) show that with a 10% drop in relative profitability compared to the base scenario the production per farm and total production still increase but less. Compared to the base scenario the production per farm and total production are 10% lower. This is because in model I a 1% reduction in relative profitability leads to a 1% reduction in production per farm. The number of farms is in both scenarios the same because it is, as mentioned in the model description, independent of relative profitability.

For France (model II) we see only a small difference between both scenarios. Total production is for both scenarios constant and the total number of farms is largely determined by the autonomic trend. Actually the reduction in farm numbers is a bit less in scenario I because to compensate for the fall in production per farm more farms have to be active. Results not presented here show that without the condition that total production should remain constant total production would increase 0.29% in the base scenario and decrease by 9.74% in scenario I. Production per farm would go up by 90.13% in the base scenario and 71.11% in scenario I. The number of farms would go down with 47.25% in both scenarios. This shows that to keep total production at the fixed level relative profitability of dairy farming has to be increased in scenario I to prevent a reduction in total production. This increase is 11.08%. This has to come from milk processors or government.

For Bulgaria (model I) we see a large decrease in the number of farms and a strong increase in production per farm. As a result total production falls with 5.03% in the base scenario and with 14.53% in scenario I. Just as in the Netherlands the reduction in the number of farms is independent from the scenario. Total production and production per farm are in scenario I 10% lower than in the base scenario. Given this outcome it is likely that the processors in Bulgaria will try to prevent the reduction in production. So instead of model I model II is relevant. If this is the case the number of farms falls with the same percentage (75.58%) as in model I and the production per farm increases more (309.55%). These changes are the same in both scenarios with model II. To make it possible that total production remains constant relative profitability has to be increased. For the base scenario this is 5.30% and for scenario I 17.0%. This support has to come form milk processors directly via higher prices or indirectly through technical support as is already now the case.

For Scotland (model II) we see that the differences between both scenarios are small. The number of farms is largely determined by the autonomic growth in farm numbers, and given the fixed total production this results in the production per farm. In the alternative scenario the number of farms falls a bit less, this is because of the larger reduction in production per farm in that scenario. Results not presented here show that if total production would not be fixed (model I) it would grow with 10.71% in the base scenario and would decrease with 0.36% in scenario I. Farm numbers would go down with 31.33% in both scenarios as they are in model I not dependent on the relative profitability. This result shows that only in scenario I some extra support is needed to fix total production at the initial level. From this it follows that probably model I is more relevant for Scotland than model II.

5.2 Interviews

In the Netherlands respondents strongly indicate that the cooperatives feel the obligation to collect all milk supplied by their members. Many Dutch dairy farmers currently feel limited by the production constraints from the quota. They are expected to increase scale, until other factors affecting their production will become limiting. They indicate this would be environmental and labour constraints. The dairy cooperatives in the Netherlands (>90% of all milk is supplied to cooperatives) are expected to process the milk and export largely the processed products.

Many French stakeholders consider the potential concentration of milk production in certain parts of France and the disappearance in other parts as an undesirable development and they indicate the government shares this opinion. To prevent milk processors from terminating milk collection in less efficient regions as Centre, there currently are ideas to impose national guidelines for milk supply contracts and to introduce a collective that manages the milk supply in France on a national level.

Long term contracts are already frequently used in Bulgaria. The Bulgarian respondents indicate to expect that production standards for physical milk quality will increase. From some of the Bulgarian respondents and from the literature (see e.g. Dries et al., 2008: 23) follows, that many Bulgarian milk processors experience shortage of high quality milk. Processors in Bulgaria focus on assuring the quality standards of the EU and are expected to try to decrease the costs accompanied with this. From the literature follows that some milk processors have set up their own dairy farms (see Dries et al., 2008). Also from the interviews follows that some stakeholders expect a further chain integration, drop in farm numbers and an increase in production per farm.

In Scotland it is expected that contracts between retailers and farmers, guaranteeing a minimum price for all the supplied milk based on the production cost of the farmer, will become standard. The motivation for the Scottish retail lies in the benefits of a secured supply of high quality fresh milk as Scotland is a net importer of dairy products and the Scottish milk production is expected to decline further.

Table 5 summarises the results.

