The Structural Effect of Cooperatives on Price Volatility in the European Dairy Sector

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Abstract

Theoretical models and empirical evidence suggest that high market shares of cooperatives can force investor-oriented firms to pay higher producer prices within a region. In the same vein, cooperatives may force investor-oriented firms to reduce price volatility. We use panel data from 27 European Union member states over the period 2001-2015 to investigate how the market share of cooperatives in a country affects milk price volatility. Our key finding is that a higher market share of cooperatives reduces price volatility at the national level. Volatility is influenced by a number of other

variables, such as fluctuation in raw milk production, oil price volatility spillover, and the number of dairy processors. Policy-makers should consider that the promotion of cooperatives might positively affect price stability in the dairy sector.

Keywords: Industrial organization; panel data; milk; competitive yardstick

1. Introduction

The 2009 and 2016 milk crises have raised concerns about the future of the European Union's dairy industry. Low farm-gate prices make it difficult for farmers to recover their costs which made many dairy farmers give up milk production (Pieralli et al. 2014; Zimmermann and Heckelei 2012). In addition, farmers face high price volatility, and they have to deal with short-term price fluctuation for several commodities (Bergmann et al. 2016; Fousekis et al. 2016). Such price risks make it difficult for farmers to plan ahead (Garrido et al. 2015; Harwood et al. 1999; Lien et al. 2006; Meuwissen et al. 2001).

Cooperatives have a market share of approximately 55% in the European Union dairy market (Hanisch et al. 2012). As farmer-owned and controlled organizations, cooperatives have a strong interest to provide a favorable business environment for long-term investments of their member-owners (Kloosterboer 2015). The competitive yardstick theory suggests that in oligopsonistic markets, cooperatives ensure higher farm-gate prices for agricultural produce within a region (Cotterill 1987; Liang and Hendrikse 2016; Sexton 1990), and recent empirical evidence supports these claims (Hanisch et al. 2013; Milford 2012). In the same vein, cooperatives could offer more stable prices to farmers, forcing investor-oriented firms to follow. As a consequence, regional prices would be more stable. In this paper, we use panel data from 27 European Union member

states to investigate the impact of national market shares of cooperatives in the dairy processing industry on price volatility. By doing so, we want to initiate a discussion on the different structural effects different farmer-organizations may have on price volatility.

2. Empirical Strategy and Data

We use yearly coefficients of variation (CV) from monthly national farm-gate prices as a measure of realized annual price volatility (Piot-Lepetit and M'Barek 2011)[1]. To explain volatility our main variable of interest is the turnover market share of cooperatives in raw processed milk (COOPSHARE) which is taken from an earlier study (Hanisch et al. 2013). We include several variables to control for additional drivers of milk price volatility (cf. Table 1). Fluctuations in the oil price may impact dairy production costs and therewith price volatility (Baffes 2011; O'Connor and Keane 2011). Likewise, national variations in the amount of supplied milk, given a constant demand for raw milk, should induce price changes. We use the annual coefficients of variation of monthly oil prices (CV_OIL_PRICE) and yearly milk production based on monthly data of raw milk deliveries to dairies as independent variables (CV_DELIVERY). We include in our models the national trade balance for milk (TRADE_BAL) and dummy variables indicating whether a country is in Southern Europe (SOUTH), with lower seasonal variations in dairy production, or a new member state (NEW_MS). We also include the year (YEAR) to control for a possible linear time trend. Lastly, the number of dairies per 1,000 tons of delivered milk (NUM_DAIRIES) is included to investigate the role of market concentration. Datasets are available upon request.

[1] Farm-gate milk prices were retrieved from https://dairy.ahdb.org.uk/market-information/milk-prices-contracts/farmgate-prices/eu-farmgate-milk-prices/
All other variables were taken from EUROSTAT or from (Hanisch et al. 2013).

Table 1: Summary statistics of variables for the pooled data

Variable Name	Description	N	Mean	Std. Dev.	Min	Max
CV	Yearly coefficient of variation of farm-gate milk prices per country	369	6.17	4.00	0.19	23.50
COOPSHARE	National market share of cooperatives in the dairy market	405	0.54	0.31	0.1	1
YEAR	Linear yearly time trend (2001 = 1; 2015 = 15)	405	8	4.33	1	15
CV_OIL_PRICE	Yearly coefficient of variation of Brent crude oil spot price	405	12.67	6.56	3.98	30.43
CV_DELIVERY	Yearly coefficient of variation of milk deliveries to dairies per country	377	9.17	9.53	3.07	52.99
TRADE_BAL	= (milk exports - imports)/total milk production per country	304	0.01	0.12	-0.49	0.45
SOUTH	= 1 if country from Southern Europe	405	0.26		0	1
NEW_MS	= 1 if new member state	405	0.33		0	1
NUM_DAIRIES	Number of dairies per 1,000 tons of delivered milk per country	245	1.23	2.59	0.02	14.62

Results

Table 2 displays regression results that use the coefficients of variation (CV) as the dependent variable. All models show a good fit and have high explanatory power. Column

(1) presents a fixed effects model, columns (2) and (3) present random effects models,[2] and (4) an ordinary least squared regression using the pooled data.

