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Where is the butter? Tracking recent butter and curd price changes across major milk producing regions in Poland

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Abstract:

This paper analyzes prices of two important food products of consumers in Poland, namely butter and curd to establish market integration of these two very different products and the recent large increase of butter prices. Poland is the fourth largest milk producer in the European Union and a butter exporter. The analysis focuses on two major milk producing regions. The analysis uses series of weekly butter and curd prices for each region for the period from January 5, 2014 to November 5, 2017. Additionally, an indicator of the phasing of the EU milk quota system is included in the analysis. The modeling approach verifies the presence of "one price" by testing the series for stationarity and cointegration confirming the latter. Ultimately, the analysis uses the Vector Error Correction model and the first-differences of observations confirming very strong spatial integration of the two regional markets. Interestingly, the markets for both butter and curd in two regions remained strongly integrated although butter is subject to international trade, whereas curd is exclusively sold on the domestic market and its prices remained mostly unaffected by the butter price fluctuations.

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JEL Codes: Q13, Q02

#2608



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Introduction

Recent years have witnessed major fluctuations in prices of butter worldwide. Price fluctuations resulted from demand changes in two large markets, the United States and China. Those two countries were joined by Russia, which increased its imports since January 2017 following the trade embargo it imposed in August 2014. Developments on the supply side involved changes in managing the supply of milk in the European Union (EU) by terminating the production quota system in September 2016, and the modernization of the dairy industry in New Zealand, the world's largest butter exporter. Price increases in the world market offered opportunity for exporters, but given the lag response on the supply side, changes in trade volume affected domestic butter prices, especially in countries with large dairy industries. Among the latter is Poland, which is among the top 10 cow milk producers in the world and fourth in the EU. Butter and other dairy products play an important role in the diets of Polish consumers and the recent price increases were unwelcomed news.

Butter is the most popular dairy spread in Poland and used daily by the vast majority of households. Butter is also used in cooking but the use of vegetable oils has become more common. Butter is more expensive than vegetable oils or other animal fats and increasing concerns about health may have contributed to the reduction of butter use in cooking. Nevertheless, butter flavor is preferred by many consumers.

Monthly per capita butter consumption declined by about 19% between 2000 and 2012 (Figure 1), but has been stable in recent years. However, per capita consumption of vegetable oils has been steadily declining between 2000 and 2015 (Figure 1). Its consumption decreased

by more than 26% in per capita terms suggesting the relative increase of the importance of butter. Interestingly, the monthly per capita consumption of cheese and curd, which is produced from the same raw material, cow's milk, shows a different pattern between 2000 and 2015 (Figure 1). Between 2010 and 2012, consumption increased but subsequently showed a tendency to decline since 2012. Curd has been very popular and is eaten fresh and in numerous dishes in Poland. Indeed, at the time of transition from the centrally planned to market economy (1989-1990), following price liberalization the low-fat curd price remained under price control for a short period (together with a few other food products) because of its importance in diets, especially of low income households. Curd is still consumed in substantial volumes in Poland, but its consumption varies by regions. In contrast to butter, curd is a more perishable product, which cannot be stored long term, for example frozen, without a substantial loss of sensorial quality.

Milk production can thrive if there is adequate processing capacity. Traditionally, dairy processing plants have been common in milk producing regions. However, once the price liberalization took place in 1989, farmers responded by re-allocating resources to production of more profitable commodities. The following shift in regional milk production (Sobczyński et al., 2014) led to closure of some processing plants. The EU milk quota system (abolished only in September 2016) limited milk production and discouraged, even penalized, over-quota production. As a result, a wave of consolidations followed and markedly reduced the number of milk and dairy companies operating in the country. Some regions saw a near extinction of dairy farming.

The focus in the current study is on the northern and central regions. Both are leading regions in milk production in Poland, but the central region is a net importer of milk and dairy products because of the location of the two largest urban areas, Warsaw and Łódź. The northern region includes the two sparsely populated voivodships of Podlaskie and Warmińsko-Mazurskie.

