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COMPETITIVENESS OF THE ESTONIAN DAIRY SECTOR, 1994–2014

Ants-Hannes Viira, Raul Omel, Rando Värnik, Helis Luik, Birgit Maasing, Reet Põldaru

Estonian University of Life Sciences, Institute of Economics and Social Sciences, Fr. R. Kreutzwaldi 1, Tartu 51014, Estonia

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Vastutav autor: Corresponding author: Ants-Hannes Viira
e-mail: ants-hannes.viira@emu.ee

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ABSTRACT. Historically, the dairy sector has been one of the most important and competitive branches of the Estonian agriculture and food industry. Since the beginning of the transitional period 25 years ago, Estonian society and its economy have gone through significant institutional, political and societal changes, which have also affected the dairy sector. This paper provides a review of the competitiveness of the Estonian dairy sector. The competitiveness of dairy farms, the dairy processing industry and dairy exports are discussed from several perspectives applied in the studies of competitiveness. Also, the context of the transition to a market economy and institutional, policy and market changes are considered. In the past 20 years, the Estonian dairy sector has maintained its competitiveness in export markets. However, there are several aspects that need to be addressed in order to maintain competitiveness in the long term. Estonian dairy farms need to increase their total factor productivity. The negative trends in the declining lifespan of dairy cows and declining content of milk components should be stopped. The Estonian dairy processing industry needs to increase labour productivity and value per kg of processed milk. To avoid the negative effects of specialisation on certain products and markets, the portfolio of export markets and products should be expanded. The EU dairy market is going through deregulation, and farm payments in Estonia fell in 2014. This is not the first time in 20 years that agricultural policy has not been overly protective of the dairy sector. Therefore, the future competitiveness of the Estonian dairy sector depends mainly on its adaptive capacity in the light of changing markets, policies and institutions.

Introduction

Dairy has been one of the most important export orientated sectors in the Estonian agriculture and food industry. In 1925, food and drinks comprised 28.7% of the value of total exports, and butter alone comprised 22.1% of the value of total exports. In 1924/1925, animal products comprised 53.3% of the value of Estonian agricultural output (Pihlamägi, 2004). In 2014, the share of animal products in total agricultural output was 46.5%, and milk comprised 27.8% of the value of Estonian agricultural output. In 2013, the manufacturing of dairy products comprised 2.3% of value added in manufacturing, and 0.5% of total value added. In 2014, milk and dairy products comprised 1.6% of the value of total exports (Statistics Estonia, 2015). If one considers the value of other products of dairy farms (*e.g.* cattle, fodder, cereals, and oilseeds)[1], and the value created in other segments (both up- and downstream) of the milk value chain (*e.g.* input providers, logistics, dairies, retailers, education, research and development, *etc.*), the significance of dairy and associated activities in the Estonian economy is larger than the abovementioned figures suggest. As dairy is an export-orientated branch, with 135.9 million euros' worth of net dairy exports in 2014, it is crucial that the dairy sector maintains and strengthens its competitiveness on external markets in order to sustain the leading role in Estonian agri-food value chains.

[1] According to the authors' calculations based on the standard results of the Estonian FADN survey in 2014 (Rural Economy Research Centre, 2015b), specialised dairy farms comprised 36.9% of total labour use, 46.1% of total output, 43.4% of intermediate consumption, 35.3% of total assets and 44.7% of total liabilities of all farms represented by Estonian FADN sample (FADN Public Database, 2015).

In the past 25 years, Estonian agriculture and society have been subject to significant reforms and institutional changes. These have also affected Estonian dairy farms and dairy processors. Therefore, medium or long term reviews of Estonian agriculture should consider the transition context. This paper aims to review the development of the Estonian dairy sector between 1994 and 2014, and analyse the competitive position of Estonian dairy farms and its dairy processing industry from various perspectives[2]. First, the theoretical frameworks applied in the studies of competitiveness are reviewed. Second, the institutional, policy and market context is reviewed, with the aim of providing the background for the development of the dairy sector. Third, the development and competitiveness of milk production and dairy processing is analysed. Fourth, the trends in the domestic demand of dairy products are reviewed. Fifth, the foreign trade performance of the main classes of dairy products is studied. In the discussion and conclusions section, the interrelations between the competitiveness of Estonian dairy farms and the dairy processing industry, institutional, policy and market contexts, domestic demand and foreign trade performance are considered.

Theoretical framework of competitiveness

Measuring the competitiveness of the dairy sector has been an important research topic for many authors and it has been analysed from various standpoints (Thorne, 2004; Fertő, Hubbard, 2003; Dillon *et al*., 2008, Donnellan *et al*., 2009; Tacken *et al*., 2009; Omel, Värnik, 2009; Van Berkum, 2009; Latruffe, 2010; Latruffe, 2014; Jansik *et al*., 2014; Jedik *et al*., 2014; Irz, Jansik, 2015). Competitiveness is a relative, complex, multidimensional and undetermined concept. Since the general theory of competitiveness is non-existent and there is no single definition (Ahearn *et al*., 1990; Sharples, 1990), different interest groups define competitiveness differently, thereby sometimes misusing the concept. The authors mostly agree that a competitive firm must be able to offer products that meet the market demand (in terms of price, quality and quantity), ensuring, at the same time, adequate profit or an increase in the market share in its home country or abroad (Martin *et al*., 1991; Smit, 2010; Vuković *et al*., 2012; Jansik *et al*., 2014).

The structure-conduct-performance paradigm (Figure 1), being descriptive and providing an overview of industrial organisation, is one of the frameworks applied in the competitiveness studies (Van Berkum, 2009).

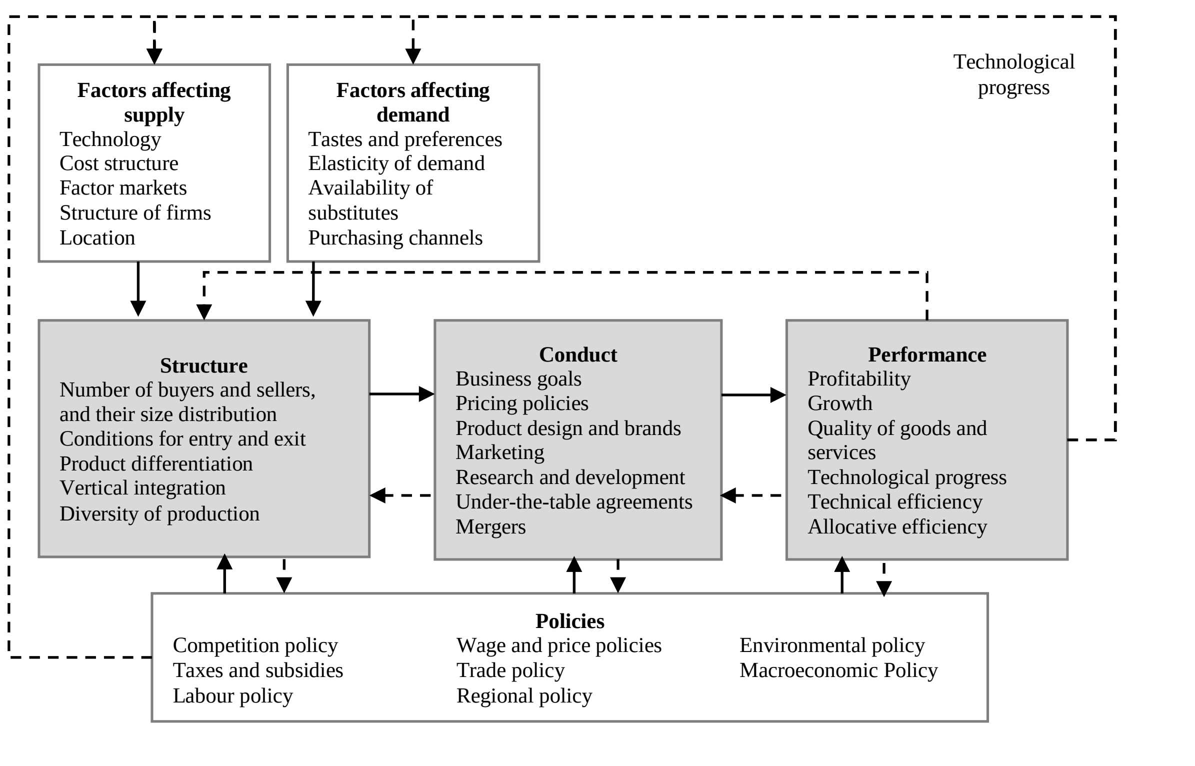

Figure 1. The framework of the structure-conduct-performance paradigm. Source: Lipczynski *et al*. (2005)

[2] The first five years of transition are not included due to the incompatibility of data. Estonian independence was restored in 1991; therefore, the data from 1990 reflects Soviet Estonia, which had a command economy and the currency of the Soviet Union. In addition, in the beginning of the 1990s, Estonia had a very high inflation rate. Therefore, the monetary data from the beginning of the transitional period is not easily comparable with later periods.

According to this approach, an industry's performance (success) depends on the conduct (behaviour) of its firms, which in turn depends on the structure of the industry. The industry's structure depends on the basic conditions, such as the factors that affect supply (technology) and demand. Government policies also have an important role in this framework, as they affect both sellers and buyers in the market (Carlton, Perloff, 2015).

Competitiveness can be evaluated from various perspectives. Bojnec and Fertő (2014) conclude that competitiveness can be analysed at three levels: national (macroeconomic), industrial (branch) and firm (microeconomic) level. There are different approaches to analysing competitiveness such as traditional trade theory, industrial organisation theory and strategic management theory (McCalla, 1994; Garcia Pires, 2010; Donnellan *et al*., 2011; Gapšys, 2013). Reimer and Stiegert (2006) studied several aspects in international competition based on the strategic trade approach. It has been suggested that the trade theory based approach is essentially a supply-side approach to competitiveness, where relative price differences have remained the main indicators of competitiveness. From the industrial organisation theory point of view, it is possible to define the variables affecting the company's economic situation (Figure 1) and estimate their respective effects (Van Duren *et al*., 1991; Shatrevich, 2014). Efficiency and value added through cost management and product differentiation are characteristics that define competitiveness from the strategic management theory point of view (Kennedy *et al*., 1997).

Some authors emphasise that each company can gain a competitive advantage over its competitors in some attributes for a short period, but it is highly improbable that it can hold its superiority for a longer period (Kennedy *et al*., 1997). Therefore, in order to maintain competitiveness, it must be periodically analysed and respective corrective actions must be taken. In addition to such traditional competitive advantages as the availability of inputs and price efficiency, demand for the product, the company's strategy, the overall development of the sector and government actions are also important. There is no consensus as to the importance of defining the sources of competitiveness; some authors think that defining the sources of competitiveness is crucial because they are directly related to measuring competitiveness and its indicators (Buckley *et al*., 1988; Thorne, 2004). It is believed that an ideal combination of competitiveness indicators will provide a good overview of the competitiveness of a company, branch of industry or country. However, it is necessary to distinguish between the different stages in the measurement of competitiveness. Competitiveness indicators measure the competitiveness of the company, whereas competitive potential measures its sources. The process of competition, on the other hand, finds expression in how the competitive potential is transferred into competitiveness.

Competitiveness has been found to be closely linked to productivity, a parameter characterising the efficiency of the process, and measuring the conversion of inputs into outputs. Several authors have used partial productivity indicators to measure competitiveness (Latruffe, 2010; Jansik *et al*., 2014; Irz, Jansik, 2015). However, without taking into account production costs or profitability indicators, a low partial productivity indicator does not necessarily mean low competitiveness potential, as low production costs can compensate for low partial productivity. For example, high labour productivity may reflect high efficiency resulting from a better use of technology. However, it may also be caused by substituting inefficient capital for labour. Therefore, partial productivity indicators do not adequately characterise the company's competitiveness. To reduce this shortcoming, the total factor productivity (TFP) indicator, which combines all inputs and outputs used in production, is used (Jansik *et al*., 2014; Kimura, Sauer, 2015; Irz, Jansik, 2015).

In addition to the competitiveness of an individual company, the competitiveness of the entire value chain, which may be based on trade, and terms of trade, may prove the determining factor. Comparative advantage in domestic production in the areas where the opportunity costs are lower or equal to international prices is an important factor that affects competitiveness. Therefore, countries specialise in such lines of production where they are able to keep the opportunity costs low. It has been suggested that in order to determine the specialisation of a country it is important to take account of the comparative advantage as, due to lower costs, it makes it possible for the country to increase the production for export (Houck, 1992). Therefore, trade based on comparative advantage ensures a more efficient resource allocation in the economy. Competitive advantage is sometimes used as a synonym of comparative advantage. It is suggested, however, that competitive advantage is mainly a political concept, giving the sector a trade advantage through grants/subsidies, tax incentives, trade restrictions or other interventions in the country (Jeffrey, Grant, 2001). Consequently, in order to determine what a country is expected to produce for export, both the comparative and the competitive advantage are taken into account. Omel and Värnik (2009) suggest that price and quality are the two main factors that determine the competitiveness of products both in domestic and export markets. Lower production costs provide a competitive advantage in (lower) price, while better quality, an attractive brand or additional benefits attract consumers to pay a higher price for the product.