Table 2. Regression results

	(1) Fixed Effects Panel	(2) Random Effects Panel	(3) Random Effects Panel	(4) OLS Pooled Data
COOPSHARE [a]		-1.831*	-3.729***	-3.759***
		(1.203)	(1.382)	(1.279)
YEAR	0.032	0.066	0.175**	0.167**
	(0.055)	(0.050)	(0.080)	(0.080)
CV_OIL_PRICE	0.174***	0.178***	0.204***	0.205***
	(0.029)	(0.030)	(0.037)	(0.037)
CV_DELIVERY	-0.141	0.070**	0.079***	0.079***
	(0.132)	(0.029)	(0.028)	(0.025)
NEW_MS		-0.474	-1.154	-1.141
		(0.732)	(0.784)	(0.723)
SOUTH		-3.429***	-2.759***	-2.685***
		(0.783)	(0.937)	(0.861)
TRADE_BAL	0.370	0.306	-1.419	-1.117
	(3.167)	(2.083)	(2.964)	(2.839)
NUM_DAIRIES			-0.537**	-0.554**
			(0.234)	(0.224)
Constant	5.153***	4.824***	5.406***	5.436***
	(1.535)	(1.161)	(1.355)	(1.280)
N	298	298	189	189
R^2	0.120			0.317
Log lik.	-771.709			-504.538
χ^2		67.557	77.954	
F	9.127			10.451
R^2 overall	0.001	0.232	0.317	
R^2 adjusted	0.021			0.287
R^2 within	0.120	0.112	0.190	
R^2 between	0.104	0.586	0.635	

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; [a] We use a one-sided test for the hypothesis that $\beta < 0$ for this variable. Tests for all other variables are two-sided for the hypothesis that $\beta \neq 0$.

[2] A Hausman test (Hausman (1978)) does not reject the null hypothesis of non-systematic differences in coefficients between model (1) and corresponding random effects model (2), i.e., the random effects model provides efficient and unbiased estimates ($\chi 2 = 4.55$, $p = 0.3368$, $df = 4$).

The coefficient of our main variable of interest has a negative sign and is statistically significantly different from zero at the one percent level in models (3) and (4). The higher the national market share of cooperatives, the lower is the fluctuation of dairy prices in the market. Moving from a market with no cooperatives to a market that is fully controlled by cooperatives reduces the coefficient of variation by approximately 3.7 which would be equal to a decrease of approximately one standard deviation for most countries under investigation, as shown by models (3) and (4).

Other statistically significant drivers of milk price volatility are oil price volatility, variations in monthly milk deliveries, and being located in the South. Further, we find a time trend that shows that volatility has increased over the last 15 years.[3]

3. Discussion

We have found that a high market share of cooperatives has a positive effect on price stability in European dairy markets when controlling for several other market characteristics. This should be kept in mind in the discussion of ex-ante policy measures after the milk quota phase-out in 2015. Laws and regulation that positively affect dairy cooperatives might also reduce milk price volatility, which may further increase in the future. Similarly, if there is a relatively large number of dairies in a country prices are more stable. Consequently, competition may be targeted. Future research may investigate the impact of cooperative strength on price volatility in other sectors and regions. For such an endeavor, it may be useful to distinguish among different degrees of world market integration.

[3] We also tested for a policy-induced structural break in price movements after the phase out of the European milk quota regime. We did not find a statistically significant effect. Estimates are available upon request.

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Appendix

Table 3. COOPSHARE and mean coefficients of variation by country

Country	COOPSHARE	CV		
		Mean	Std. Dev.	N
Austria	0.95	6.49	2.59	15
Belgium	0.67	8.68	4.24	15
Bulgaria	0.1	5.56	2.02	7
Cyprus	0.1	1.96	0.82	13
Czech Rep.	0.66	4.88	3.75	14
Denmark	0.95	5.27	3.64	15
Estonia	0.345	6.82	5.00	13
Finland	0.97	7.26	2.51	15
France	0.55	7.03	2.48	15
Germany	0.65	6.64	3.79	15
Greece	0.35	2.98	2.77	15
Hungary	0.308	5.77	2.28	14
Ireland	0.99	8.29	4.30	15
Italy	0.42	2.63	1.95	15
Latvia	0.33	8.01	5.33	13
Lithuania	0.1	11.74	4.97	13
Luxembourg	0.1	7.94	3.59	15
Malta	0.91	4.06	2.01	11
Netherlands	0.8	9.33	4.90	15
Poland	0.72	7.45	4.24	13
Portugal	0.7	5.22	3.04	15
Romania	0.1	6.84	1.71	7
Slovakia	24.5	5.24	3.47	13
Slovenia	0.8	4.07	2.29	13
Spain	0.4	4.71	4.15	15
Sweden	1	5.14	3.69	15
United Kingdom	0.5	6.49	2.59	15