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ARDL Models Concerning Cattle Number and Cow Milk Production in Bulgaria

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Summary

The present paper estimates and forecasts the cattle number and quantity of cow milk produced in Bulgaria for 2018, using autoregressive distributed lag (ARDL) models. Furthermore, it identifies some of the factors that influence them. The ARDL models were constructed on the basis of the annual data for the period between 01.11.2000 and 01.11.2017.

The long-run coefficients in the cattle number model were significant, showing the cattle number was positively related to calves' price, but negatively related to milk product consumption. Significant short-run relations were observed between cattle number and: calves' price and consumption of milk products.

The long-run coefficients in the second model for cow milk production show that the production of cow milk was in a positive association with the number of dairy cows, the prices of cow milk and the consumption of milk products. The conducted Wald Test exposed that there was a short-run connection between cow milk production and dairy cows. Dummies' coefficients were negative numbers, meaning that the adaptation periods, following changes in agrarian policy, led to a decrement in cattle number, as well as in cow milk production.

Keywords: cattle number, cow milk production, ARDL models, Bulgaria

JEL: Q10, C32

Introduction

Cattle-breeding and dairy sectors are interconnected branches of agriculture, which have a vital role in milk and milk products supply of the population worldwide.

Agriculture and in particular cattle-breeding and dairy farming are the subject of research by Bulgarian and foreign research teams, in terms of their development and role for the agrarian business (Stoyanova, 2011), and from the point of view of their effectiveness (Popescu and David, 2014; Stankov et al., 2015). Some researchers in Bulgaria state that the cattle-breeding sector is the most preferable among the livestock branches and it is with the highest economy efficiency (Stankov, 2015) but there are still outgoing restructuring processes (Ivanov and Stoichev, 2018). Furthermore, other researches outline that cattle breeding is among the agrarian sectors with the greatest potential for competitiveness in Bulgaria (Gorton et al., 2000).

In the scientific literature studies can be found, according to which cow milk production

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is influenced by various factors that can be grouped into the following categories: genetics, natural environment, management and economics, adopted technologies on farm level, and social factors.

Bidireac et al., 2014 stated that cow milk production is influenced by the genetics of dairy cows and by the exploitation process of farm animals. Kino et al. (2018) exposed the relationship between warm weather and decreasing milk productivity per cow.

In the group of management and economics can be included the farms' size, education of farm managers, labour characteristics, and etc. The adopted technologies and innovations can also impact the quantity and quality of the production (Tyapugin et al., 2015). The group of social factors is connected with the consumer attitude to milk and milk products (Kapaj and Deci, 2017). Consumed levels are explained mainly by the diet of individuals, their beliefs, habits, traditions, culture, purchasing power, and etc. Some empirical data can cast light on the situation in the branch.

Since 2000, a decrement in cow milk production in Bulgaria has been observed: the largest quantity was produced in 2004 (1 305 582 thousand liters) and the smallest - in 2017 (939 978 thousand liters) (www.mzh.government.bg). The negative tendency is explained by the crisis in the dairy sector caused by excess supply of milk from the world markets and relatively unilateral and uncompetitive Bulgarian milk production (Directorate MMPO, 2018).

The situation in cattle number is similar: from 728 336 heads in 2003 to 526 112 heads in 2012 (www.mzh.government.bg).

The tendencies in the consumption of milk and milk products per a member of a household are as follow: milk - decreased from 28.9 in 2000 to 17.2 liters in 2017; yoghurt - increased from 22.1 to 27.6 kg; cheese - increased from 9.2 to 11.4 kg; yellow cheese - increased from 1.9 to 4 kg (www.nsi.bg).

In the present study, an attempt to find some of the main factors, influencing cattle number and cow milk production in Bulgaria on a national level have been made, using ARDL models (see Pesaran et al., 1999; Pesaran et al., 2001).

ARDL models are widely used for exploring money demand (Achsani, 2010; Dritsakis, 2011), credit growth (Adeleye et al., 2017), GBP (Morley B. 2006; Atif et al., 2010), investments and savings (Yadav et al., 2018), as well as in agriculture (Awokuse and Xie, 2015; Hye, 2009; Asumadu-Sarkodie and Owusu, 2016).

The aim of the present paper was to estimate and forecast the cattle number and quantity of the produced cow milk in Bulgaria for 2018, using autoregressive distributed lag (ARDL) models, as well as to find some of the main factors, influencing them.