The weekly regional wholesale butter and curd prices permit examining the integration of the two regions leading in milk production in Poland. The absence of integration may affect the prices that dairy farmers receive, while consumers may be paying prices higher than under conditions of full market integration. Indeed, the transmission of gains from cost-saving milk producing technology may be absorbed by dairy processors and the increasingly concentrated food retailing associated with the expanding presence of supermarket chains.

The regions differ in per capita income, with the northern region characterized by incomes below the national average, while the central region includes the area with the highest per capita income in the country. Therefore, any price changes of the two products translate into much different effects on consumers. The period under consideration begins on January 5, 2014, and ends on November 5, 2017. The period is characterized initially by low inflation, followed by an extended period of deflation, and only recently the inflation rate increased to nearly two percent annual rate (www.bankier.pl, 2018).

Butter and curd consumption in Poland

Butter and curd consumption varies across types of households and rural versus urban household location. The reported per capita amounts of butter and curd are based on the household panel maintained and surveyed by the Main Statistical Office (GUS) and are not

directly comparable to national monthly per capita consumption figures already mentioned. However, the panel data provide interesting insights because they allow seeing differences across different population segments.

Between 2013 and 2015, rural households ate less butter (about 21% less) and curd (from 19% to 21% less) than urban households (GUS, 2014; 2015; 2016). Among rural residents, the consumption of both products was stable, while there has been a slight increase in per capita butter consumption among urban residents. When household employment status is taken into account, the monthly consumption amount varies substantially. Households of consumers working for wages reported eating about 22% less butter than households of retired or disabled consumers between 2013 and 2015 (GUS, 2014; 2015; 2016). Households of the self-employed ate from 12% to 17% more butter than those working for wages. Surprisingly, retired or disabled consumers ate relatively more butter than self-employed or employee households reflecting the strong preference for butter, perhaps the influence of the permanent shortage of butter experienced earlier in life.

Curd consumption was increasing in all three household types in the period 2013-2015 (GUS, 2014; 2015; 2016). The highest consumption was in households of retired or disabled consumers, 0.80 kg monthly per capita in 2015, or about 7% more than in 2013. In households of the self-employed, the increase was similar during that period, but in households of consumers employed for wages the increase was only 4% (GUS, 2014; 2015; 2016). It appears that the relative importance of curd is higher for households of retired or disabled consumers as compared to the other two household types.

The average per capita monthly consumption of butter and curd is reported for each voivodship, but not for dairy price reporting regions (Figure 2). Four voivodships form Northern region and two are included in Central region. Among the four from the North, the average per capita butter consumption in Podlaskie Voivodship is the lowest among all 16 voivodships and amounted to 150 g per month between 2014 and 2016 (GUS, 2017). Also, in Warmińsko-Mazurskie the consumption was low and stable during that period, 200 g per month. The butter consumption was higher in Kujawsko-Pomorskie, where it grew from 210 g to 250 g between 2014 and 2016, but it was still below the national average of 280 g per capita per month in 2016. In contrast, in two voivodships forming Central region, per capita consumption on Łódzkie Voivodship matched the national average each year during the period 2014-2016. In Mazowieckie, the average monthly consumption ranged from 230 g in 2014 to 250 g in 2016, the level below the national average, but, generally, higher than in voivodships located in Northern region.

During the period 2014-2016, the monthly average per capita curd consumption in Podlaskie and Warmińsko-Mazurskie Voivodships was among three lowest in all regions in Poland (GUS, 2017), and substantially below the national average; 14% and 13% less, respectively. The consumption was about 5% lower in Kujawsko-Pomorskie Voivodship, and only in Pomorskie Voivodship the consumption exceeded the national average among all Northern region voivodships. In Central region, per capita consumption of curd often exceeded the national average between 2014 and 2016.