According to Balassa (1965), the revealed comparative advantage expresses the successfulness of the trade performance of the country. It is assumed that the structure of international trade describes both the relative costs of production and non-price factors. One of the most important factors that determines the structure of international trade is comparative advantage. According to the theory of comparative advantage, a country will specialise on the production of products with comparative advantage and will export these products and import products with comparative disadvantage. Therefore, by comparing exports and imports of the products belonging to the same commodity group the advantage in production of specific products can be described.

In the following, an eclectic approach (Van Berkum, 2009) is used, *i.e*. the competitiveness of the Estonian dairy sector in the period 1994–2014 is analysed from different perspectives. First, the policy context and accompanying effects on institutional and market context is reviewed. The competitiveness of milk production and milk processing is discussed in light of partial productivity measures, literature on total factor productivity change in Estonian dairy sector and growth rates of milk production and processing. In addition, the structure of dairy farms is considered. Demand is analysed from two perspectives: domestic and export markets. Competitiveness in export markets is discussed based on the revealed comparative advantage indices.

Institutional, policy and market context

The development of the Estonian dairy sector in the last 25 years has been affected by the institutional changes at the beginning of the 1990s, changes in agricultural policy and world markets. In Figure 2, the developments of the Estonian producer price of milk in the period 1992–2013 are compared to the prices in Germany and New Zealand. The German producer prices of milk are considered an indicator of the European Union's (EU) average prices, which are affected by the EU agricultural policy and world market prices. New Zealand, a country where the effects of market distorting policies are relatively low (in the EU, the average Producer Support Estimate (PSE) in 1992–1995 was 35%, while in New Zealand the average PSE in 1992–1995 was 1% (OECD, 2014), is considered a representative of the world market price level.

In 1992–1995, major reforms related to regaining the independence of the Republic of Estonia were initiated, resulting in the establishment of new production structures (private farms and agricultural enterprises), free trade, the disappearance of former markets and subsidies (Viira *et al*., 2009; Viira, 2014). During this period, the Estonian government decided to follow a liberal economic policy, which had a detrimental effect on the agricultural sector (Unwin, 1997). The liberal trade policy opened the Estonian market for subsidised agricultural and food imports from other countries, resulting in PSE estimates of –89% in 1992, –10% in 1994 and 0% in 1995 (OECD, 2002; Estonian Ministry of Agriculture, 2003). From Figure 2 it stems that during this period the producer prices of milk in Estonia were an average of 30% below the price level in New Zealand, and markedly (70%) lower compared to German prices.

In 1996–2001, the scope and budget of Estonian agricultural policy increased. After the adoption of the action plan for becoming an EU member in 1996, the agricultural policy was developed so that it would harmonise with the EU's Common Agricultural Policy (CAP) at the time of accession. Direct payments were implemented and legislative provisions for applying import licences and tariffs were adopted. However, foreign trade remained liberal (Viira *et al*., 2009; Viira, 2014). From Figure 2, it appears that Estonian producer prices of milk in this period were similar to prices in New Zealand, while German prices were declining but remained at nearly 100% higher level compared to New Zealand and Estonia.

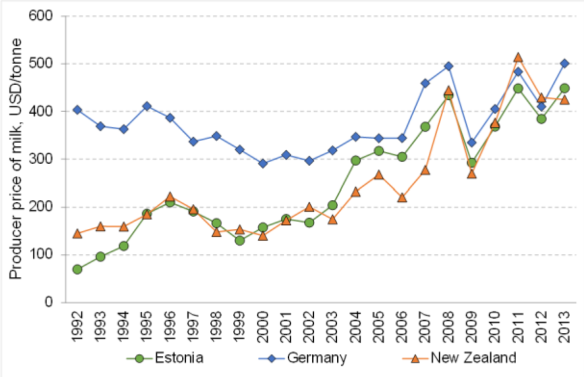

Figure 2. Producer price of milk in Estonia, Germany and New Zealand in the period 1992–2013. Source: Faostat (2015)

On 1 May 2004, Estonia became an EU member and applied the CAP with direct payments, milk quotas, export subsidies, EU import licences and tariffs, intervention stores, private storage aid, investment subsidies and other measures. From Figure 2, one can notice that the EU accession raised milk producer prices in Estonia by about 25% compared to prices in New Zealand. This implies the effect of the policy change (EU accession) on the milk prices in Estonia. However, in 2004–2008, Estonian producer prices of milk remained an average of 13% lower compared to prices in Germany.

However, the policy context in the EU is not constant. Since 2008, the world market prices have been at higher levels compared to the previous decades, and the EU's CAP has become more market orientated, deregulating the dairy market and lowering price supports in dairy product supply chains (Bojnec, Fertő, 2014; European Commission, 2015a). The EU average PSE declined from 31% in 2005 to 20% in 2013 (OECD, 2014). Therefore, the differences between the German (EU), Estonian and New Zealand price levels have decreased. In 2008–2013, Estonian producer prices of milk comprised 98% of the prices in New Zealand and 90% of the German prices, on average. On 1 April 2015, the EU's 31-year-old milk quota system was abolished and the EU milk producers entered into a policy environment with even less market regulation and more (world) market orientation (European Commission, 2015a).

Following higher world market prices compared to previous decade, the gradual increase of milk quotas from 2008 and the elimination of milk quotas in 2015 (European Commission, 2015), farmers in many EU member states increased milk production. In 2008–2014, milk production in the EU28 member states increased by 10.5 million tonnes (7.1%). However, the distribution of the growth is uneven across the member states. Figure 3 depicts the relative growth in number of dairy cows and average milk yields in the period 2008–2014. Balloons that represent EU member states indicate volume of milk production in 2008. The dotted line represents iso-production curve, indicating how much the milk yield should increase or decrease in order to maintain the constant milk production volume if the number of dairy cows decreases or increases. In 2008-2014, the total number of dairy cows in EU28 member states decreased by 846,000 (3.5%). The number of dairy cows increased in seven EU member states: Italy (by 13.0%), Ireland (10.1%), Cyprus (7.3%), Luxembourg (1.9%), Germany (1.8%), Netherlands (1.4%), and Austria (1.4%). The most noteworthy of these member states are Germany, Italy, Netherlands and Ireland, since these countries contribute a significant part (39.4%, in 2014) of total EU milk production. These countries could be regarded as competitive milk producers with a high impact on the EU dairy market.

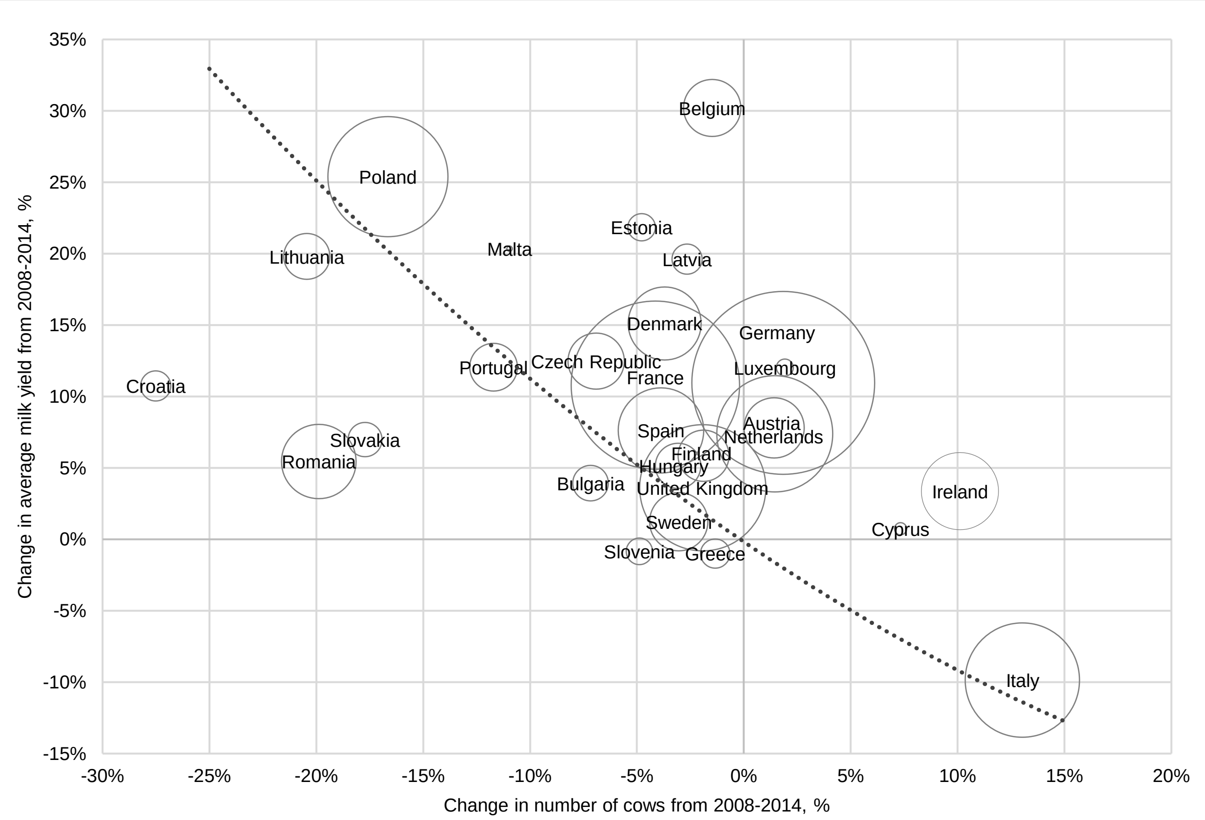

Figure 3. Changes in number of dairy cows and average milk yield per cow in the EU countries in the period 2008–2014. The size of the balloons indicate volume of milk production in 2008, while the dotted line indicates the iso-production curve. Source: Eurostat (2015)

In 2008–2014, milk production declined in nine EU member states: Croatia (by 36.1%), Romania (15.5%), Slovakia (12.0%), Slovenia (5.7%), Lithuania (4.7%), Bulgaria (3.5%), Greece (2.3%), Sweden (1.8%) and Portugal (1.1%). From the point of view of the Estonian dairy sector, the decrease in milk production in Lithuania and Sweden are more relevant, since these markets are closer, and Lithuania is one of the most important trading partners for the Estonian dairy sector. In 2008–2014, the number of dairy cows decreased by 4.8% in Estonia, average milk yield increased by 21.9% and total milk production increased by 16.0%. Therefore, as illustrated by the distance between the centre of the Estonian balloon and the iso-production curve in Figure 3, the relative growth in milk production in Estonia was one of the quickest in the EU, being third after Belgium (28.3%) and Latvia (16.4%).

Milk production

Milk production could be considered as an identity of the number of dairy farms, average number of dairy cows per farm and average milk yield per cow. After regaining independence, milk production in Estonia declined significantly. In 1992–1996, milk production decreased by 26.6% from 919.3 to 674.8 thousand tonnes (Figure 4). In the beginning of the period, the producer prices of milk in Estonia were below the prices in New Zealand, which could be considered a proxy of world market prices (Figure 2). This was due to the liberal trade policy without tariffs and non-tariff trade barriers (Viira *et al*., 2009; Viira, 2014). In 1992–1994, Estonian producer prices of milk ranged from 48–74% of the price level in New Zealand. At this price level, many of the dairy farms were unable to continue production, the number of dairy cows decreased by 32.3% and the average milk yield per cow stagnated at average 3,474 kg/cow between 1992 and 1995 (Figure 4).

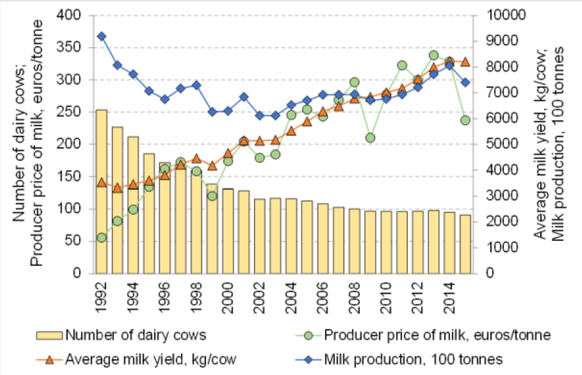

Figure 4. Number of dairy cows, average milk yield, milk production and producer price of milk in Estonia in the period 1992–2015. Source: Statistics Estonia (1996, 1998, 2000, 2001, 2015)
*Figures for 2015 are forecasted based on data from 9 months

Estonian producer prices of milk reached the New Zealand price level in 1995. Since then, the producer price of milk in Estonia has followed the trends in the world market; it has affected the number of dairy farms, number of dairy cows and milk yields, therefore determining the total milk production. In 1996–1998, production recovered: in 1998, production exceeded the 1996 production levels by 8.1%, while the number of dairy cows decreased by 7.6% and average yield improved by 17.0%. At that time, Estonian producer prices of milk ranged from 94–112% of New Zealand prices.

