Forecast of the milk production demand and supply in Latvia

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Abstract

The purpose of this investigation is to analyze the milk production supply amounts relation to its price and milk products consumer prices index in 2002-2015 time periods in Latvia. Latvia farmers have seasonal milk production with peak every summer and through every winter, to produce milk at as low a cost as possible. Between 2002 and 2015 milk production supply is increased twice or from 384871.4 to 807572.1 ton. In 2002 the average milk production supply price in Latvia was 135.7 EUR per ton and between 2002 and 2008 milk price was increased till 338.9 EUR per ton. Milk prices in 2015 were, on average, around 25-29% lower than in 2014 and was in average 135.7 EUR per ton. Therefore, after the abolition of milk quotas in the European Union, the cow milk production in Latvia has increased continuously and increased by 3176 tonnes (0.4%) in 2015 compared to 2014. According to the analysis of covariance milk supply amount is influenced by milk products consumer price index (CPI) and year, and milk products CPI depends on milk production supply price and year. There is significant interaction effect between factors; the effect of milk products CPI on milk supply and production supply price on milk products CPI is different for different years.

Keywords: milk suplly and demand; milk products consumer price index; time series models;

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1. Introduction

Milk production is of great importance to the European Union (EU) and milk is produced in all EU Member States. Total EU-28 cow milk production is estimated around 160.1 million tons in 2014 year and 161.9 million tons in 2015. Since 1984 the EU milk supply was managed by the EU milk quota system which expired at the end of March 2015 (Tropea, 2015). In the EU dairy sector, despite low prices, during the year 2015 milk production increased by 1.8 million tons or 1.1 %. Milk deliveries are expected to slightly increase at EU level in 2015 and probably in 2016 (European Commission, 2015).

Dairy farming is one of the important sectors in agricultural economy in Latvia. After joining the EU milk supply was under EU milk quota system and milk price depends of the situation in the world and EU milk market. Between 2002 and 2008 milk price was increased and in 2009, due to economic situation in the world, the milk purchase price decreased by 32.6% in 2009 compared to 2008 and by 16.8% compared to 2005 (Silina, Palacenko, Bugina & Ancan,2011). The prices of purchased milk started to increase in 2010 and the number of cows during the last five years have increased and in 2014 reached 130.7 thousand cows. Average milk yield per cows during the last decade has increased and has reached 6993 kg in 2014. Within the framework of milk supply quota 804.4 thousand tons of milk was supplied in 2014 (Lazda-Lazdina, 2015) and accounted for 0.6% of total EU-28 milk production. According to dairy farming data, Latvia in 2014 has exhausted 99.1% of its annual milk quota, which means that the quota will most likely not be exceeded, before the abolition of milk quotas in the European Union (Latvia is below the milk quota). The average purchased milk price in Latvia decreased from EUR 305 per ton in 2013 to EUR 291 per ton in 2014 or was reduced by 4.6% (Lazda-Lazdina, 2015). According to Milk Market Observatory prices in June 2015 were, on average, 20% lower than in June 2014 across the EU, with reductions ranging from 15-16% in Austria and Italy to 28-29% in Latvia and Estonia (Matthews, 2015). Therefore, cow milk production has increased continuously and increased by 3176 tons (0.4%) in 2015 compared to 2014.

Therefore, the goal of this article is to analyze the milk production supply amounts relation to its price and milk products consumer prices index in 2002-2015 time periods in Latvia.

2. Analysis of milk production supply

The total monthly milk supply in Latvia from 2002 – 2015 is analyzed, using the milk production supply and milk price data of Central Statistical Bureau of Latvia (2016). Between 2002 and 2015 milk production supply is increased twice or from 384871.4 to 807572.1 ton. Latvia farmers produce more milk in the summer months than in other time period. For example, in 2015 summer milk production in June, July and August was 29.5% and winter milk production in December, January and February was 21.5% of total annual milk production.

For climatic reasons most of the EU countries have seasonal milk production and it is related to seasonal cows calving. As a result by Reijs et al. (2013) shows Ireland is compared to North-West European countries and 100% of its farms practice a full cows grazing and block calving at spring and as a result milk production depends on the season. The peak milk production is in May and low level production in December/January. Seasonality of milk production influences milk processing industry and grazing of the cows in North-West European countries is decreased. In the indoors farms over the whole year milk production is more balanced compared to pasture based farms.

According to the general linear model analysis (Table 1) the milk production supply were influenced significantly at the 1% level by factors of time trend and month as seasonal effect. Milk production supply in Latvia was analyzed by seasonal time series decomposing model.