Materials and Methods

The ARDL models were constructed using annual data, derived from the Ministry of Agriculture, Food and Forestry, Republic of Bulgaria (www.mzh.government.bg) and from the National Statistical Institute (www.nsi.bg) for the period 01.11.2000 – 01.11.2017, except for the production of cow milk, where the data begun from 01.11.2001. Time series in logarithmic values under this research were:

- cattle number (in heads): ***ln_cattle***;
- produced cow milk (in thousand liters): ***ln_cow_milk***;
- dairy cows (in heads): ***ln_dairy_cows***;
- milk products consumption per member of a household for 1 year (kg milk equivalent): ***ln_milk_pr***. This variable included the annual consumption of fresh milk, yoghurt, cheese and yellow cheese, converted into milk equivalent under the Methodology of Ministry of agriculture and

food for conversion of dairy products from cow milk into milk equivalents;

- real sale price of cow milk per 1000 liters (in BGN): ***ln_cow_milk***. The nominal price was deflated with the Consumer Price Index with a base 12.1995;

- real sale price of calves per 1ton live weight (in BGN): ***ln_price_calves***. The nominal price was deflated in the same way as the milk price.

The dummy variables included in the models represent the adaptation periods, following changes in agrarian policy. During the adaptation periods, farmers adjust their businesses to the new conditions.

The variables were tested for stationarity using Augmented Dickey-Fuller test (ADF) and Kwiatkowski–Phillips–Schmidt–Shin test (KPSS) (Kwiatkowski et al., 1992). ARDL models could be developed nevertheless the variables are stationary at level *I(0)* or stationary at first difference *I(1)* (Pesaran et al., 1999; Pesaran et al., 2001).

The maximal number of lags for the stationarity tests was 5, which was approximately ¼ of the number of observations.

We take into consideration the models for cattle number and quantity of the produced cow milk represented below:

$$\ln\_cattle_t = a_0 + a_1 \ln\_milk\_pr_t + a_2 \ln\_price\_calves_t + e_t \quad (1)$$

$$\ln\_cow\_milk_t = a_0 + a_1 \ln\_dairy\_cows_t + a_2 \ln\_price\_milk_t + a_3 \ln\_milk\_pr_t + e_t \quad (2)$$

Where e_t is the error term.

Aiming at analyzing and forecasting the production of cow milk and cattle number, various ARDL models were developed on the basis of the model (1) and model (2). The models were compared with one another with the help of Akaike criterion, R-squared and F-statistics. The best fitted regression models were used for further analysis (model (3) and model (4)) and they had the following expression:

$$d(\ln\_cattle)_t = \beta_0 + \sum_{i=1}^{2} \beta_{1i} d(\ln\_cattle)_{t-i} + \sum_{i=1}^{2} \beta_{2i} d(\ln\_milk\_pr)_{t-i} + \beta_3 d(\ln\_price\_calves)_{t-1} + \beta_4 dummy\_cattle + \beta_5 \ln\_cattle_{t-1} + \beta_6 \ln\_milk\_pr_{t-1} + \beta_7 \ln\_price\_calves_{t-1} + \varepsilon_t \quad (3)$$

$$d(\ln\_cow\_milk)_t = \beta_0 + \beta_1 d(\ln\_cow\_milk)_{t-1} + \beta_2 d(dairy\_cows)_{t-1} + \beta_3 d(\ln\_price\_milk)_{t-1} + \sum_{i=1}^{2} \beta_4 d(\ln\_milk\_pr)_{t-i} + \beta_5 dummy\_milk + \beta_6 \ln\_cow\_milk_{t-1} + \beta_7 \ln\_dairy\_cows_{t-1} + \beta_8 \ln\_price\_milk_{t-1} + \beta_9 \ln\_milk\_pr_{t-1} + \varepsilon_t \quad (4)$$

where: **d** - first difference; $ß_0$ – intercept; from $ß_1$ to $ß_3$ in model (3) and from $ß_1$ to $ß_4$ in model (4) are the short-run coefficients; $ß_4$ in model (3) and $ß_5$ in model (4) are the dummy's coefficients; from $ß_5$ to $ß_7$ in model (3) and from $ß_6$ to $ß_9$ in model (4) are the long-run coefficients; ε_t – white noise; **dummy_cattle** – dummy variable for cattle number. It has value 1 for the period from 2007 to 2010 and for 2016 and 2017. The period between 2007 and 2010 differ from the rest of the years, because in 2007 Bulgaria joined the EU and farmers faced new challenges coming from the external environment. In addition, global economic crises (Angelov, 2009) and new market and product requirements and regulations made the sector unstable. In the other hand, the dummy can be explained with a reduction in agrarian Gross Value Added: for 2007 a decrease was observed of 29.7% compared to 2006 (MAFF, 2009). The sector was lagging behind and further losses of positions in the economy were expected. Although Bulgaria was in the EU with an active CAP and RDP, still the administrative services were working on adaptation of some Ordinances of the Measurements (2007-2013), which led to a time lag of farm funding (DFZ, 2018, Applicable national legislation). The years 2016 and 2017 were connected with changes in cattle farming as a whole, because the derogation period expired at the end of 2015. This period was granted to Bulgaria to meet the quality standards for raw cow milk.