Butter export and import in Poland

The EU is the second largest butter exporter in the world following the undisputable lead of New Zealand between 2012 and 2016 (FAO, 2016). Australia and the United States have also exported butter, but the volume exported has been steadily declining during the aforementioned period, with United States exports declining by more than 73%. Poland's butter exports are included in the EU totals. Polish butter exporters were temporarily affected, like the EU as a whole, by the trade embargo imposed by the Russian Federation in August 2014. Poland was the fourth largest butter producer in the EU following France, Germany, and the Netherlands during the period 2014-2016, and was the only country among the top four that steadily increased butter production. The importance of Poland in butter production matches the country's position in total cow milk production in the EU and the domestic expansion of the dairy sector.

The volume of butter exported from Poland was declining between 2014 and 2017. In 2014 Poland exported about 36 thousand tons of butter, and 52 thousand tons in 2017 (IERGZ, 2017). Poland also imported butter throughout the period, most likely because the supermarket chains sourced butter from their suppliers, who could be located in any EU country. The imports were part of supermarket chain shipments and not always involved Poland-based dairy processors or distributors. The volume imported was fairly stable between 2014 and 2016 and amounted to about 14-16 thousand tons annually. The net trade in butter was positive through 2016, but is estimated to be negative in 2017. Since the final figures are not yet available, the net balance estimate suggests that imports exceed exports by 18

thousand tons (IERGZ, 2017) It is possible that the imports led to the decrease on butter prices in the late 2017 (Figure 3).

Data

Regional differences across dairy farms based on the annual FADN data (Sobczyński et al., 2014) are not matched by the publicly available wholesale price data. The latter are weekly observations, available on a regional basis, but the regions for butter and curd prices differ (Figure 2) from the four FADN regions.

Prices of butter and curd are recorded weekly in each voivodship and averaged for each region (Figure 2). The northern region encompasses the following voivodships: Podlaskie, Warmińsko-Mazurskie, Kujawsko-Pomorskie, and Pomorskie, while the central region includes Mazowieckie and Łódzkie. Mazowieckie is the leading dairy producing voivodship in Poland, taking advantage of natural conditions and the largest domestic food market located in Poland's capital, Warsaw. Podlaskie is the second largest milk producing voivodship, while Mazursko-Warmińskie also has a number of dairy farms and favorable natural conditions. An average price for the country as a whole is also calculated and recorded by the Central Statistical Office.

Price records are for wholesale prices and quoted per 100 kg for butter and curd. At retail, butter is usually sold in 250g packets, although smaller packets have become available. Curd is sold in various size packets or containers at retail, typically ranging from 100g to 500g with the 250g packet being most common. Curd fat content varies from "whole" to "fat free" with the "half fat" being sold most often. This study uses a total of 194 weekly observations for the northern and central regions as well as Poland as a whole for the period from January 5,

2014 to November 5, 2017. Six observations are missing in the series because the data were either not collected or not published by the government agency.

Prices of butter have been slowly decreasing from January through the middle of the summer in 2014 only to noticeably drop following the trade embargo announcement by Russia (Figure 3). The decline continued until May 2016, with a short recovery in late 2015. Between June 2016 and October 2017, there were two waves of butter price increases. The first started in June 2016 and peaked in January 2017. After a short hiatus, butter prices resumed their upward trend in April peaking in October 2017, when they began a rapid decline. It is quite likely that domestic butter prices and prices in the two regions responded to external developments, which included large purchases of butter by the United States and China that coincided with the modernization of dairy herds in New Zealand. Additionally, from January through May 2017, Russia has increased butter imports, and although the imports did not originate from countries covered by the embargo, they affected butter prices worldwide.

Curd prices showed quite different behavior than butter prices during the period under consideration (Figure 4). For more than two years, from January 2014 to May 2016, the prices showed a decreasing tendency observed also in the case of butter prices. However, since May 2016, butter prices rapidly increased, but curd prices remained stable showing sideways movements, with no clear increasing or decreasing tendency. The lack of any rise of prices reflects the perishable nature of the product, the stability of consumer preferences, and the largely unchanged consumption of curd and products using it as an ingredient. The sensorial specificity of curd also makes it an unattractive export commodity since consumers tend to prefer local or regional curd with familiar tastes and textures.