Table 1. Analysis of Month and Time Trend Factors that Influence Milk Supply

Source	Type III Sum of Squares	df	Mean Square	F	Sig.

Corrected Model	29303385531.8	12	2441948794.3	268.8	0.000
Intercept	46062797208.0	1	46062797208.0	5070.7	0.000
Month	11147782916.3	11	1013434810.6	111.6	0.000
Time trend	17466484614.5	1	17466484614.5	1922.7	0.000
Error	1408041158.2	155	9084136.5		
Total	470088070188.7	168			
Corrected Total	30711426690.0	167			

R Squared = 0.954 (Adjusted R Squared = 0.921)

Seasonal milk production with peak every summer and through every winter, the seasonal and random fluctuations constant in size over time can be described using an additive decomposing model. The time trend, seasonal and irregular decomposing model components of milk supply production were described using an additive model (Figure 1).
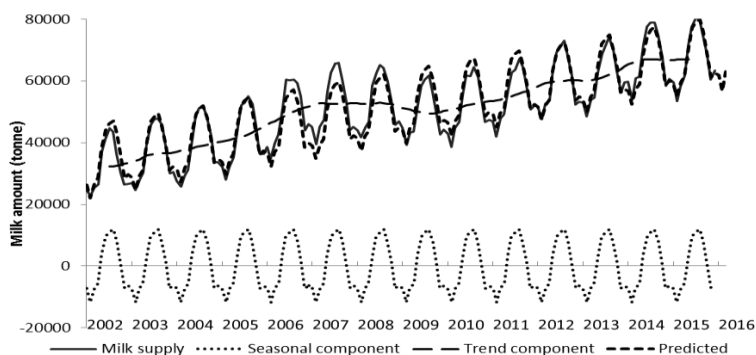

Figure 1. Time series decomposing model components and predicted milk supply amount in 2002-2015

The prediction values of milk in Latvia for January and February 2016 were obtained using the results of estimated time series model (1), where Mi is a milk production (ton), Ti is trend by month, as well January – November are the month seasonal factor.

M_i=27116.2 + 210.8·T_i - 1086.5·January - 5399.9·February - 929.4·March + 613.3·April + 9794.0·May + 15810.8·June + 17462.5·July + 18186.6·August + 13906.3·September + 7225.5·October − 1028.9·November + ε_i (1)

The results show that the trend coefficients, differential intercept associated with the December, coefficient for February, as well as May till October coefficients are statistically significant at the 1% level. This one may conclude that there is month seasonal factor operating of each year. The trend coefficient of 210.8 tell us, that for each month, after taking into account seasonal effect, the average milk supply is expected to increase by about 210.8 ton. The average level of milk supply in December 2001 was 27116.2 ton and in the January 2002 it was less by 1086.5 ton. Respectively in February 2002 the average level of milk supply was less by 5399.9 ton, in March it was less by 929.4 ton, in April it was higher by about 613.3 ton, in May it was higher by 9794.0 ton, in June it was higher by about 15810.8 ton, in July it was higher by about 17462.5 ton, in August it was higher by 18186,6 ton, in September it was higher by 13906.3 ton, in October it was higher by 7225.5 ton and in November it was less by 1028.9 ton.

Figure 1 shows produced and predicted ton of supply milk, which demonstrate that there are no significant variations among the actual and prediction value during the 2002 – 2015. The absolute percentage error was under 8%, which is considered as a good approximation.

3. Milk production supply and milk products consumer price index

The first question which has been researched was – to analyze milk price and relationship between milk production supply price and milk products consumer price index (CPI). In 2002 the average milk production supply price in Latvia was 135.7 EUR per ton. Between 2002 and 2008 milk price was increased and the highest milk price 338.9 EUR per ton was in February 2008. The financial crisis in the global economy caused international demand for dairy produce to decline in late 2008 and had a dramatic impact on product prices during the first half of 2009 (Blasko, 2011).

In summer 2009 the average milk price in Latvia was around 155 EUR per ton and during the winter of 2009 was stabilized. The milk price increase from year to year with seasonal fluctuations with milk price peak 351.5 EUR per ton in March 2014. In the end of the 2014 the milk price was the same level than in the first half 2007. The milk products CPI reflects changes in the prices of milk products in a period of time from 2002 till 2015, where the CPI base or comparison period is year 2005, which is expressed by 100 index points (2005=100).