The next drop in milk production occurred in 1999 when the producer price of milk decreased by 23.8% compared to 1998. The crisis was initiated by multiple events in the second half of 1998: the decline in dairy prices on world market, problems on the Russian export market, excessive precipitation that caused some of the harvest to fail and problems in the Estonian financial sector (Ministry of Agriculture, 1999). Because of the significant reduction in the milk price, in comparison to 1998, the number of dairy cows decreased by 12.7%, average milk yield per cow decreased by 6.4% and milk production decreased by 14.2%.

In 2000 and 2001, milk prices recovered, and while by 2001, compared to 1999, the number of dairy cows had declined by 7.1%, milk yields exceeded the 1999 level by 23.5%. Therefore, milk production in 2001 exceeded the 1999 level by 9.2%. The third drop in milk production occurred in 2002 because of the decrease in world market prices and unfavourable weather (drought) (Ministry of Agriculture, 2003). In 2002, the producer price of milk decreased by 12.4% compared to 2001, the number of dairy cows decreased by 10.1%, average milk yield by 0.3% and milk production by 10.6%.

In 2003–2008, milk producers experienced a favourable period with increasing milk prices and increasing subsidies (Figure 5). In 2004, Estonia became an EU member. The EU accession changed Estonian agricultural policy. Estonia entered the more protected and subsidised EU common market. Therefore, producer prices increased, farm payments increased and farmers had better access to investment subsidies. In addition, the access to credit improved, which in turn facilitated investments into modern technologies. It has been estimated that new cowsheds were built or old ones renovated in 182 dairy farms between 2001 and 2011. Therefore, at least 60% of Estonian dairy cows are in modern cowsheds equipped with modern technologies (Viira *et al.*, 2011). In specialised dairy farms between 2004 and 2008, total subsidies (excluding subsidies on investments) per dairy cow increased from 397 to 729 euros (83.4%) and fixed assets (excluding land, permanent crops and quotas) per dairy cow increased from 3,222 to 5,240 euros (62.7%). In 2003–2008, the number of dairy cows decreased by 14.0%; however, milk yields improved by 31.0% and milk production increased by 13.5%. In 2003–2008, Estonian milk producer prices amounted to 117–133% of the New Zealand price level. In Estonia, not a single year before and after this period has seen such favourable producer prices of milk compared to New Zealand, and such high average subsidy levels per dairy cow and kg of produced milk.

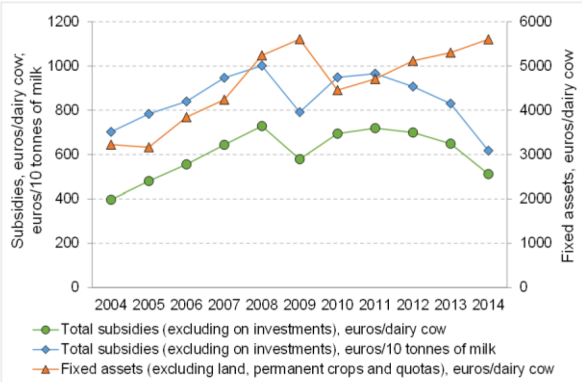

Figure 5. Total subsidies and fixed assets in specialised dairy farms (FADN farm type 45) in Estonia in the period 2004–2014. Source: FADN Public Database (2015) (years 2004–2012); Rural Economy Research Centre (2015a) (years 2013–2014)

The fourth price shock that induced the reduction in milk production occurred in 2009 when the producer price of milk dropped by 29.1% (by 86.3 euros/tonne) compared to 2008. The number of dairy cows decreased by 3.7% and milk production decreased by 3.3%. Average milk yield did not decrease, but the growth rate slowed down to 0.8% compared to the previous year. The price shock coincided with the economic crisis, due to which, the government reduced additional top-up payments and the average subsidy level per dairy cow decreased by 150 euros and per tonne of milk by 21.0 euros. The cut in subsidies amplified the effects of the milk price and economic crisis for Estonian dairy producers.

From 2010 to the first half of 2014, milk producers faced another period with comparatively favourable milk prices. In 2010, the average subsidy level per dairy cow recovered to 95.2% of the 2008 figure. Since the

EU further liberalised the dairy market, the price difference between Estonian and New Zealand producer prices diminished. In 2010–2012, the Estonian producer prices amounted to 87–98% of the prices in New Zealand. Since 2008, the abolition of milk quotas was anticipated as a result of the CAP "Health Check" (European Commission, 2015a) and farmers even increased production in 2012, when there was a short-term (8 months) decline in the producer price of milk. In 2011–2013, the number of dairy cows increased by 1.8%, the first such increase since 2003. In 2010–2013, milk yields improved by 13.8% and milk production increased by 14.2%.

The fifth shock in milk prices occurred in the second half of 2014, after Russia announced an import ban on 6 August (European Commission, 2015b). After that, the producer prices of milk fell to 250 euros/tonne and below. While, due to the favourable prices in the beginning of the year, the average milk producer price was 328 euros/tonne in 2014, the average price in the first nine months of 2015 was 237 euros/tonne, which is 27.7% lower. Because of the low prices, the number of dairy cows declined by 4.8% in the first nine months of 2015, average milk yield declined by 0.1% and milk production declined by 5.0% compared to the same period in 2014. Another reason behind the reduction of milk production in the beginning of 2015 is related to the milk quota. In the last quota year of 2014/2015, Estonia for the first time exceeded the national milk quota by 1.2% (ARIB 2015). Due to the low milk prices, milk producers were in a critical economic situation as it was; therefore, many of them reduced production in order to avoid exceeding the quota and paying the super levy. As was the case in the 2009 crisis, the sharp decline in milk price in 2014 was accompanied by a reduction in average subsidy level. Compared to 2013, the average subsidy level per tonne of produced milk cow declined by 21.2 euros in 2014. However, though the economic crisis was the reason behind the reduction of subsidies in 2009, in 2014 the reasons were political and related to the changing priorities of the new coalition and government.

Therefore, the decreases in Estonian milk production have mainly been caused by various market shocks, but agricultural policy has also played a role. In 1992–1996, the shock was related to institutional changes and the free market, accessible to subsidised exports from other countries that reduced Estonian milk producer prices below world market (New Zealand) averages (Figure 2). From 1997 onwards, the price shocks have been related to changes in world market prices. From Figure 4, it appears that the milk price decrease in 2009 and 2012 did not cause a significant decrease in milk production. This could be explained by higher subsidies compared to the period before EU accession, which helped sustain producers during the period when prices were low. It can also be explained by the changes in farm structures over time, as less competitive farms have left the sector during previous crises and the majority of those that have remained are competitive in the current world market context. However, the 2014–2015 crisis may be more severe. In addition to poorer market conditions, there has been a major policy change with the removal of milk quotas and reduction of average subsidy level in Estonia. Therefore, there are uncertainties about future price levels following the crisis.

Structure of dairy herds

According to the structure-conduct-performance paradigm, the structure of firms is one determinant of supply and therefore a determinant of performance (competitiveness) of the industry. In Northern Europe, the general tendency is towards larger average dairy farms. According to Jansik *et al*. (2014), in Denmark and Estonia, the share of dairy cows in farms with 100 cows and over in 2010 was highest among the EU countries surrounding the Baltic Sea. At the same time, in Poland, Lithuania and Latvia, the percentage of dairy cows kept in small farms was the highest. Jansik *et al*. (2014) conclude that in more concentrated dairy sectors, the transaction costs are lower and the lower transaction costs contribute to the better competitiveness of such sectors. Larger dairy farms were also found to be better performing in Estonia by Kimura and Sauer (2015).

Table 1 gives an overview of the changes in a number of dairy herds in different size classes between 1993 and 2015. It has to be noted that Table 1 is based on the data of dairy herds in milk recording, but milk recording is not mandatory; therefore, not all the dairy herds participate. However, the advantage of milk recording data is in a longer time frame and more detailed information about different size classes. In 2014, 95.9% of Estonian dairy cows were under milk recording. From Table 1, one can note that the number of dairy herds declined by 82.1% between 1993 and 2015. The decrease has been largest (both in absolute and relative terms) in herds of 1–10 cows (–93.9%) and 101-300 cows (–72.2%). In the first case, small family farms have exited during the transition and after the EU accession (Viira, 2014). In the beginning of the 1990s, farms with 101–300 dairy cows were probably successors of privatised former collective and state farms (or parts of these). The large decline of herd numbers in this size class could be explained by the inability of farmers to cope with the free market reality of the 1990s (Viira *et al*., 2009; Viira, 2014) and the phenomena of the "disappearing middle" (Munton, Marsden, 1991). Data from November 2015 suggests that the decline in small farms groups continues due to the recent crisis in dairy markets. During the crisis, from 2014 to November 2015, the size classes where the number of herds has not changed or has increased are 51–100 cows (small family farms), 301–600 cows (both family farms and enterprises), 901–1,200 cows (large-scale enterprises) and >1,200 cows (large-scale enterprises).

Table 1. Number of dairy herds in different size classes under milk recording in the period 1993–2015

Year	Farm size class, number of dairy cows								Total
	1–10	11–50	51–100	101–300	301–600	601–900	901–1200	>1200	
1993	2,815	291	161	342	120	27	6	5	3,767
1995	2,128	291	127	278	74	14	5	3	2,920
1997	1,685	484	116	240	67	13	4	3	2,612
1999	1,832	682	116	188	60	12	4	3	2,897
2001	1,958	716	103	173	52	15	2	4	3,023
2003	1,727	637	103	164	60	13	4	4	2,712
2005	1,122	585	91	155	62	13	3	5	2,036
2007	489	465	100	135	63	17	4	3	1,276
2009	346	375	95	122	61	17	4	4	1,024
2011	273	314	93	110	63	17	3	6	879
2013	210	277	75	107	58	25	6	6	764
2014	176	256	78	108	53	24	8	6	709
2015 November	172	229	90	95	58	15	8	7	674
Change in 1993–2015	–93.9%	–21.3%	–44.1%	–72.2%	–51.7%	–44.4%	33.3%	40.0%	–82.1%

Source: Yearbooks of Estonian Livestock Performance Recording Ltd.

Figure 6 depicts the proportion of total milk production in different size classes between 1994 and 2014. One can note that the six largest dairy farms (according to Estonian Livestock Performance Recording, 2015) produced 12% of total milk production in 2014, while the 14 largest dairy farms produced 21% of total milk and the 38 largest companies produced 41% of Estonian milk. Farms with 1–10 dairy cows produced 1% of total milk, farms with 11–50 cows 6% and farms with 51–100 cows 5% of total milk in 2014. Therefore, farms with 100 or fewer cows contributed just 11% of total milk production.

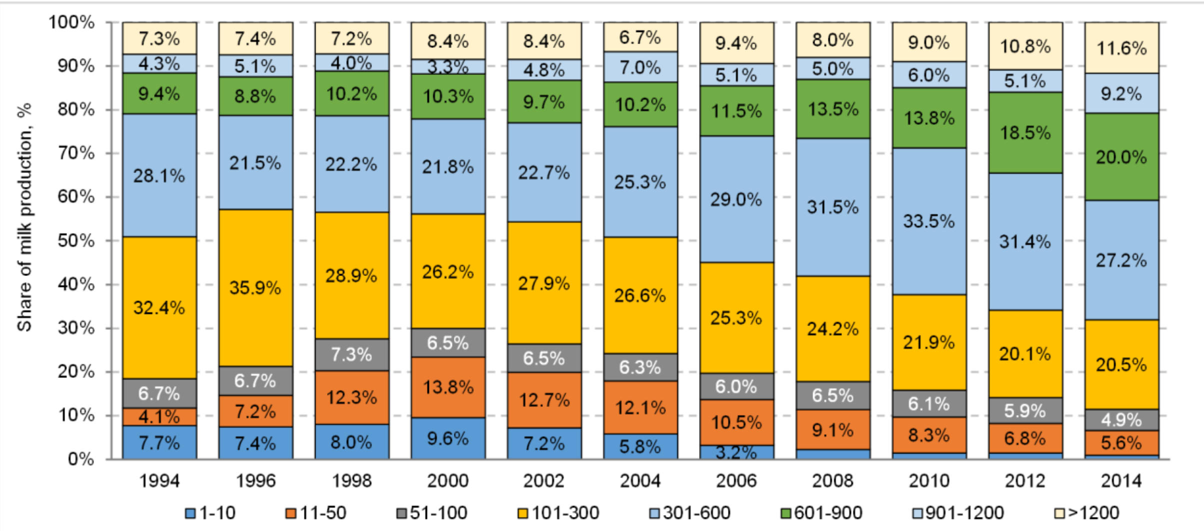

Figure 6. Share of milk produced in herd size classes in the period 1994–2014. Source: Yearbooks of Estonian Livestock Performance Recording Ltd

There has been also a significant change in the structure of breeds. In 1990, 49.1% of dairy cows were Estonian Red and 50.7% were Estonian Holsteins, but by 2014 the shares of both breeds were 20.0% and 79.1% respectively (Estonian Livestock Performance Recording, 2015). As a result of the increase in the significance of large dairy farms, where cows are kept indoors all year round, and change in the structure of dairy breeds, the seasonality of Estonian milk production has significantly decreased. In 2003, milk collection in the highest volume month (June) exceeded the lowest volume month (November) by 1.40 times. In 2014, the peak-to-low ratio was 1.18 (Statistics Estonia, 2015). In Lithuania, in 2014, the peak-to-low ratio of milk collection was 1.67, and in Latvia 1.47 (Eurostat, 2015). The lower seasonality of milk collection is a factor that makes the processing of Estonian milk more efficient because the processing industry can utilise their capacity more evenly throughout the year.