The difference in curd prices as compared to butter is associated with distinguishable price levels between the central and northern regions. The lower curd prices in the northern region appear to have been quite stable, whereas curd prices in the central region have declined somewhat during the considered period. The gap between curd prices in the two regions was much wider at the beginning of the period than towards the end (Figure 4). The slow narrowing of the price gap may reflect the growing integration of markets over time.

Modeling approach

The aim of this paper is to examine spatial integration of butter and curd prices in two neighboring regions, both with large dairy sector, but one being a surplus region (Northern), while the other is a deficit region (Central). The study basically applies a model proposed by Richardson (1978), which describes the relationship between prices of the same commodity between two markets as:

$$P_{it}^1 = \beta_0 P_{it}^2 \beta^1 T_{it} \beta^2, \quad (1)$$

where P_{it}^1 and P_{it}^2 are prices for butter (or curd) in time t in markets 1 and 2; T_{it} is transfer and transactions costs of butter (or curd) between the two regional markets.

Price analysis begins with the tests of individual price series to establish the series stationarity. In absence of stationarity, the estimated model may lead to spurious results and erroneous interpretation. If non-stationarity is detected the series are tested for cointegration. Given the plots of price data, the cointegration of price series is likely and allows for the application of Vector Error Correction (VEC) model. Prior to the estimation of the VEC models, the Granger causality test is applied to check the ability of any price series in forecasting behavior of another price series. Cointegration may imply causality between a pair of variables

(Granger, 1988). The causality in this study is considered between prices of butter or curd in Central and Northern regions and the test will verify if causality can be detected and establish its direction, for example, uni- or bi-directional. Indeed, given the proximity of both regions transportation costs should not be an obstacle in shipping either butter or curd from one region to another, but testing is necessary to confirm that observation.

Finally, given the presence of external shocks resulting in the rapid ascend of butter prices, the analysis performed in this study includes the simulation of the impulse response. The impulse response is used in time-series analysis and traces the effects of the shock over time. Should, for example, Central region market experience a shock, it should evoke response in Northern region market.

Results

The first step was to apply unit root test to individual series to verify whether they were stationary (MacKinnon, 1996). Results of the augmented Dickey-Fuller (ADF) test showed that the two butter price series and two curd price series have unit roots in levels.

Next, the series were tested again in first differences and they rejected the hypothesis that the series had unit roots.

As the series were non-stationary, the price series of butter and curd for Central and Northern regions were subject to tests establishing whether they were cointegrated. The test involved five different specifications, namely: considering the intercept and trend, and linear and quadratic functional forms. The applied test indicated the cointegration in the case of all price series at the preselected 5 % significance level (MacKinnon-Haug-Michelis, 1999).

The application of the Granger causality tests yielded results suggesting bi-causality and implied that both series for each food product, butter and curd, from one region can be used in forecasting the behavior of prices in the other region (Table 1). Consequently, the lagged prices (in first- differences) were included in the specified VEC equations. A binary variable indicating the phase out of the EU milk quota system was also included starting in March 2015; that is it accounts for possible reaction of dairy producers to the anticipated termination of the quota that took place in September 2016 (Table 2 and Table 3).

To simulate the interaction of the series in the VEC system and understand their dynamics (e.g., persistence of a shock), the impulse response to one-standard deviation shocks generated from the VEC model were performed (see Figures 5 and 6). The response of butter prices in Northern region is initially slightly different than in Central region, but it takes about the same amount of time for butter prices in both regions to return to equilibrium. Prices of curd in Northern region also seem to react initially in a different way to the shock than in Central region. However, eventually, after about the same period curd prices return to equilibrium in both regions. However, in a space of about one week following the shock, the prices in both regions may behave differently, but by the fourth week the disturbances diminish. Because prices return to equilibrium within a four week period, while only in the first week they may behave differently, there is inadequate amount of time for any market participant to take advantage of such short term price distortion. Taking advantage of price behavior is further limited by the increasing share of the supermarket chains in the food retail sector and the contracts on delivery of butter and curd with the dairy processors.