dummy_milk – dummy variable for the produced cow milk. It has value 1 for the period 2007 – 2009 and for 2015. The period from 2007 to 2009 was associated with the EU membership. The explanation is the same as for the dummy_cattle. During 2015 the new program period of the Rural Development Program (2014-2020) started and this reflected in altered conditions for farm business. Also in March 2015 EU milk quotas had been dropped, leading to liberalization in cow milk production.

The long-run models' coefficients (model (5) and (6)) were derived from the ARDL models (3) and (4).

$$\ln\_cattle_t = \alpha_0 + \alpha_1 \ln\_milk\_pr_t + \alpha_2 \ln\_price\_calves_t + e_t \quad (5)$$

$$\ln\_cow\_milk_t = \alpha_0 + \alpha_1 \ln\_dairy\_cows_t + \alpha_2 \ln\_price\_milk_t + \alpha_3 \ln\_milk\_pr_t + e_t \quad (6)$$

where: α_0 is the intercept; α_1, α_2 and α_3 are the independent variables' coefficients.

Model (7) and (8) represent the short-run versions of the ARDL models (3) and (4) with included error correction term:

$$d(\ln\_cattle)_t = \beta_0 + \sum_{i=1}^{2} \beta_{1i} d(\ln\_cattle)_{t-i} + \sum_{i=1}^{2} \beta_{2i} d(\ln\_milk\_pr)_{t-i} + \beta_3 d(\ln\_price\_calves)_{t-1} + \beta_4 dummy\_cattle + \beta_5 ect\_cattle_{t-1} + \varepsilon_t \quad (7)$$

$$d(\ln\_cow\_milk)_t = \beta_0 + \beta_1 d(\ln\_cow\_milk)_{t-1} + \beta_2 d(dairy\_cows)_{t-1} + \beta_3 d(\ln\_price\_milk)_{t-1} + \sum_{i=1}^{2} \beta_4 d(\ln\_milk\_pr)_{t-i} + \beta_5 dummy\_milk + \beta_6 ect\_milk_{t-1} + \varepsilon_t \quad (8)$$

in which: **ect_cattle** is the error correction term for cattle number (residuals of the model (5)); **ect_milk** is the error correction term for the produced cow milk (residuals of the model (6)); $ß_5$ in model (7) and $ß_6$ in model (8) are the coefficients in front of the error correction terms (speed of adjustment in long-run);

The error correction terms were included instead of long-run coefficients in order to calculate the speed of adjustment in long-run.

The relation between the long-run coefficients was assessed by applying the Wald test, where the H_0 (no cointegration exists) in models (3) and (4) could be written as follow: $ß_5 = ß_6 = ß_7 = 0$ (model (3)) and $ß_6 = ß_7 = ß_8 = ß_9 = 0$ (model (4)). The F-statistics of Wald test, at 5% significance level, were compared to the critical bounds established by Pesaran et al., 2001.

After that, the ARDL models (3) and (4) were estimated and forecasts for 2018 were computed based on static forecasting method.

Various diagnostic tests were used to assess the models: Breusch-Godfrey test for serial autocorrelation, White Heteroskedasticity and Jarque-Bera test, CUSUM, CUSUM of Squares, Root Mean Squared Error. Wald test was applied for detecting short-run causation.

Results and Discussions

Table 1 showed the results of the applied stationarity tests, concerning ln_cattle, ln_dairy_cows, ln_cow_milk, ln_milk_pr, ln_price_calves and ln_price_milk.