Milk yield

Average milk yield per dairy cow is the most common productivity measure of dairy farms. In 2001–2014, average annual milk yield per dairy cow among the EU member states increased most rapidly in Estonia (by 58.3%), Lithuania (by 46.7%) and Latvia (by 44.4%) (Eurostat, 2015). From Figure 7, it appears that among the selected countries, Estonian average milk yield per cow was third highest in 2014, and the yield growth outpaced the other countries. While average milk yield could be regarded as the most common productivity indicator, it should be remembered that it is a partial productivity measure and does not necessarily reflect the total factor productivity of dairy farms.

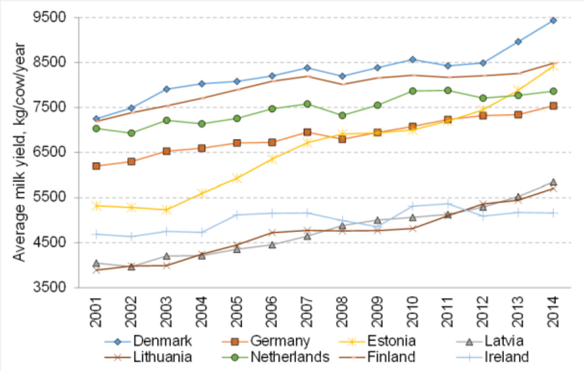

Figure 7. Average milk yield in selected countries in the period 2001–2014. Source: Eurostat (2015)

Rapidly increasing and high average milk yield has been the pride of the Estonian dairy sector, indicating the high productivity of dairy cows. However, some negative trends accompany the positive trend of increasing milk yield. In 2001–2014, the average milk yield per cow in the herds that were under milk recording increased by 59.0% to 8,728 kg/cow/year (Figure 8). At the same time, the average life span of dairy cows decreased by 1.6 years. While the average age at the first calving decreased by 0.3 years, the average productive time (from first calving to culling) decreased by 1.3 years (29.9%). Nonetheless, Riisenberg (2012) found that the low average productive time of dairy cows does not have a significant negative effect of farm profits considering the (low) price of in-calf heifers and high milk yield.

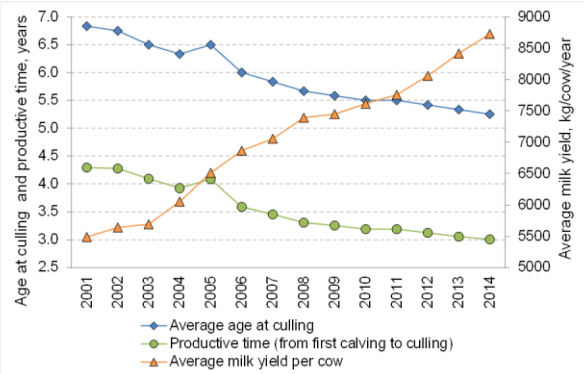

Figure 8. Average milk yield, age at culling and productive time in herds under milk recording in the period 2001–2014. Source: Estonian Livestock Performance Recording Ltd. (2015)

Still, at least two aspects of this trend require further consideration. Decreasing the productive time of dairy cows results in fewer calves per cow's lifetime. Since 52% of the calves are male and 48% female (Estonian Livestock Performance Recording Ltd., 2015), the number of alternatives for selecting replacement heifers is declining. In the longer term, this could undermine the quality of the stock of Estonian dairy cows. The other aspect relates to the more short-term effects on farm revenues. The shorter life span of dairy cows means that there are fewer opportunities for selling (in-calf) heifers. Therefore, the revenue from selling heifers declines. Kimura and Sauer (2015) found that livestock output declined by 7.2% per annum in Estonian dairy farms between 2003 and 2012, thereby reducing the aggregated output growth measure. Luik *et al.* (2014) found that in the group of farms with highest technical efficiency the average age of dairy cows at culling was higher than in the group of farms with medium technical efficiency. In periods of high milk prices, this does not pose problems for dairy farmers. In periods of low milk prices, however, the revenue from selling heifers is a very important additional stream of income for farmers. In 2005–2013, beef contributed an average of 6.9% of the total output of Estonian specialised dairy farms; however, the value of beef constituted an average of 46.5% from farm net income[3]. In 2009, when milk prices were low, the value of beef amounted to 109.6% of farm net income (FADN Public Database, 2015). This implies that while beef contributes a relatively small proportion of total farm output, the changes in its value have a much more significant impact on net farm income. Therefore, *ceteris paribus*, increasing the average life span of dairy cows could improve farm profits in the short term, while improving the selection of heifers for herd replacement in the long term.

While historically, milkfat (for making butter) was the component of milk of most commercial value, nowadays milk protein (for making cheese and whey products) attracts the greater value (Augustin *et al.*, 2013). Similarly, the analysis by Põldaru *et al.* (2010) indicate that the variation in cheese prices have larger effect on producer price of milk, compared to butter prices. The trends of Estonian average milk fat and protein content follow this pattern. In 2003 to 2013, along with the rapid increase in milk yields and the increase of the percentage of Estonian Holstein cows[4], the average fat content of milk decreased by 0.14 percentage points (by 3.4%) to 3.99% (Figure 9). At the same time, the average protein content of milk increased by 0.12 percentage points (by 3.7%) to 3.37% (Eurostat, 2015). Though the increase in milk protein content evens out the decline in milk fat content, and the combined milk fat and protein (milk

[3] Farm net income includes value of total output, balance of current subsidies and taxes, and balance of subsides and taxes on investments, from which total intermediate consumption, depreciation, wages, rent and interests paid are subtracted. This could be regarded as a farm profit before remuneration of own (unpaid) labour (FADN Public Database, 2015).

[4] Milk solids (milk fat and protein) have declined more rapidly in those years when an increase in average milk yield has been high. In 2009, when average milk yield increased by a modest 0.8%, average milk fat content increased by 0.01 percentage points, and average milk protein content increased by 0.02 protein points. The negative effect of increasing milk yield on milk fat and protein content is reported also by Kiiman *et al.* (2013). Estonian Holstein cows have a lower average milk fat and protein content compared to Estonian Red cows. In 2014, the average milk fat content of Estonian Red cows was 4.12%, and that of Estonian Holstein cows was 3.97%. For average milk protein content, the respective figures were 3.43% and 3.35% (Estonian Livestock Performance Recording Ltd. (2015).

solids) content is virtually unchanged, one should consider the Estonian figures in the context of neighbouring and major dairy export countries. From Figure 9, it stems that the average milk fat content in Estonia in 2013 was 0.41 percentage points (9.3%) lower than in the Netherlands and merely 0.05 percentage points (1.3%) higher than in Ireland. However, between 2003 and 2013 the decline in average milk fat content in Estonia was steepest among the EU member states. At the same time, Ireland witnessed one of the largest increases (by 0.21 percentage points and 5.6%) in milk fat content in the EU. However, Latvia witnessed a steep decline (by 0.21 percentage points and 4.9%) in average milk fat content between 2009 and 2013.

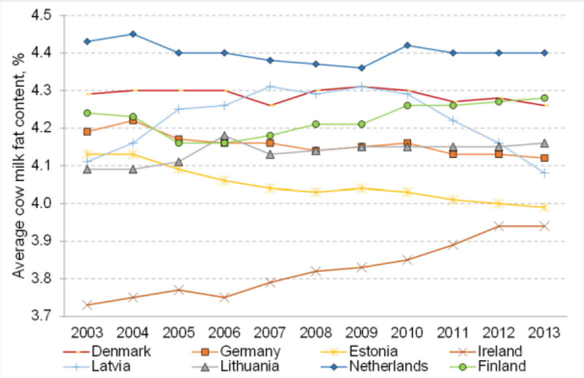

Figure 9. Average cow milk fat content in selected countries in the period 2003–2013. Source: Eurostat (2015)

From Figure 10, it appears that the average milk protein content in most of the observed countries increased between 2003 and 2013. However, the changes have been more modest when compared to the changes in average milk fat content. From the observed countries, the increase in milk protein content in Finland was largest (0.15 percentage points and 4.5%). In Germany and Lithuania, the average milk fat content declined in the observed period by 0.02 percentage points (by 0.6%). In 2013, the protein content of milk was highest in the Netherlands and Denmark (3.53% and 3.52% respectively). Milk protein content was lowest in Lithuania and Latvia (3.25% and 3.26% respectively). Estonian milk protein content exceeded the Lithuanian average by 0.14 percentage points (4.3%). The combined average milk fat and protein content in Estonia in 2013 was 7.36%, while in the Netherlands it was 7.93%, which exceeds the Estonian figure by 0.57 percentage points (7.7%). The Danish aggregated figure exceeded the Estonian measure by 0.42 percentage points (5.7%).

According to Bojnec and Fertő (2014), the Netherlands and Denmark were the EU countries with the highest dairy export competitiveness. High milk yields and milk fat and protein content could be regarded as contributors to the competitiveness of Dutch and Danish dairy chains. While average milk, milk fat and protein yields per dairy cow increased markedly in Estonia, aggregated milk fat and protein content remains lower compared to the Netherlands, Denmark and Finland.

The content of milk fat and protein in milk could affect both the efficiency of farms and the processing industry. Luik *et al*. (2014) found that when milk yield is constant, the higher percentage of milk solids was positively affecting the technical efficiency of Estonian dairy farms. The processing industry pays a higher price for milk with higher milk fat and protein content. However, Riisenberg (2012) concluded that while price adjustment for milk protein content is more significant in comparison to price adjustment for milk fat, price adjustments related to milk content are not sufficient to motivate farmers to maximise milk fat and protein content instead of milk output per cow. Compared to Finnish practice, the price adjustment (measured in Euros per tonne of milk) for 0.1% of fat was 7.5 times lower in Estonia, and price adjustment for protein was 4.1 times lower (Riisenberg, 2012). The quality class of milk, which is related to milk hygiene, has a more significant effect on the producer price of milk. Lower milk solids content implies relatively higher transporttation and processing costs per kg of processed dairy products. Therefore, increasing the content of milk solids in 1 kg of milk (which is not rapidly alterable) would improve the efficiency of the dairy processing industry. One of the more rapid solutions for cheese manufacturers, as suggested by Augustin *et al*. (2013), is to choose milk from specific farms for improved cheese making properties. There could be also long-term solutions to the problem: Vallas *et al*. (2012) found that the genetic improvement of Estonian Holstein cows would have positive effects on milk coagulation properties, and thereby on cheese making. Several factors affect milk fat and protein content, of which feed content (more significant for Estonian Red cows), breeding (more significant in case of Estonian Holstein cows), and the good care of animals are the most important. Milk fat content is more responsive to changes in daily farming practices compared to milk protein content. Breeding provides more scope for increasing milk protein content (Riisenberg, 2012).