Concluding remarks

Poland is one of the top cow milk producers in the EU. Dairy farming and processing is concentrated in a few regions (Sobczyński et al., 2014). Two top milk producing areas are Mazowieckie and Podlaskie Voivodships. They are included in Central and Northern regions, respectively, that form dairy price reporting districts (Figure 2). Among dairy products, butter is the primary dairy spread and curd is a common food in diets of the majority of consumers in Poland. A recent, sudden increase in butter prices turned the country into a net importer of butter in 2017. Butter imports were encouraged by the price increase. Curd prices, however, did not show a similar price changes during the considered period and remained largely unaffected.

Results show both products in the two regions to be strongly integrated. The price transmission is 0.99 in the case of butter prices between two regions and 1.08 in the case of curd prices. The effect of abolishing the EU milk quota had the opposite effect on butter prices causing them to decrease, but it had a positive effect on curd prices. The dynamic simulation of price reaction to an external shock suggests that the prices of butter and curd adjust within four weeks, although the path of adjustment varies and is smoother in the case of butter prices. The short period of price deviation from equilibrium and a very short period of prices behaving differently in both regions do not offer adequate opportunities for gains from price changes. Additionally, the increasing importance of supermarket chains, many of them operating on a international scale, and the use of contracts for delivery of dairy products may indirectly prevent any lasting price distortions.

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Table 1. Pairwise Granger Causality Test results.

Butter				Curd			
Sample: 1 201 Lags: 14				Sample: 1 201 Lags: 14			
Null Hypothesis:	Obs	F-Statistic	Prob.	Null Hypothesis:	Obs	F-Statistic	Prob.
P12 does not Granger Cause P11	187	4.30867	0.0000	P22 does not Granger Cause P21	187	1.79152	0.1811
P11 does not Granger Cause P12		2.74802	0.0012	P21 does not Granger Cause P22		2.3031	0.1271
Note: P11=Central region butter prices; P12=Northern region butter prices; P21= Central region curd prices; P22= Northern region butter prices							

Table 2. Vector Error Correction regression results for prices of curd in Central region in Poland.

Sample (adjusted): 4 201		
Included observations: 198 after adjustments		
Standard errors in () and t-statistics in []		
Cointegrating Eq:	CointEq1	
LP21(-1)	1	
LP22(-1)	-1.080458	
	-0.25468	
	[-4.24238]	
Intercept	0.440823	
Error Correction:	D(LP21)	D(LP22)
CointEq1	-0.230183	0.1742
	-0.06622	-0.04747
	[-3.47616]	[3.66977]
D(LP21(-1))	-0.441216	-0.08237
	-0.07995	-0.05731
	[-5.51857]	[-1.43716]
D(LP21(-2))	-0.219427	-0.117344
	-0.07129	-0.0511
	[-3.07798]	[-2.29615]
D(LP22(-1))	-0.03617	-0.218505
	-0.10587	-0.07589
	[-0.34165]	[-2.87907]
D(LP22(-2))	-0.043659	-0.050163
	-0.10015	-0.07179
	[-0.43594]	[-0.69870]
Intercept	0.008827	-0.007107
	-0.00373	-0.00267
	[2.36934]	[-2.66109]
DQUOTA	-0.013581	0.010072