Table 1. *Tests for stationarity at 5% significance level*

Variable	ADF*	KPSS**
ln_cattle	*I(1)*	*I(0)*
ln_dairy_cows	*I(1)*	*I(1)*
ln_cow_milk	*I(1)*	*I(0)*
ln_milk_pr	*I(1)*	*I(1)*
ln_price_calves	*I(0)*	*I(0)*
ln_price_milk	*I(0)*	*I(0)*

Source: Authors' *calculations.*
*Models with *included constant. Lag selection was based on Schwarz Info Criterion;*
** Models *with included constant. Newey-West Bandwidth criterion was applied;*

According to the conducted ADF tests, cattle and dairy cow numbers, milk production and consumption of milk products were stationary at first difference; the prices of cow milk and calves were stationary at level. KPSS tests confirmed the results from the ADF tests except for the cattle number and cow milk production.

According to the results of the conducted Wald test for models (3) and (4), the long-run coefficients were in equilibrium relationship: the calculated F-statistics of Wald test were higher than the upper bounds from the Table of Pesaran et al., 2001, the case with unrestricted intercept and no trend (F-statistics of 29.57 for model (3) and 52.20 for model (4)).

The estimates and some diagnostic tests of the ARDL models were represented below.

Table 2. *Estimates of the model with a dependent variable d(ln_cattle) (model (3))*

Variable	Coefficient	T-statistic (probability)
d(ln_cattle(-1))	-0.158429	-1.2855 (0.2549)
d(ln_cattle(-2))	-0.050418	-0.5508 (0.6055)
d(ln_milk_pr(-1))	0.754973	7.1951 (0.0008)
d(ln_milk_pr(-2))	-0.576537	-5.0447 (0.004)
d(ln_price_calves(-1))	-0.503731	-3.5043 (0.0172)
dummy_cattle	-0.077957	-5.9653 (0.0019)
Intercept	6.989429	3.2523 (0.0226)
ln_cattle(-1)	-0.508347	-4.6365 (0.0057)
ln_milk_pr(-1)	-0.484333	-2.9711 (0.0311)
ln_price_calves(-1)	0.599569	4.1554 (0.0089)
R-squared	0.9852	
F-statistic (probability)	37.0851 (0.0005)	
Breusch-Godfrey Serial Correlation LM Test: Obs*R-squared (probability)	5.9811 (0.0503)	
Heteroskedasticity ARCH Test: Obs*R-squared (probability)	1.9097 (0.3849)	
Jarque-Bera test: coefficient (probability)	0.9210 (0.6310)	

Source: *Authors' calculations.*

Fig. 1. *CUSUM test of the model for d(ln_cattle) at 5% significance level (model (3))*
Source: *Authors' calculations.*

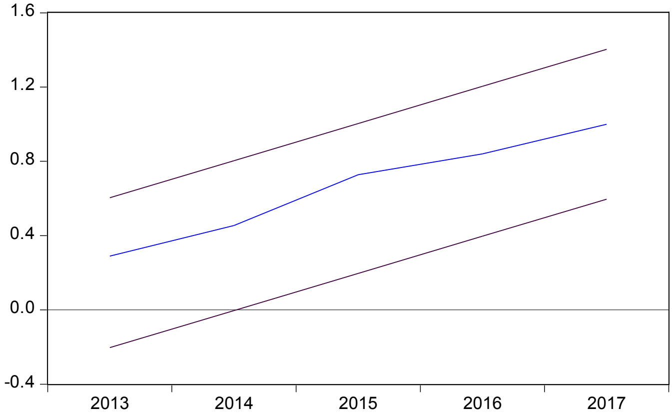

Fig. 2. *CUSUMSQ test of the model for d(ln_cattle) at 5% significance level (model (3))*
Source: *Authors' calculations.*

The ARDL model, used for forecasting the cattle number, was significant (F-statistic = 37.0851; probability = 0.0005) with a coefficient of determination of 0.9852 (Table 2). The test for serial autocorrelation LM test (2 lags included) and heteroskedasticity test had probability higher than 0.05, so we couldn't reject the H_0 hypothesis of the two diagnostic tests and accept that there were no the serial autocorrelation and heteroskedasticity. According to the Jarque-Bera test, the residuals were normally distributed and the graphics of CUSUM and CUSUMSQ showed that the model was stable (Fig. 1 and Fig. 2). The included dummy appeared to be highly significant, showing that the years from 2007 to 2010 and from 2016 to 2017, affected cattle number. Dummy's coefficient was a negative number, meaning that the adaptation periods, following changes in agrarian policy, led to a reduction in cattle number.