Table 2. Analysis of Influence of Milk Production Supply Price and Year to Milk Products Consumer Price Index

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	235190.6	27	8710.8	843.2	0.000
Intercept	2345.9	1	2345.9	227.1	0.000
year	2251.0	13	173.2	16.8	0.000
milk production supply price	402.2	1	402.2	38.9	0.000
year * milk production supply price	901.6	13	69.4	6.7	0.000
Error	1446.3	140	10.3		
Total	3224370.3	168			
Corrected Total	236636.9	167			

R Squared = 0.994 (Adjusted R Squared = 0.993)

Analysis of covariance (Table 2) shows that the milk products CPI significantly depends on milk production supply price (p<0.001) and interaction effect of year and milk production supply price (p<0.001). The significant interaction effect of year and milk production supply price means that the

differential slope coefficients are statistically significant, strongly indicating that the regressions for the different years are different.

Analyses of covariance results show that when milk production supply price increase the milk products consumer price index also increase. For example in 2002 and 2003 time period when the milk production supply price was at the level of 125.4 EUR per ton to 149.5 EUR per ton the milk products CPI was in range from 70.3 to 74.6 (2005=100), but in 2015 when the milk production supply price was at the level of 203.5 EUR per ton to 227.9 EUR per ton the milk products CPI was in range from 158.3 to 171.5 (2005=100). Figure 2 shows that in 2015 the slope coefficient of milk production supple price is 0.29, it means that for each EUR per ton of milk production supple price the average milk production CPI is expected to increase by about 0.29 (2005=100).
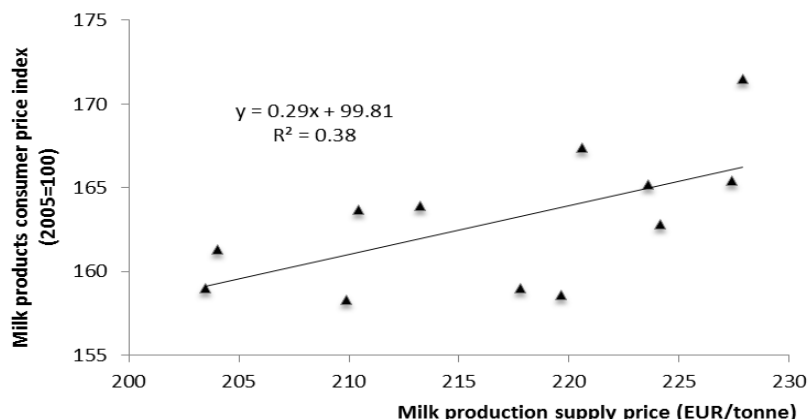

Figure 2. Relationship between milk production supply price and milk products consumer price index in 2015

The second question which has been researched was – to analyze relationship between milk production supply amount (tons) and milk products consumer price index (CPI) in 2002 and 2015 time period. Due the problem of milk production supply amount data heteroscedasticity, a log transformation is used.

Table 3. Analysis of Influence of Milk Products Consumer Price Index (MPCPI) and Year to Milk Supply Amount

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9.844	27	0.365	12.604	0.000
Intercept	5.919	1	5.919	204.602	0.000
year	1.321	13	0.102	3.513	0.000
MPCPI	0.155	1	0.155	5.361	0.022
year * MPCPI	1.307	13	0.101	3.474	0.000
Error	4.050	140	0.029		
Total	19622.39	168			
Corrected Total	13.894	167			

R Squared = 0.709 (Adjusted R Squared = 0.652)

Analysis of covariance (Table 3) shows that milk production supply amount (tons in log transformation) significantly depends on milk products consumer price index (p<0.05) and interaction effect of year and milk products CPI (p<0.001). The significant interaction effect of year and milk products CPI means that the differential slope coefficients are statistically significant, strongly indicating that the regressions for the different years are different. Analysis of covariance results show

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that milk production supply amount (tons) decrease by 1.3% when the milk products CPI increase by one index point (2005=100).

4. Conclusions

In this study the amount of milk production supply from 2002 to 2015 were evaluated and predicted by seasonal time series decomposing model. According to the research results milk production supply amount significantly depends on time trend and month seasonal factor ($p < 0.001$). For climatic reasons Latvia has seasonal milk production and during the last decade the milk production was increased.

Milk products consumer price index significantly depends on milk production supply price ($p < 0.001$) and interaction effect of year and milk production supply price ($p < 0.001$). Milk products consumer price index increase when the milk productions supply price increase. Milk production supply amount significantly depends on milk products consumer price index ($p < 0.05$) and interaction effect of year and milk products CPI ($p < 0.001$). Analysis of covariance results show that milk production supply amount (tons) decrease by 1.3% when the milk products CPI increase by one index point (2005=100).

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