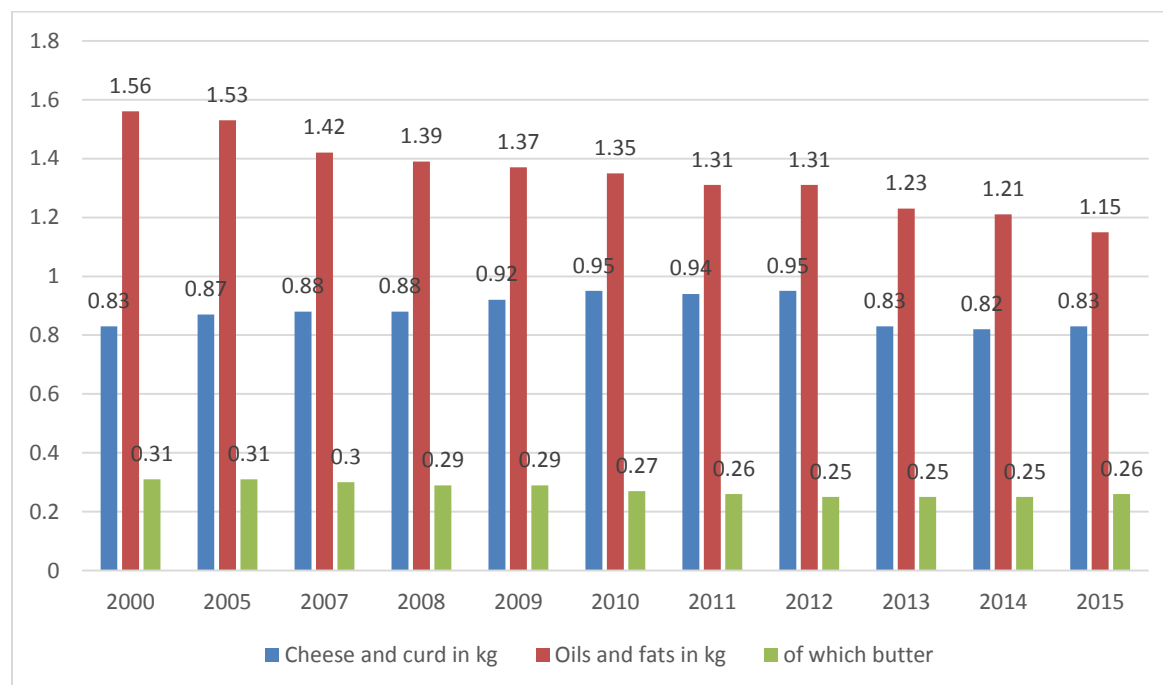
	-0.00484	-0.00347
	[-2.80770]	[2.90463]
R-squared	0.312965	0.17877
Adj. R-squared	0.291383	0.152973
Sum sq. resids	0.069129	0.035525
S.E. equation	0.019025	0.013638
F-statistic	14.50104	6.929676
Log likelihood	507.0947	573.0024
Akaike AIC	-5.051462	-5.717196
Schwarz SC	-4.93521	-5.600944
Mean dependent	-0.000609	0.000103
S.D. dependent	0.0226	1.48E-02
Determinant resid covariance (dof adj.)		6.62E-08
Determinant resid covariance		6.16E-08
Log likelihood		1081.717
Akaike information criterion		-10.76482
Schwarz criterion		-10.4991

Table 3. Vector Error Correction regression results for butter prices in Central region in Poland.

Sample (adjusted): 4 201		
Included observations: 198 after adjustments		
Standard errors in () & t-statistics in []		
Cointegrating Eq:	CointEq1	
LP11(-1)	1	
LP12(-1)	-0.991243	
	-0.01247	
	[-79.5083]	
Intercept	-0.087263	
	-0.09166	
	[-0.95204]	
Error Correction:	D(LP11)	D(LP12)
CointEq1	-0.187467	0.282365
	-0.09545	-0.06663
	[-1.96408]	[4.23779]
D(LP11(-1))	-0.169814	0.030962
	-0.10253	-0.07158
	[-1.65620]	[0.43257]
D(LP11(-2))	0.034337	0.121629
	-0.08559	-0.05975
	[0.40117]	[2.03562]
D(LP12(-1))	0.434961	0.176198
	-0.10662	-0.07443
	[4.07964]	[2.36738]
D(LP12(-2))	0.424332	0.18897
	-0.10046	-0.07013
	[4.22374]	[2.69450]
DQUOTA	-0.001852	0.005106
	-0.00228	-0.00159
	[-0.81222]	[3.20775]