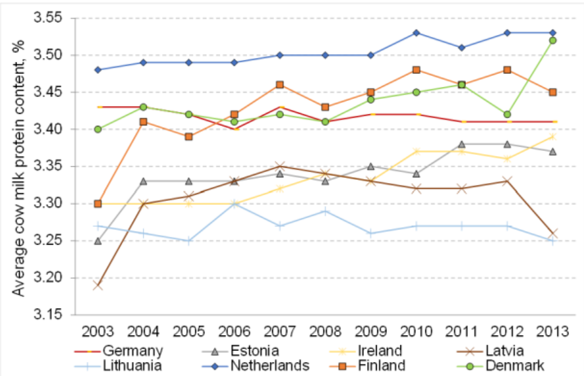

Figure 10. Average cow milk protein content in selected countries in the period 2003–2013. Source: Eurostat (2015)

Productivity of dairy farms

One of the most recent studies on the productivity of Estonian dairy farms (which compared dairy farms in Estonia, the Netherlands and the United Kingdom using farm level FADN data) concluded that the total factor productivity (TFP) declined between 2003 and 2012 on an average Estonian dairy farm by 0.48% per annum, *i.e.* annual growth rates of inputs usage exceeded the annual output growth rates (Kimura, Sauer, 2015). While the output growth in Estonian dairy farms was highest among the three countries, input growth exceeded output growth in Estonia. In the Netherlands and in the United Kingdom, total input usage decreased. In Estonia, the output growth rate (average 4.4% per annum) was reduced by negative growth (on average –7.2% per annum) of livestock output. While the labour usage declined by 7.5% per annum and land usage by 0.6% per annum, growth in inputs such as capital (8.4% per annum), material (6.0% per annum) and service (8.6% per annum) significantly contributed to the average annual growth of 4.6% in total inputs. However, the market share weighted average TFP growth in Estonian specialised dairy farms was 0.85% per annum, indicating diverging productivity growth rates in large, middle and small farms. TFP growth was positively affected by the number of dairy cows, milk yield and stocking density, implying that the main driver of productivity growth in Estonian specialised dairy farms was size expansion and increasing milk yield in a relatively small number of large farms (Kimura, Sauer, 2015).

Previous studies show mixed results regarding the productivity and competitiveness of Estonian dairy farms. Research by Vasiliev *et al.* (2011) found negative productivity growth in Estonian dairy farms for 2001–2003 and 2004–2006. They suggest that the increase in capital input was not harnessed in the best possible way, while average milk yield and production intensity positively contributed to productivity growth. The positive effects of milk yields on the technical efficiency of dairy farms were reported by Luik *et al.* (2011), Põldaru and Roots (2014) and Luik *et al.* (2014). Jansik *et al.* (2014) found (based on aggregate FADN data) that TFP in Estonian dairy farms increased by average 2.5% per annum between 2004 and 2010. Omel and Värnik (2009), based on the domestic resource cost analysis, concluded that both small and large scale producers had a competitive advantage in milk production in the 2001–2006 period. However, large-scale producers were more competitive and, over time, the competitiveness of Estonian milk producers was declining.

Processing industry

Milk production and processing are two segments of the same value chain. Therefore, to a great extent, their competitiveness is interdependent. However, the phenomenon of raw milk trade (Jansik *et al.*, 2014) has emerged in recent years, and this could be regarded as an indicator of the competitiveness of milk production and/or the manufacturing of dairy products. From Table 2, it appears that the raw milk trade increased in most of the observed countries. The relative significance of raw milk trade is largest in the Baltic countries. In 2014, in Estonia, the net export of raw milk amounted to 25.2% of collected milk. In Latvia, the figure was 28.0%. At the same time, Lithuania is a net importer of raw milk. In 2014, raw milk import amounted to 18.7% of milk collection and 15.8% of milk processed. Raw milk exports from Estonia and Latvia to Lithuania achieved a significant volume in the past 10 years, and it accelerated following the milk market crisis in 2009. However, it appears that the net import of raw milk decreased in Lithuania in 2014 and the volume of milk processed increased in Latvia and in Estonia. It is too early to conclude that the trend of increasing raw milk exports from Estonia and Latvia to Lithuania has changed and has been replaced by increase in the processing the milk within the borders of the countries where it is produced. From the rest of the observed countries, the raw milk trade is more significant in Ireland, which imports 6.2% of the milk that is processed. In Finland, raw milk trade is negligible, while Denmark and the Netherlands export 3.6% and 2.5% of collected raw milk, respectively. Germany is a raw milk importer, though raw milk imports amount to just 1.5% of processed milk volume.

Growth rates are another indicator by which to compare the development of milk production and processing (Jansik *et al.*, 2014). In regard to Latvia and Estonia, the divergence between the relative change in milk collection and processed milk volume in the 2004–2014 period is largest among the observed countries. In the case of Lithuania, the milk processing volume increased by 49.7%, while milk collection increased by 26.1% and milk production declined by 2.7%. In the Baltic countries, there is still some room for increasing milk collection without increasing milk production. While more than 96.9% of produced milk is delivered to the processing industry in Germany, Netherlands, Denmark, Finland and Ireland, the percentage of milk collected amounts to 80.1% in Lithuania, 83.0% in Latvia and 90.7% in Estonia. Based on the figures of raw milk trade and growth rates of milk collection and processing, one could conclude that milk production in Estonia and Latvia developed more quickly than milk processing in the 2004–2014 period, and therefore the competitiveness is better in this segment of the supply chain; in Lithuania, however, the situation is opposite.

Public data for calculating the productivity characteristics of the dairy processing industry is not as rich as in case of dairy farms. In Table 3, labour productivity figures are given for manufacturers of dairy products for 2008–2013 period. For that, the production value is divided by the number of employees, resulting in the production value per employee. Following the approach suggested by Jansik *et al.* (2014) in relation to the labour productivity of dairy farms, this figure is divided into two components – volume (tonnes) of milk processed per employee and production value per kg of milk processed – as described by the following equation:

$$\frac{V}{L} = \frac{Q}{L} * \frac{V}{Q},$$

V denotes production value, L denotes number of employees and Q stands for quantity of processed milk.

Table 2. Milk production, collection, processing and raw milk trade balance in the period 2004–2014

Country	Trait	2004	2006	2008	2010	2012	2014	Change, 2004–2014
Estonia	Milk production, 1000 t	651.9	691.5	693.6	675.4	720.7	804.8	23.5%
	Milk collection, 1000 t	536.1	605.9	605.9	621.1	649.1	730.0	36.2%
	Percentage of collected milk, %	82.2%	87.6%	87.4%	92.0%	90.1%	90.7%	10.3%
	Raw milk trade balance[a], 1000 t	3.3	–57.6	–55.6	–62.5	-159.2	-184.0	
	Milk processed[b], 1000 t	539.4	548.3	550.3	558.6	489.9	546.0	1.2%
	Ratio of processed to collected milk	100.6%	90.5%	90.8%	89.9%	75.5%	74.8%	–25.7%
Latvia	Milk production, 1000 t	784.0	812.1	832.1	830.9	870.6	968.9	23.6%
	Milk collection, 1000 t	463.6	592.3	634.8	625.2	718.4	804.5	73.5%
	Percentage of collected milk, %	59.1%	72.9%	76.3%	75.2%	82.5%	83.0%	40.4%
	Raw milk trade balance, 1000 t	-9.3	–34.7	–65.5	–111.7	-211.5	-225.4	
	Milk processed, 1000 t	454.3	557.7	569.3	513.6	506.9	579.1	27.5%
	Ratio of processed to collected milk	98.0%	94.1%	89.7%	82.1%	70.6%	72.0%	-26.5%
Lithuania	Milk production, 1000 t	1,842	1,885	1,879	1,733	1,775	1,791	-2.7%
	Milk collection, 1000 t	1,138.6	1,296.8	1,382.1	1,278.3	1,359.9	1,435.6	26.1%
	Percentage of collected milk, %	61.8%	68.8%	73.6%	73.8%	76.6%	80.1%	29.6%
	Raw milk trade balance, 1000 t	0.0	113.2	190.0	181.6	301.8	268.4	
	Milk processed, 1000 t	1,138.6	1,410.1	1,572.1	1,459.8	1,661.7	1,704.0	49.7%
	Ratio of processed to collected milk	100.0%	108.7%	113.7%	114.2%	122.2%	118.7%	18.7%
Finland	Milk production, 1000 t	2,448.9	2,413.0	2,310.9	2,336.3	2,296.7	2,400.0	-2.0%
	Milk collection, 1000 t	2,372.7	2,347.6	2,253.9	2,288.6	2,254.0	2,357.2	-0.7%
	Percentage of collected milk, %	96.9%	97.3%	97.5%	98.0%	98.1%	98.2%	1.4%
	Raw milk trade balance, 1000 t	0.0	0.0	0.3	19.0	21.1	9.9	
	Milk processed, 1000 t	2,372.7	2,347.6	2,254.2	2,307.6	2,275.1	2,367.0	-0.2%
	Ratio of processed to collected milk	100.0%	100.0%	100.0%	100.8%	100.9%	100.4%	0.4%
Denmark	Milk production, 1000 t	4,568.4	4,627.2	4,656.0	4,910.0	4,915.7	5,162.0	13.0%
	Milk collection, 1000 t	4,433.8	4,492.1	4,585.6	4,817.5	4,915.7	5,112.6	15.3%
	Percentage of collected milk, %	97.1%	97.1%	98.5%	98.1%	100.0%	99.0%	2.0%
	Raw milk trade balance, 1000 t	–6.3	–32.5	-192.9	-187.0	-164.2	-183.7	
	Milk processed, 1000 t	4,427.5	4,459.6	4,392.7	4,630.5	4,751.5	4,928.9	11.3%
	Ratio of processed to collected milk	99.9%	99.3%	95.8%	96.1%	96.7%	96.4%	-3.5%
Germany	Milk production, 1000 t	28,244.7	27,995.0	28,656.3	29,593.9	30,672.2	32,381.1	14.6%
	Milk collection, 1000 t	27,112.8	26,821.2	27,465.6	28,659.1	29,701.8	31,375.3	15.7%
	Percentage of collected milk, %	96.0%	95.8%	95.8%	96.8%	96.8%	96.9%	0.9%
	Raw milk trade balance, 1000 t	–293.2	160.4	537.1	488.6	721.6	471.4	
	Milk processed, 1000 t	26,819.6	26,981.6	28,002.7	29,147.7	30,423.4	31,846.7	18.7%
	Ratio of processed to collected milk	98.9%	100.6%	102.0%	101.7%	102.4%	101.5%	2.6%
Netherlands	Milk production, 1000 t	10,904.7	10,994.7	11,620.5	11,940.5	11,881.0	12,660.4	16.1%
	Milk collection, 1000 t	10,531.8	10,625.6	10,936.0	11,626.1	11,675.6	12,468.4	18.4%
	Percentage of collected milk, %	96.6%	96.6%	94.1%	97.4%	98.3%	98.5%	2.0%
	Raw milk trade balance, 1000 t	–319.3	–357.8	–439.3	-373.6	-298.2	-311.6	
	Milk processed, 1000 t	10,212.6	10,267.7	10,496.7	11,252.5	11,377.4	12,156.8	19.0%
	Ratio of processed to collected milk	97.0%	96.6%	96.0%	96.8%	97.4%	97.5%	0.5%
Ireland	Milk production, 1000 t	5,307.1	5,271.8	5,113.7	5,349.7	5,399.3	5,821.3	9.7%
	Milk collection, 1000 t	5,267.8	5,224.5	5,089.9	5,327.0	5,379.7	5,818.7	10.5%
	Percentage of collected milk, %	99.3%	99.1%	99.5%	99.6%	99.6%	100.0%	0.7%
	Raw milk trade balance, 1000 t	96.8	140.0	54.5	48.3	96.3	385.5	
	Milk processed, 1000 t	5,364.6	5,364.5	5,144.4	5,375.4	5,476.0	6,204.3	15.7%
	Ratio of processed to collected milk	101.8%	102.7%	101.1%	100.9%	101.8%	106.6%	4.7%

[a] Raw milk trade balance is calculated as a difference between the import and export of products under CN code 04012099 milk and cream of a fat content by weight of > 3% but <= 6%, not concentrated nor containing added sugar or other sweetening matter (excl. In immediate packaging of <= 2 l).
[b] Milk processed is the sum of collected milk and raw milk trade balance.
Source: Eurostat (2015)

The first figure of the pair characterises the mechanisation and automation of the dairy processing industry, while the second figure indicates the average value of dairy processing industry products. It appears that labour productivity and the value of production per kg of processed milk in Estonian dairy processing industry exceed the figures of the Latvian and Lithuanian dairy sectors. However, production value and amount of milk processed has increased more in Lithuania, and Lithuanian dairy processing companies are catching up in the volume of milk processed per employee. There are three possible ways as to how Estonian and other Baltic dairy manufacturers could increase their labour productivity: 1) invest in the automation of processing plants (*e.g.*, from table 3 it appears that in Ireland, 1,041.1 tonnes of milk was processed per average employee in 2012, while in Estonia this figure was 4.5 times lower; at the same time, the value of production per kg of processed milk was lower in Ireland than in Estonia); 2) invest in product development and innovation to increase the production value per kg of milk processed (*e.g.* in Finland, the average turnover per kg of milk was 1.22 euros in 2013, while in Estonia the production value per kg of processed milk was 0.72 euros, *i.e.* 41.0% lower; at the same time, the volume of milk processed per employee was 2.0 times lower in Finland than in Ireland); 3) do both, 1) and 2). Germany and Netherlands represent the middle ground between options 1) and 2) with the volume of processed milk per employee and average value of products per kg of processed milk between the extremes of Ireland and Finland.