Table 3. *Long-run and short-run estimates of the model for cattle number (model (5) and model (7))*

Variable	Coefficient	T-statistic (probability)
I. Long-run estimates (dependent variable ln_cattle)		
Intercept	13.749327	9.6120 (0.0002)
ln_milk_pr	-0.952761	-6.4521 (0.0013)
ln_price_calves	1.179448	3.5214 (0.0169)
II. Short-run estimates (dependent variable d(ln_cattle))		
d(ln_cattle(-1))	-0.158418	-3.0481 (0.0186)
d(ln_cattle(-2))	-0.050436	-1.0601 (0.3243)
d(ln_milk_pr(-1))	0.754967	9.9660 (0.0000)
d(ln_milk_pr(-2))	-0.576527	-6.9249 (0.0002)
d(ln_price_calves(-1))	-0.503758	-6.2617 (0.0004)
dummy_cattle	-0.077959	-10.276 (0.0000)
Intercept	0.000112	0.0274 (0.9789)
ect_cattle(-1)	-0.508367	-11.1439 (0.0000)
Breusch-Godfrey Serial Correlation LM Test: Obs*R-squared (probability)	5.3680 (0.0683)	
Heteroskedasticity ARCH Test: Obs*R-squared (probability)	1.9088 (0.385)	

Source: *Authors' calculations.*

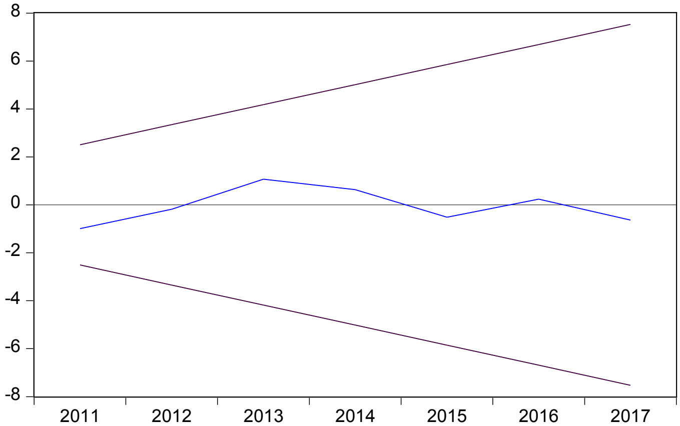

Fig. 3. *CUSUM test of the short-run model with for d(ln_cattle) at 5% significance level (model (7))*
Source: *Authors' calculations.*

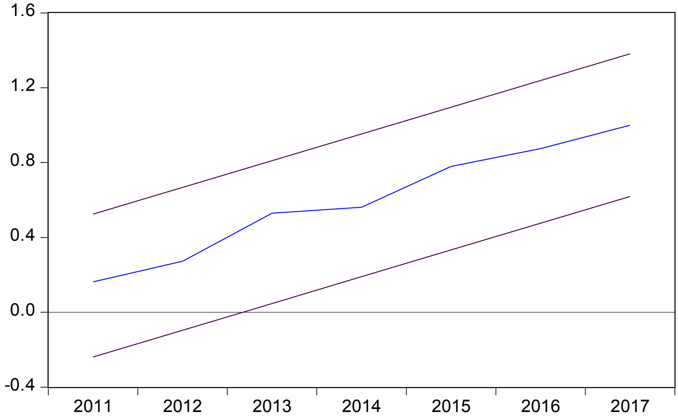

Fig. 4. *CUSUMSQ test of the short-run model for d(ln_cattle) at 5% significance level (model (7))*
Source: *Authors' calculations*

Table 3 represents the long-run and short-run estimates of the model for cattle number. All long-run coefficients were significant and showed that the cattle number had a positive relation with the calves' price, but negatively connected with the consumption of milk products.

The negative sign of the coefficient of milk products consumption probably is due to the fact that the impact of milk consumption is not one-sided on all cattle categories. The cattle category comprises dairy cows, as well as other categories of cattle, including for meat production. The calves' price influences directly all categories of cattle, because calves from dairy and beef breeds could be sold at market prices, but the consumption of milk products influences only the dairy cattle.

Wald Test showed that there was short-run causality from the calves' price to the cattle number (chi-square (probability) = 39.2093 (0.0000)); short-run dependency was also found between the cattle number and milk products consumption (chi-square (probability) = 195.3607 (0.0000)). The speed of adjustment in long-run (equilibrium) was found to be highly significant with a negative sign of 50.84%. The diagnostic tests showed that the short-run model was stable (Fig. 3 and Fig. 4) and with no serial correlation and heteroskedasticity (Table 3).