[Table 5 here]

6. Discussion and conclusions

The CAP reform implies for some countries and regions not a large change as milk quotas have not been binding in the past. The only remaining effect is that prices become more volatile. For these countries and regions the trend in the structural change continues. This could imply that production falls below a threshold at which milk processors or retailers take action to maintain total milk production at a certain level (e.g. Bulgaria). For other countries and regions there is a large effect as milk quotas are binding and quota abolition implies a shock. This is especially true if national governments or milk processors not undertake action as it is the case in the Netherlands. The change will be smaller if national governments try to regulate production as in France. For Scotland results are mixed. The model suggests that not much extra support is needed to maintain total production at the same level while the interviews suggest different.

The model developed is rather simple but it does illustrate well the effects to be expected. Key variables in the model are growth in farm size, autonomous decrease in the number of farms (exit) and market size. The model could be extended in many directions, e.g. distinguishing between different groups of farms, making farm growth and exit endogenous, taking into account price volatility and estimation of the effect of relative profitability on production. Despite this the model gives insight in the future development of the structure in the dairy sector in the EU.

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Table 1. Total milk production (in 1,000 tons), number of farms with milk production, average milk production per farm (in tons) and milk production per cow (in kg) in the selected case study regions in 2003 and 2007.

	North-Holland (Netherlands)		Centre (France)		North East Scotland		South-East Planning region (Bulgaria)	
	2003	**2007**	**2003**	**2007**	**2003**	**2007**	**2003**	**2007**
Total milk production	543	578	483	483	73	77	201	196
Number of farms	1370	1186	2020	1520	130	110	23600	12610
Average milk production per farm	397	488	483	483	565	699	8	16
Milk production per cow	7169	7415	6491	6892	5670	7204	3677	3846

Source: FADN, 2009

Table 2. Production of dairy products in 2007 in 1,000 tons and exports in tons per selected country.

	The Netherlands	France	Bulgaria
Cheese produced	732.0	1,754.7	68.6
Cheese exported	562.6	650.7	16.0
Fresh milk produced	750.0	3,764.0	337.2
Fresh milk exported	n.a.	n.a.	n.a.
Butter and –oil produced	129.2	337.2	1.4
Butter and –oil exported	154.0	62.8	1.1
Condensated milk produced	330.7	65.7	0.4
Condensated milk exported	274.0	70.7	77.0
Milk powder produced[2]	1009.0	181.5	193.3
Milk powder exported	151.5	249.5	n.a.

Source: PZ, 2009

Table 3. Overview of interviews; divided in subcategories

	Farmers	Chain	Policy makers, public advice, research	Total
France	3	2	5	10
Bulgaria	4	2	9	15
Netherlands	3	3	4	10
Total	10	7	18	35

[2] Skimmed and non skimmed milk powder together

Table 4. Model input and effect (percentage change) in 2017 compared to 2007 in base scenario and with a 10% drop in relative profitability in 2008.

	The Netherlands	France	Bulgaria	Scotland
Inputs:				
Farm growth %	5.30	7.40	16.29	5.45
Exit rate %	-3.54	-6.86	-14.50	-4.09
Total production constant	No	Yes	No	Yes
Results (% change):				
Base scenario:				
Number of farms	-27.70	-47.40	-75.58	-37.97
Average production per farm	59.17	90.13	288.94	61.22
Total production	15.08	0	-5.03	0
Scenario I:				
Number of farms	-27.70	-47.39	-75.58	-37.27
Average production per farm	43.25	90.06	250.05	59.41
Total production	3.57	0	-14.53	0

Table 5. Expectations of stakeholders and experts on structure in dairy farming.

	Relation processor-farm	Structure dairy farming	Strategy milk processors	Government
France	Long term contracts to guarantee local supply.	Decrease number of farms and increase in farm size.	Production in some regions for local markets, in some regions also export oriented.	Possibly national guidelines for supply contracts to regulate regional milk market (in favour of less efficient production areas).
The Netherlands	- Milk price determined in free market. - No quantity control.	Decrease number of farms and increase in farm size.	Export oriented.	No national quantity regulation.
Bulgaria	-Continuation of long-term contracts -Increase of milk processed by processors - Increase in requirements on physical milk quality -Increase of chain integration.	Decrease number of farms and increase in farm size.	-Increase efficient use capacity of processing plants. -Increase quality of processed dairy products -Increase production of value added products.	No quantity regulation on national scale.
Scotland	Contracts to guarantee milk supply.	Decrease number of farms and increase in farm size.	Local production for fresh market.	No quantity regulation on national scale.

Source: interviews