Table 3. Production value, number of employees, milk processed and labour productivity in the manufacture of dairy products in the period 2008–2013

Country	Trait	2008	2009	2010	2011	2012	2013
Estonia	Production value, million euros	320.7	268	309.9	345.8	328.2	362.1
	Number of employees	2,349	2,180	2,165	2,271	2,117	2,088
	Milk processed per employee, t	234.3	268.6	258.0	240.0	231.4	239.9
	Production value per employee, 1000 euros	136.5	122.9	143.1	152.3	155.0	173.4
	Production value per kg of processed milk, euros	0.58	0.46	0.55	0.63	0.67	0.72
Latvia	Production value, million euros	333.5	239.7	284.5	323.5	332.7	367.6
	Number of employees	3,718	3,165	3,024	3,011	3,163	3,120
	Milk processed per employee, t	153.1	150.6	169.8	165.4	160.2	167.9
	Production value per employee, 1000 euros	89.7	75.7	94.1	107.4	105.2	117.8
	Production value per kg of processed milk, euros	0.59	0.50	0.55	0.65	0.66	0.70
Lithuania	Production value, million euros	844	656.3	801.2	967.1	938.6	1,068.8
	Number of employees	8,625	8,095	7,627	7,597	7,721	7,607
	Milk processed per employee, t	182.3	177.0	191.4	202.9	215.2	216.8
	Production value per employee, 1000 euros	97.9	81.1	105.0	127.3	121.6	140.5
	Production value per kg of processed milk, euros	0.54	0.46	0.55	0.63	0.56	0.65
Finland	Turnover, million euros[a]	2327,9	2326,9	2277,7	2372,5	2489,5	2807,4
	Number of total employed staff[a]	4779	4612	4590	4690	4845	5254
	Milk processed per employee, t	471,7	499,1	502,7	485,3	469,6	438,9
	Turnover per employee, 1000 euros	487,1	504,5	496,2	505,9	513,8	534,3
	Turnover per kg of processed milk, euros	1,03	1,01	0,99	1,04	1,09	1,22
Germany	Production value, million euros	24,775.5	20,308.0	22,252.9	25,020.5	24,405.5	28,583.2
	Number of employees	38,080	35,809	36,450	39,737	41,062	42,068
	Milk processed per employee, t	735.4	805.0	799.7	755.2	740.9	734.6
	Production value per employee, 1000 euros	650.6	567.1	610.5	629.7	594.4	679.5
	Production value per kg of processed milk, euros	0.88	0.70	0.76	0.83	0.80	0.92
Netherlands	Production value, million euros	9,154.2	7,365	8,150.8	9,405.1	8,775.9	10,357.7
	Number of employees	11,801	12,134	11,470	12,078	12,234	12,695
	Milk processed per employee, t	889.5	909.0	981.0	928.1	930.0	939.3
	Production value per employee, 1000 euros	775.7	607.0	710.6	778.7	717.3	815.9
	Production value per kg of processed milk, euros	0.87	0.67	0.72	0.84	0.77	0.87
Ireland	Production value, million euros	3,290	2,750.3	3,441	3,828.3	3,671.2	3,638.9
	Number of employees	5,012	4,901	4,886	5,127	5,260	
	Milk processed per employee, t	1,026.4	1,003.0	1,100.2	1,095.6	1,041.1	
	Production value per employee, 1000 euros	656.4	561.2	704.3	746.7	697.9	
	Production value per kg of processed milk, euros	0.64	0.56	0.64	0.68	0.67	0.65

*Data for Denmark is missing; some of the data for Ireland in 2013 is missing
Source: Eurostat (2015), in the case of Finland, the data with superscript[a] are from Statistics Finland (2015)

One could ask that if labour productivity and the value of dairy products per kg of processed milk in Lithuania is lower than in Estonia, what makes the Lithuanian dairy processing industry more competitive than the Estonian and Latvian counterparts. Jansik *et al.* (2014) conclude that the total factor productivity has improved in the Lithuanian dairy processing sector at a quicker pace compared to Estonia and Latvia. In 2000–2011, the average annual total factor productivity growth in the Lithuanian dairy processing industry was 2.4%, while in Latvia it was 1.5% and in Estonia 0.3%. The other factors contributing to the greater competitiveness of the Lithuanian dairy processing industry are its more effective ability to find new export markets, scale effects in the processing industry and its larger domestic market, which gave Lithuanian dairies a better starting point for growth.

Milk demand

Food in general has many demand drivers, with the two main components of milk demand being population and consumption per capita. In 2003–2014, Estonia's population decreased by 4.3% to 1.32 million (Figure 11).

At the same time, the total consumption of fresh milk remained unchanged and per capita fresh milk consumption increased by 4.3%. In the 2003–2014 period, per capita fresh milk consumption was lowest (121.6 kg) in 2004, and highest in 2008 (140.8 kg). Income is one of the major drivers of consumption. Fresh milk is one of the products with low demand elasticity in relation to income because people tend to consume a relatively fixed amount of it. However, Figure 11 reveals that there is some correlation between fresh milk consumption changes and average net wage. Since 2004, economic growth accelerated and with it, net wages increased. The beginning of the recession in 2009 led to a decrease in net wages. At the same time, between 2009 and 2011, per capita fresh milk consumption decreased.

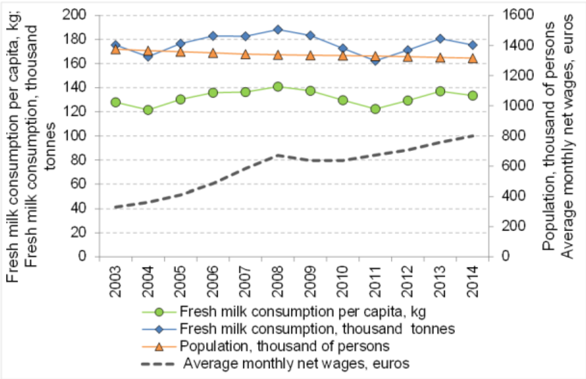

Figure 11. Fresh milk consumption *per capita,* fresh milk consumption, population and average net wage in Estonia in the period 2003–2014 Source: Statistics Estonia (2015)

When comparing Estonian per capita milk (milk products, excluding butter) consumption with the selected countries (Figure 12), one can notice the difference between Finland and the Netherlands and other selected countries. In Finland and the Netherlands, the average milk consumption per capita is larger and more stable than in other countries. In Lithuania, milk consumption per capita has been most volatile, but has an increasing trend. In Ireland, milk consumption was higher until 2003 and has declined in recent years. Estonia appears to be in the same group as Germany and Latvia in terms of milk consumption. In 2011, milk consumption varied from 214 kg/capita/year in Latvia to 395 kg/capita/year in Finland. Estonian per capita consumption was 239 kg.

In the period 2003–2104, there have been some changes in the structure of consumption of milk products in Estonia. The consumption of milk powder, skimmed milk and buttermilk decreased respectively from 3.9 to 0.6 kg/capita/year and 7.5 to 1.4 kg/capita/year. Average per capita butter consumption decreased from 4.9 to 2.1 kg. At the same time, the annual average per capita consumption of cheese and cottage cheese increased from 13.2 to 21.2 kg, and consumption of processed cheese increased from 0.8 to 5.6 kg (Statistics Estonia, 2015). These trends coincide with findings of Putnam (1989) from the end of 1980s in that, while there has been a reduction in demand for high fat fluid milk products, the consumption of relatively high-fat cheese products has been increasing.

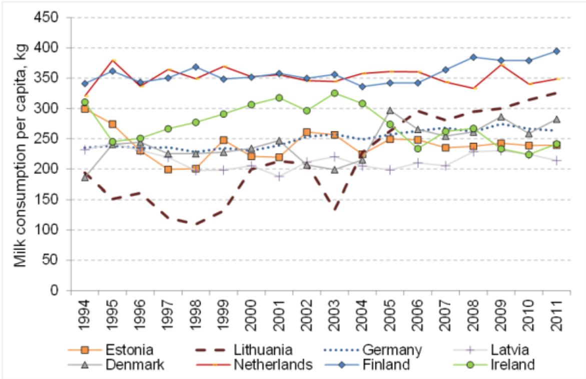

Figure 12. Milk consumption (excluding butter) per capita in the period 1994–2011 in selected countries, kg. Source: Faostat (2015)

From Figure 12 it can be seen that while per capita milk consumption has been more volatile in some countries, it is relatively stable in most countries. Therefore, potentially, when income increases, Estonian domestic consumers could demand larger quantities of milk and dairy products. However, considering the decreasing population and relatively stable per capita milk consumption (consumer preferences), a large increase in domestic demand is not likely and additionally produced milk should be marketed for export.

In recent years, there have also been changes in the purchasing channels of domestic consumers. In 2014, fresh milk was mainly (89% of consumers) purchased from stores (Figure 13), and less so from farmers. In the early 2000s, about 30% of consumers bought fresh milk from farmers. In recent years, that number has dropped significantly. Buying from farmers' markets and own production has also decreased over the years. The latter is explained by a significant drop in the number of dairy herds (Table 1). A new trend is that the number of people who do not consume fresh milk is increasing. In 2014, it amounted to 5%. Therefore, the main purchasing channel of milk in Estonia is retail stores. In the case of milk products, the general trends are similar to those of fresh milk. However, 70% of consumers bought milk products from stores as early as 2001. In 2014, stores were preferred by 95% of consumers, 2% of consumers bought milk products from farmers and 1% from markets. In recent years, 1–2% of consumers have revealed that they do not consume milk products. This trend is increasing, although the percentage of the population that does not consume fresh milk and milk products is still relatively low (TNS EMOR 2010, 2011, 2014).

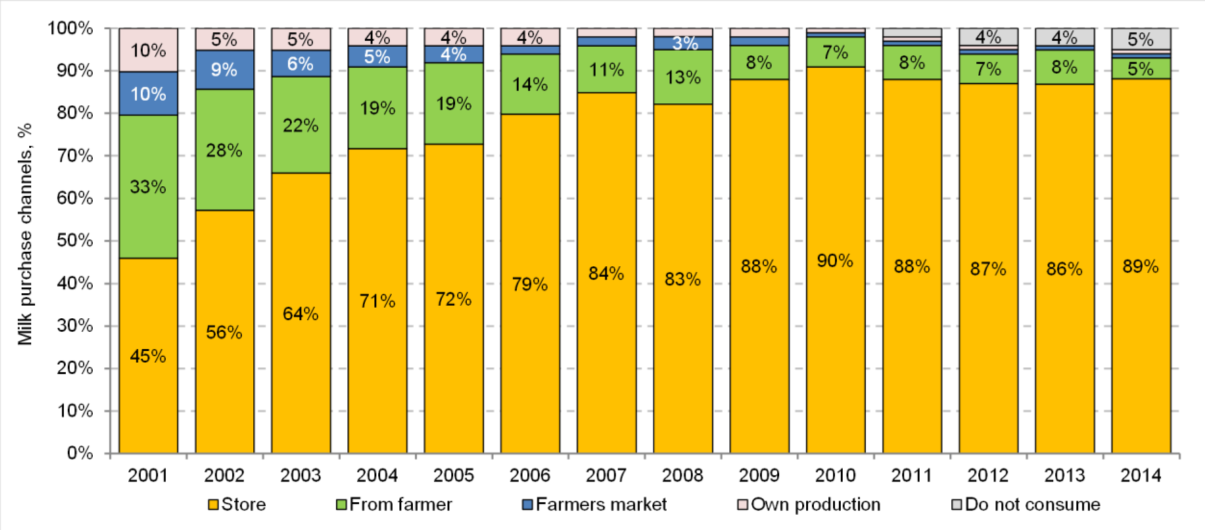

Figure 13. Milk purchasing channels in Estonia, %. Source: TNS EMOR (2010, 2011, 2014)

TNS EMOR (2010) has studied consumers' preferences with regard to the origin of milk products (Figure 14). The study included two milk products: yoghurt and cheese. Preferences regarding the origin of fresh milk were not studied, because fresh drinking milk is easily perished and is largely of Estonian origin. In the 1990s, 62% of consumers preferred yoghurt produced in Estonia. By 2010, the preference of Estonian yoghurt had increased to 81%, largely due to product development (Institute of Economic Research, 2013). Consumers' preference of cheese of Estonian origin had declined by 10 percentage points by 2010, compared to 1996. This could be associated with consumers' desire for a larger variety of cheeses when incomes and cheese consumption increases. However, as of 2010, 80% of Estonian consumers preferred yoghurt and cheese of Estonian origin.