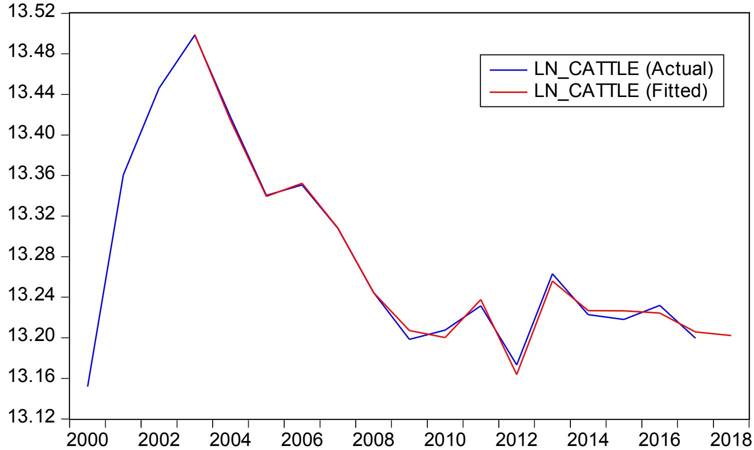

Fig. 5. *Actual and fitted logarithmic values of cattle number*
Source: Authors' calculations.

Fig. 5 represents the actual and fitted values (method - static forecast) of the logarithmic values of cattle number. Root mean squared error between the actual values and the fitted was 0.005809. The forecasted number of cattle in Bulgaria for 2018 was 541 530 heads.

Table 4. *Estimates of the model with a dependent variable d(ln_cow_milk) (model (4))*

Variable	Coefficient	T-statistic (probability)
d(ln_cow_milk(-1))	0.091498	1.2068 (0.294)
d(ln_dairy_cows(-1))	-1.213845	-4.1402 (0.0144)
d(ln_price_milk(-1))	-0.044736	-0.3424 (0.7493)
d(ln_milk_pr(-1))	0.314543	1.0461 (0.3545)
d(ln_milk_pr(-2))	-0.005795	-0.0180 (0.9865)
dummy_milk	-0.084318	-5.2630 (0.0062)
Intercept	-8.356745	-2.1312 (0.1001)
ln_cow_milk(-1)	-0.919115	-10.2612 (0.0005)
ln_dairy_cows(-1)	1.370266	5.8512 (0.0043)
ln_price_milk(-1)	0.054596	0.2600 (0.8077)
ln_milk_pr(-1)	0.724163	2.0882 (0.105)
R-squared	0.9909	
F-statistic (probability)	43.4230 (0.0012)	
Breusch-Godfrey Serial Correlation LM Test: Obs*R-squared (probability)	5.3784 (0.0679)	
Heteroskedasticity ARCH Test: Obs*R-squared (probability)	2.3871 (0.3031)	
Jarque-Bera test: coefficient (probability)	3.4077 (0.1820)	

Source: *Authors' calculations*

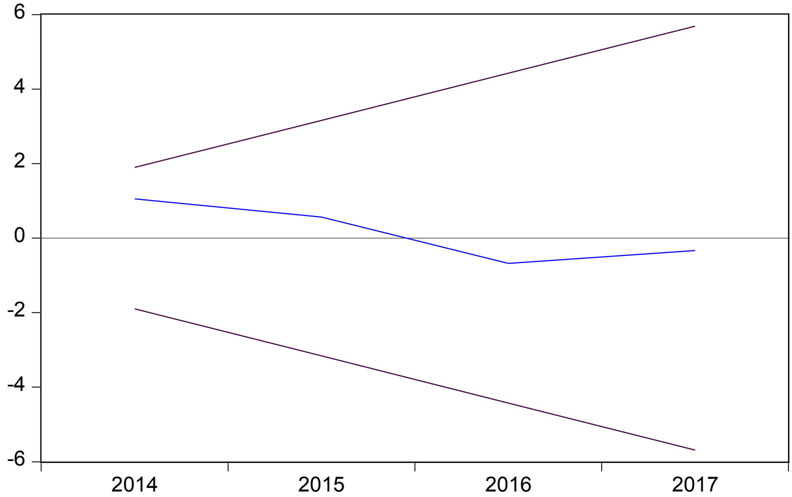

Fig. 6. *CUSUM test of the model for d(ln_cow_milk) at 5% significance level (model (4))*
Source: *Authors' calculations*