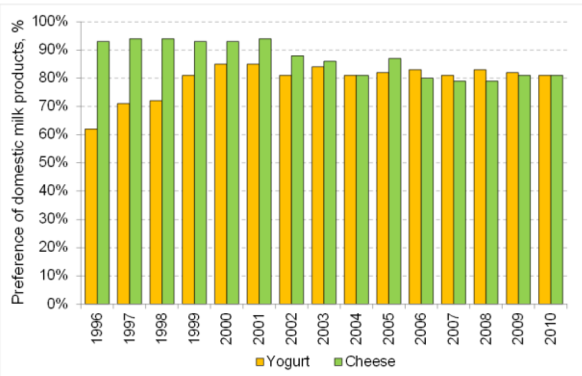

Figure 14. Preference of domestic milk products in the period 1996–2010, %. Source: TNS EMOR (2010)

Foreign trade and comparative advantage

Estonia was a net exporter of dairy products in the 1920s (Pihlamägi, 2004) and has retained this status since. However, there have been several changes in the structure of export products and markets. Therefore, one could claim that the ability to adapt to changing conditions in export markets is one of the crucial determinants of the competitiveness of the Estonian dairy sector. Dagenais and Muet (1992), and Vollrath (1991) provide analysis on the measures of comparative advantage. In the current paper, the most common indexes of revealed comparative advantage (RCA) are used. Fast economic growth in Estonia in the last two decades has caused significant structural changes. The competitiveness of agricultural commodities in the international market has changed and the structure of foreign trade has also changed. The integration of the Estonian economy into the world economy, accession to the EU and, more recently, the financial crisis have been the main drivers behind the dynamics of the Estonian dairy sector's competitiveness in export markets. In the study on the dairy export competitiveness of the EU countries, Bojnec and Fertő (2014) found that Estonia was competitive both on intra- and extra-EU markets between 2000 and 2011, along with Belgium, Cyprus, Denmark, France, Ireland, Latvia, Lithuania, the Netherlands and Portugal. In addition, Bojnec and Fertő (2014) concluded that the duration of the revealed competitive advantage (RCA>1) on the global dairy market was highest for Poland, Latvia, Lithuania and Estonia, implying long-term competitiveness on the global dairy market.

The dynamics of the export turnover of Estonian dairy products between 1994 and 2014 (Figure 15) coincides with the dynamics of producer prices of milk (Figures 2 and 4). The decline in the export turnover of dairy products in 1998–1999, in 2009 and in 2014 have coincided with the "Russian crisis", "Food crisis" and "Russian import ban". While the export turnover of dairy products was 47.6 million euros in 1994, it had increased by 304.8% to 192.8 million euros by 2014. At the same time, the producer prices of milk increased by 230.7% from 99.2 to 328.0 euros per tonne, milk production increased by 4.3% from 771.8 to 805.2 thousand tonnes and milk purchases by processing companies increased by 35.8% from 552.5 to 750.2 thousand tonnes. Therefore, the growth of export turnover exceeds the growth in production and processing volumes, and also the growth in the producer prices of milk.

Calculations of revealed comparative advantage are based on detailed trade data from the World Customs Organization's Harmonized System at 6-digit level (HS6) in 1996–2014. Furthermore, the detailed trade data is aggregated into three broader groups for distinguishing between various stages of the dairy chain. Bojnec and Fertő (2014) use a similar approach in aggregation. Using the Broad Economic Classification (BEC), the HS6 codes are divided to primary dairy products for household consumption (BEC code 112), processed dairy products mainly for industry (BEC code 121) and processed dairy and dairy products intended for final consumption in households (BEC code 122). Data is derived from the UN Comtrade database (UNSD, 2015). Similarly to Bojnec and Fertő (2014), a distinction between intra- and extra-EU trade is made. All trade with EU28 countries from 1996 to 2014 is considered here as intra-EU trade.

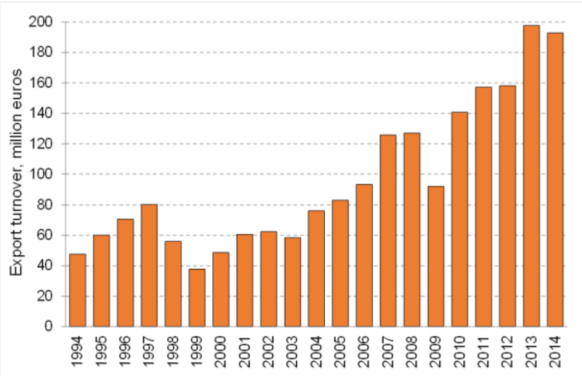

Figure 15. Export turnover (in nominal prices) of Estonian dairy products (CN codes 0401-0406) in the period 1994–2014, million euros. Source: Statistics Estonia (2015)

According to UN Comtrade data, the exports of dairy products in the mentioned categories accounted for 4.5% of Estonia's total exports in 1996 and it declined to 1.5% in 2014 (Figure 16). There has been a remark able shift from extra-EU trade to intra-EU trade. Intra-EU exports accounted for 36% in 1996, and 86% in 2014. The share of import of dairy products has been considerably low in total imports for Estonia, amounting to 1.2% in 1996 and 0.4% in 2014.

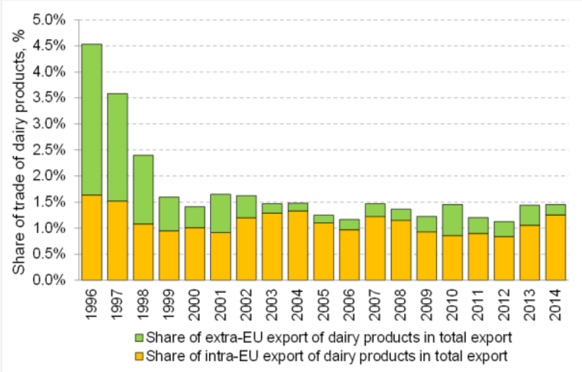

Figure 16. Share of intra-EU and extra-EU trade of dairy products in total exports of Estonia. Source: Comtrade database (UNSD 2015)

Prior to EU accession in 2004, most dairy product exports consisted of processed products. Processed products for households and industry accounted for 85% in 1996, and the share of primary products has risen since EU accession, comprising almost half of exports in 2014 (Figure 17).

However, it should be noted that the description of BEC code 112 (primary products for households) is somewhat misleading in the case of Baltic countries. Most of the value under this code is accounted for by raw milk that is exported to the dairy processing industry of neighbouring countries. The average annual growth in the share of the exports of primary dairy products, which mostly comprises raw milk for processing, was 6.5% between 1996 and 2014. The share of processed products for industry has declined and the share of processed products for households has remained at the same level.

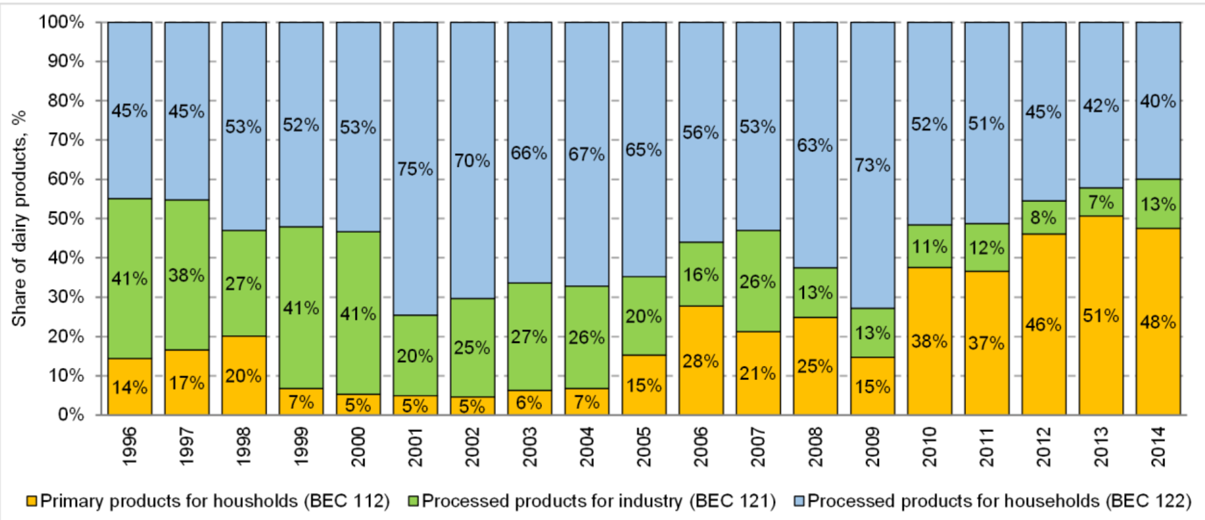

Figure 17. Share of dairy products of the various stages of the dairy chain in exports. Source: Comtrade database (UNSD 2015)

The development of the structure of the export of dairy products could be divided into three sub-periods. From 1994 until the period preceding EU accession (beginning of 2000s), the main groups of export dairy products were concentrated milk and cream, *i.e.* skim milk powder and whole milk powder (Combined Nomenclature (CN) code 0402) and butter (0405) (Figure 18). From 2001 onwards, the share of cheese (0406) in export turnover started to increase until 2009, when it reached to almost 50%. After the crisis in 2009, the share of milk and cream (0401) started to increase, and the share of other product groups began to decline. This is related to the phenomenon known as "raw milk trade", which gained momentum after the 2004 EU enlargement (Jansik *et al*., 2014). In Estonia's case, raw milk was exported to Lithuanian and Latvian markets. This also explains the growth in primary products for households (BEC112) in Figure 17. While in customs union, some amount of raw milk trade is rational (Table 2), the high value share of raw milk in the dairy exports in Estonia and Latvia reflects the lack of processing volume and competitiveness of the dairy processing industry in these countries (Jansik *et al*., 2014).

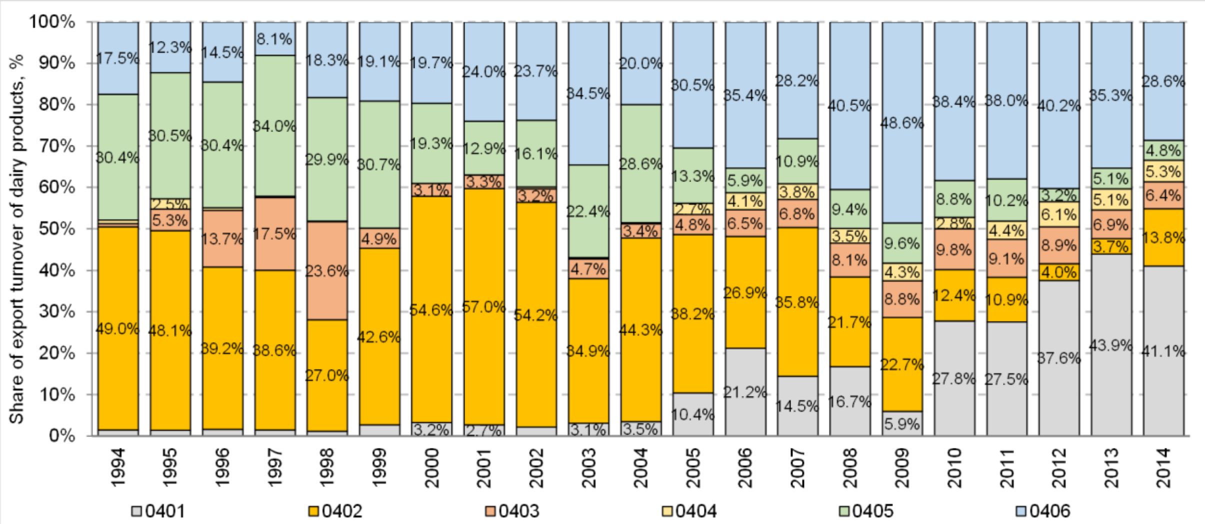

Figure 18. Structure of the export turnover of Estonian dairy products (CN codes 0401-0406) in the period 1994–2014. Source: Statistics Estonia (2015) (0401 – milk and cream, not concentrated; 0402 – milk and cream, concentrated; 0403 – buttermilk, curdled milk and cream, yogurt, kephir and other fermented or acidified milk and cream; 0404 – whey; 0405 – butter and other fats and oils derived from milk; dairy spreads; 0406 – cheese and curd)

Results from the calculations of the Balassa index of revealed comparative advantage (RCA) indicate that Estonia has a comparative advantage in the export flows of all three categories of dairy products (Figure 19).

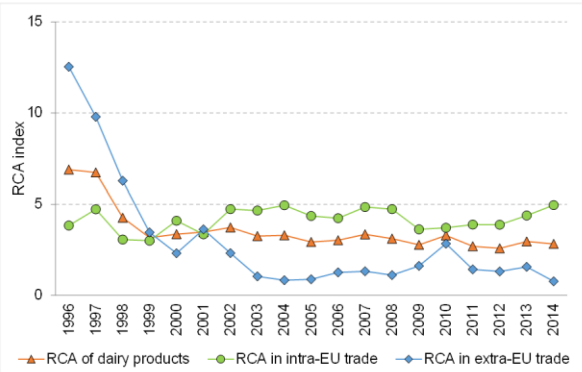

Figure 19. Dynamics of the revealed comparative advantage (RCA) index of dairy products. Source: Authors' calculations based on Comtrade database (UNSD 2015)

The RCA index of all dairy products was >1 throughout the entire period of 1996–2014. In Figure 19, a distinction between intra- and extra-EU trade is made. One can see that the RCA index for extra-EU trade was very large prior to 1999 and has declined considerably since. In 1999–2010, the RCA index remained >1 and was fluctuating between the values of 2.7 and 3.7, indicating a stable revealed comparative advantage. Though the value of the index has not changed significantly, there are changes in the structure of revealed comparative advantage. The RCA of intra-EU trade has been considerably higher than extra-EU trade since 2001. Following accession to the EU in 2004 and in the following year, the RCA index for extra-EU trade even indicated a slight disadvantage in trade. The RCA index for extra-EU trade declined below one again in 2014 due to the disappearance of the Russian export market following the import ban.

From Figure 20, it appears that there have been changes in the main export destinations in the period 1994–2014, which partly explain the changes in the revealed competitive advantage in intra- and extra-EU trade. In 1994–1998, the share of dairy products exported to Russia remained above 33% on average. The second largest export destination was the Netherlands. After the crisis in 1999, the share of Russian Federation in dairy export destinations declined and almost diminished by 2003 due to the double import tariffs policy employed by Russia. At the same time, the share of the Netherlands increased to almost 50% in 2003. Since 1999, the share of other EU15 countries also started to increase. After the EU accession in

2004, the structure of the main export destinations again changed. The Russian market opened again for Estonian dairy products and the share of Russia in export destinations began to increase. Since 2014, the share of the closest neighbouring countries of Latvia, Lithuania and Finland also started to increase. By 2014, the number of export destinations had significantly declined. The four major export markets (Lithuania, Latvia, Finland and Russia) accounted for 76.6% of the total export turnover of dairy products.

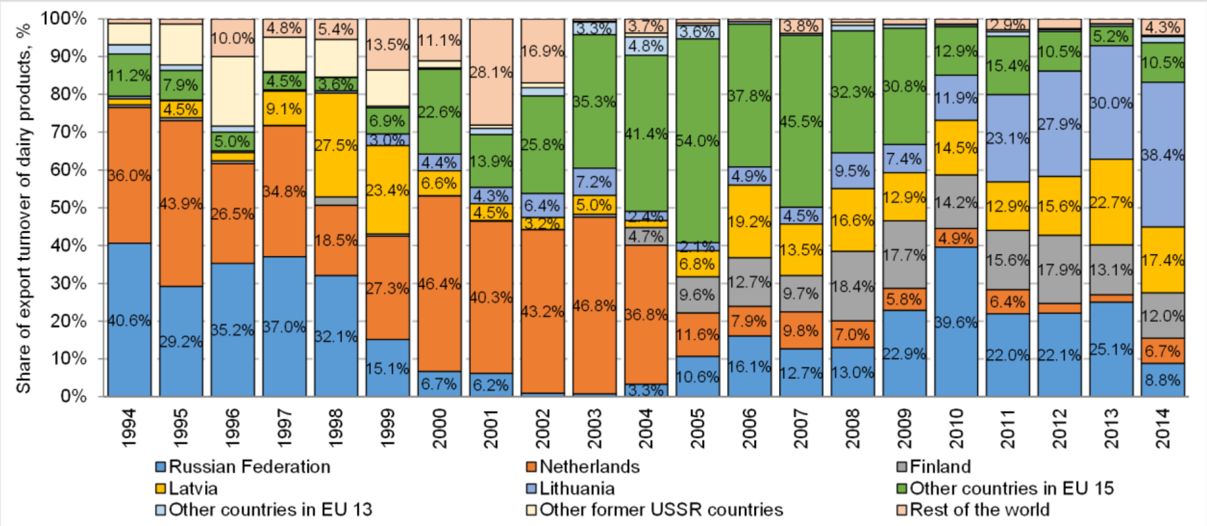

Figure 20. Structure of the export turnover of Estonian dairy products by destination in the period 1994–2014. Source: Statistics Estonia (2015)

There have also been changes in the structure of revealed comparative advantage in terms of the products in various stages of the dairy chain (Figure 21). The RCA index of processed products for households (BEC 122) showed stable decline in RCA from 4.3 in 1996 to 1.7 in 2014, remaining >1 and indicating comparative advantage. This advantage is based on the relatively successful exports to both EU and non-EU countries. There has been a considerable decline in the RCA index for processed dairy products mainly for industry use (BEC 121). The values of the Balassa index still indicate comparative advantage being slightly more successful in the direction of EU countries. Contrary to processed products, there has been an increase in the RCA index of primary products (BEC 112) for both for household and industry use. The RCA index for primary products declined before 1999 and began to rise again, reaching 8.4 in 2014 (significantly affected by raw milk export).

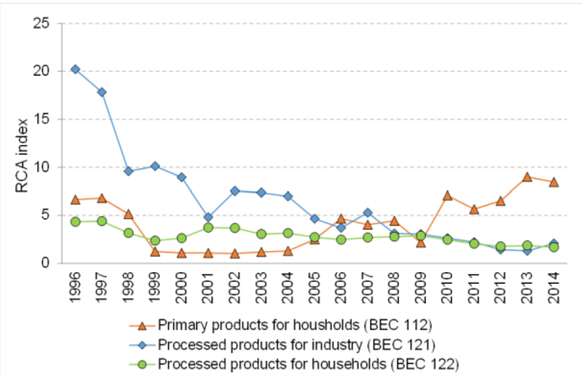

Figure 21. Dynamics of the revealed comparative advantage (RCA) index of dairy products of the various stages of the dairy chain. Source: Authors' calculations based on Comtrade database (UNSD 2015)

The analysis of revealed comparative advantage shows that there are three stages to be considered in the period between 1996 and 2014. First, the period before 2004 when there is a decline in the overall RCA of dairy products prior to 1999 and the relative successfulness of processed products for industry use. Second, the period from 2004 to 2009, where all three product categories show the same level of revealed comparative advantage. The third period is that after 2009, when the exports of primary products, including raw milk, became more advantageous compared to other products.

Discussion and conclusions

In the last 20 years, the Estonian dairy sector has remained export orientated and competitive in export markets. The strength of Estonian dairy farms lies in the high milk yields and relatively large scale farms, which reduce the transport costs for dairies. At the same time, there are aspects in dairy farms that need improvement. According to Kimura and Sauer (2015), the total factor productivity growth remains close to zero, indicating a problem with a rapid increase in input use and a decline in other animal output (live animals and beef), besides milk. The latter is affected by the reducing life span of dairy cows, which also hampers selection of heifers for the replacement of dairy cows. In the long term, this trend has negative effects on the competitiveness of Estonian dairy farms. Therefore, the challenge of dairy farms lies in how to more effectively exploit the investments made and, while maintaining the achieved high yield level, reduce input use and stop the negative trend of the decreasing average life span of dairy cows.

Rapidly increasing milk yields and an increase in the percentage of Estonian Holstein cows has reduced average milk fat content and slightly increased milk protein content. In the Netherlands, Denmark and Finland, both average milk fat and protein content exceed the Estonian figures. Therefore, the dairy processing industry in these countries uses less raw milk for the same amount of manufactured dairy products compared to Estonian dairies. In 2013, the average milk protein content in Estonia exceeded the Lithuanian figure by 4.3%. Lithuania is specialised in producing and exporting of cheese. The higher milk protein content in Estonian milk could be one reason why Lithuanian dairies import raw milk from Estonian farms. The other advantages of Estonian milk in the Baltic raw milk market lie in concentrated dairy farms (which lower transport costs) and the lower seasonality of production (which enables more efficient utilisation of processing capacity).

While milk production and collection in Estonia have increased markedly, the amount of milk processed in Estonian dairies to dairy products has increased to a lesser extent. In 2014, 25.2% of collected milk was exported as raw milk to Latvia and Lithuania. This reflects the more effective competitiveness of the Lithuanian dairy processing industry, which processes more milk than is produced in Lithuania. One of the contributory factors to the success of the Lithuanian dairy processing industry is its good ability to find markets for its products as well as its higher level of marketing innovation compared to the processing companies in other Baltic countries (Jansik *et al*., 2014; Melece, Krievina, 2015). The labour productivity in the Estonian and Baltic dairy processing industry is significantly lower compared to Scandinavian and Central European countries. Also, the value of dairy products per kg of processed milk is lower compared to Finland and Germany. In order to increase competitiveness, the Estonian dairy processing industry needs to increase the amount processed in Estonia, labour productivity and value added per kg of processed milk, and it needs to be effective in finding export markets for its products.

Bojnec and Fertő (2014) conclude that most EU countries should specialise in their dairy exports, since they are not competitive in all market segments. In recent years, the Estonian dairy sector has specialised in cheese and raw milk exports, mainly to neighbouring countries: Lithuania, Latvia, Finland and Russia. While this kind of specialisation seems rational for a small country, concentrating on specific products and markets may cause major drawbacks. The import ban imposed by Russia in 2014, for example, has resulted in a deep crisis in the Estonian dairy sector. In 2013, dairy exports to Russia comprised 25.1% of total dairy exports, and the share of the neighbouring countries of Latvia, Lithuania and Finland were 22.7%, 30.0% and 13.1%, respectively. Therefore, 90.9% of all dairy exports were targeted to neighbouring markets, which were also exporting significant amounts of dairy products to Russia. In addition, milk and cream (CN code 0401, mainly raw milk) comprised 43.9%, and cheese and curd (0406) 31.3% of all dairy exports. These two product groups comprised 75.2% of all dairy exports. Therefore, one could argue that Estonian dairy exports are already relatively specialised.

Low world market prices have had a role in the majority of crises in the Estonian dairy sector. However, in 2009, the crisis coincided with the economic recession, due to which farm payments were also reduced in Estonia. Farm payments also declined in 2014, amplifying the negative effects of low prices. However, abolition of the EU milk quotas in 2015 and an increase in EU milk production changes the policy and market context in the EU and world dairy markets. The EU and Estonian milk producers are not isolated from world markets and milk prices in the EU converge with the world market prices, implying increasing pressure on cost reduction and, potentially, increased price volatility. Appropriate measures for smoothing the effects of price volatility on farm incomes are yet to be determined.

Crises represent a turning point for trends in Estonian dairy sector's development. After each crisis, there have been some changes in the prevalent trends: in the beginning of the 1990s, the dairy sector adapted to changing institutions, agricultural policy and markets. After 1999, dairy exports were reorientated from Russia's markets to EU countries. EU accession once again changed institutional and policy context and brought along reorientation to export markets. The 2009 dairy crisis resulted in raw milk exports to other Baltic countries. The crisis that started in the second half of 2014 has resulted in a significant drop of number of dairy cows and the disappearance of Russian market once again. Therefore, the competitiveness and resilience of the Estonian dairy sector lies in its ability to adapt to changing situations. For dairy farms, it implies a greater ability to alter average production costs, and production volume, according to market situation.

The dairy industry could be considered the weaker link in the farming and industry links of the Estonian dairy chain. Therefore, the future competitiveness of the Estonian dairy sector is largely related to the development of the dairy processing industry. The potential exists (raw milk that is exported) to increase the volume of milk processed in Estonia. However, this would require the suppliers of exported raw milk (dairy farmers) to be willing to deliver this milk to local processors. One of the solutions here could lie in establishing a dairy processing company that is owned by dairy farmers. This could be established as a new company, but could also be founded on the basis of some existing dairy manufacturers. Still, considering the crisis in the dairy sector in 2015, it is questionable whether dairy farmers have the necessary capital for this investment. Therefore, it is necessary to develop the existing dairy manufacturers. In doing so, it should be considered that additionally produced dairy products should be exported. In order to reduce the risks of concentrating on neighbouring markets, new markets should be found among the countries that are not closely linked to the Russian market. It is likely that the product portfolio should be developed in accordance with the demands of these export markets. In order to increase the productivity of the Estonian dairy manufacturing industry, either the volume of milk processed per employee or the product value per kg of processed milk, or indeed both, should be increased. In the short term, the first of these options seems more plausible. However, Estonia is a small country with a small milk production volume in global terms. Therefore, it is questionable whether the long term success of the Estonian dairy industry can lie in very large scale cost efficient processing. This implies a need for intensified research, development and innovation activities in the dairy industry, which require significant investments in human and physical capital, as well as time. Consequently, research, development and innovation should be facilitated in associated public and private organisations. Ultimately, it should not be forgotten that if a product is produced efficiently, and even if it contains potentially high value added, it has to be delivered to end consumers. That requires good marketing capability in the dairy sector together with efforts from government that can facilitate the access of dairy manufacturers to new extra-EU markets.

Autorid kinnitavad artikliga seotud huvide konflikti puudumist.
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