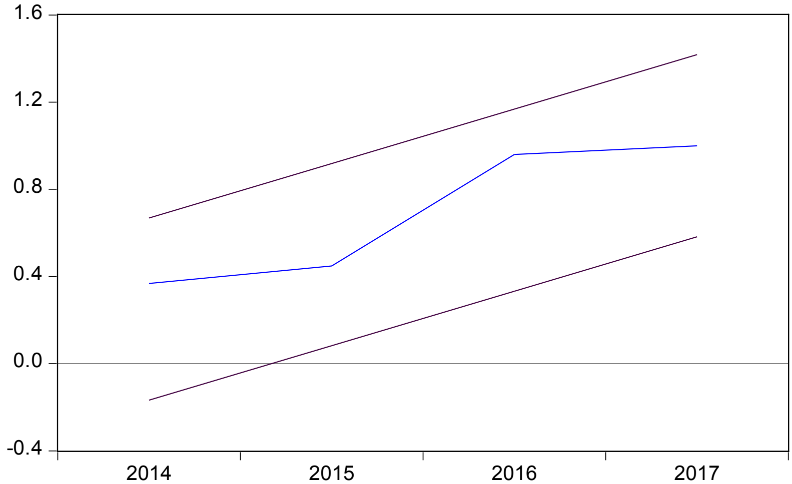

Fig. 7. *CUSUMSQ test of the model for d(ln_cow_milk) at 5% significance level (model (4))*
Source: *Authors' calculations*

The developed model for cow milk was highly significant (F-statistic = 43.4220; probability = 0.0012) (Table 4). R^2 of the model was 99.09%. According to the test for serial correlation (2 lags included) and heteroskedasticity test, there were no problems with the serial correlation and heteroskedasticity. Jarque-Bera test implied the residuals of d(ln_cow_milk) were distributed normally, CUSUM and CUSUMSQ tests indicated that the model was stable (Fig. 5 and Fig. 6). The dummy was with a high significance, showing that the years from 2007 to 2009 and 2015 influenced on cow milk production. Dummy's negative coefficient denoted a reduction in cow milk production as a sequence of the adaptation periods, following changes in agrarian policy.

Table 5. *Long-run and short-run estimates of the model for the produced cow milk (model (6) and (8))*

Variable	Coefficient	T-statistic (probability)
I. Long-run estimates (dependant variable ln_cow_milk)		
Intercept	-9.092165	-2.1914 (0.0935)
ln_dairy_cows	1.490854	6.9443 (0.0023)
ln_price_milk	0.0594	0.2560 (0.8105)
ln_milk_pr	0.787892	2.2696 (0.0858)
II. Short-run estimates (dependant variable d(ln_cow_milk))		
d(ln_cow_milk(-1))	0.091498	1.8240 (0.1109)
d(ln_dairy_cows(-1))	-1.213845	-8.0760 (0.0001)
d(ln_price_milk(-1))	-0.044736	-0.7523 (0.4764)
d(ln_milk_pr(-1))	0.314544	1.7193 (0.1293)
d(ln_milk_pr(-2))	-0.005795	-0.0330 (0.9746)
dummy_milk	-0.084318	-8.3315 (0.0001)
Intercept	-0.000008	-0.0012 (0.9991)
ect_milk(-1)	-0.919115	-19.1157 (0.0000)
Breusch-Godfrey Serial Correlation LM Test: Obs*R-squared (probability)	4.1699 (0.1243)	
Heteroskedasticity ARCH Test: Obs*R-squared (probability)	2.3871 (0.3031)	

Source: *Authors' calculations*

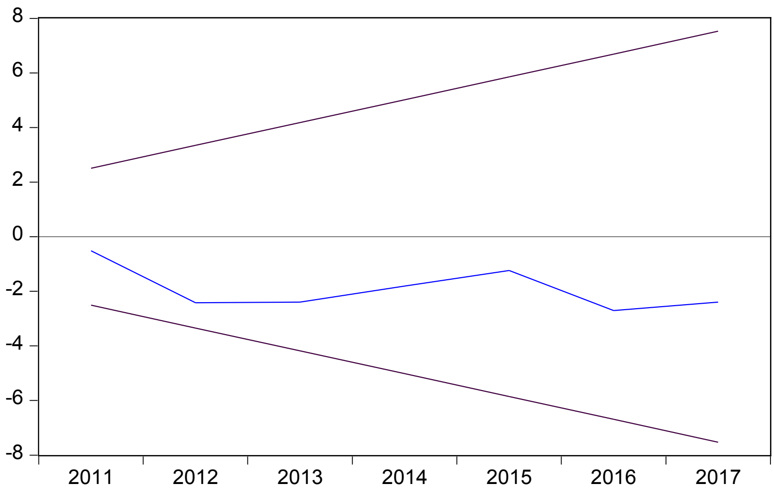

Fig. 8. *CUSUM test of the short-run model for d(ln_cow_milk) at 5% significance level (model (8))*
Source: *Authors' calculations*

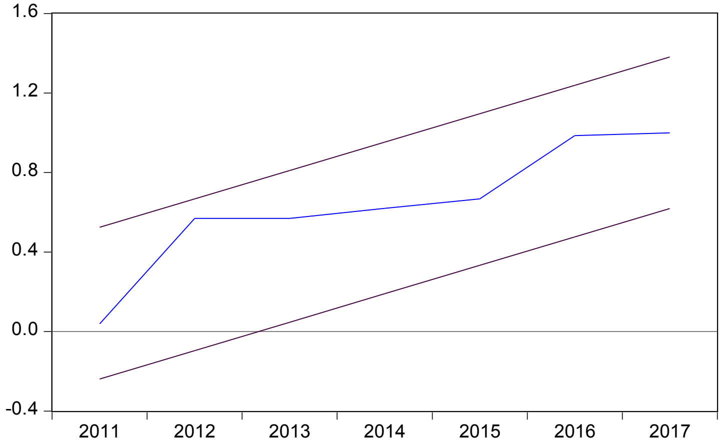

Fig. 9. *CUSUMSQ test of the short-run model for d(ln_cow_milk) (model (8))*
Source: *Authors' calculations*

Table 5 represents the long-run and short-run estimates of the regression model for the produced cow milk. Long-run coefficients showed that the production of cow milk was in a positive relation with the number of dairy cows, cow milk prices and the consumption of milk products.

The conducted Wald Test showed that, there was a short-run relationship between the cow milk production and dairy cows (null hypothesis: the coefficient of the lagged difference of milk cows was equal to zero; chi-square (probability) = 65.2223 (0.0000)). The speed of adjustment of cow milk production in long-run was 91.91%. The graphics of CUSUM test and CUSUMSQ were within the 5% confidence boundary interval (Fig. 7 and Fig. 8).

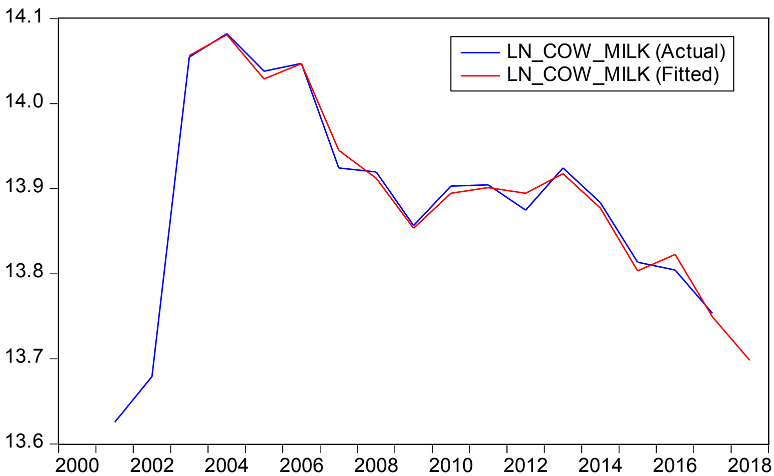

Fig. 10. *Actual and fitted logarithmic values of the produced cow milk*
Source: *Authors' calculations.*

Fig. 9 shows the actual and fitted values (method - static forecast) of the logarithmic values of the produced cow's milk. The calculated root mean squared error was a small number (0.010387), meaning that the model fits well to the observed values. The forecasted quantity of the produced cow milk in Bulgaria for 2018 stood at 889 334 thousand liters.

Conclusions

All coefficients in the cattle number long-run model had significance lower than 0.05, showing the cattle number was positively related with calves' price, yet negatively related with milk products consumption. Significant relations in short-run were observed between cattle number and: calves' price and consumption of milk products. The speed of adjustment was found to be 50.84%. The forecasted number of cattle in Bulgaria for 2018 stood at 541 530 heads.

Long-run coefficients in the second model for cow milk production denoted a positive association between production of cow milk and: the number of dairy cows, the prices of cow milk and the consumption of milk products. The conducted Wald Test showed that there was a short-run connection between the production of cow milk and dairy cows. The speed of adjustment of cow milk production in long-run accounted for 91.91%. The forecasted quantity of the produced cow milk in Bulgaria for 2018 was 889 334 thousand liters.

Dummies' coefficients were negative numbers, which suggests that the adaptation periods following changes in agrarian policy led to a decrement in cattle number as well as in cow milk production.

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