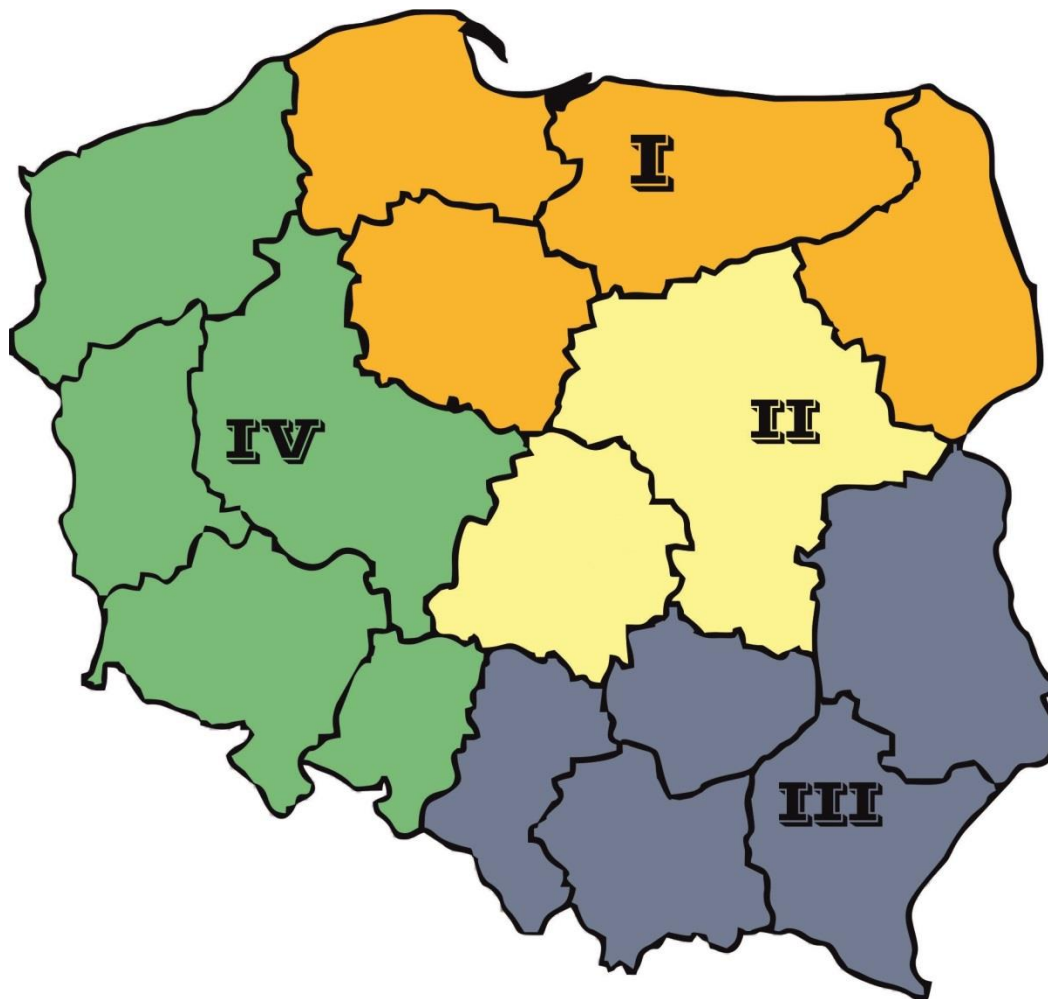
R-squared	0.273308	0.379528
Adj. R-squared	0.254383	0.36337
Sum sq. resids	0.08165	0.03979
S.E. equation	0.020622	0.014396
F-statistic	14.44216	23.48839
Log likelihood	490.6143	561.7795
Akaike AIC	-4.895094	-5.613934
Schwarz SC	-4.795449	-5.51429
Mean dependent	0.001614	0.001651
S.D. dependent	0.023882	0.018042
Determinant resid covariance (dof adj.)		7.14E-08
Determinant resid covariance		6.72E-08
Log likelihood		1073.217
Akaike information criterion		-10.68906
Schwarz criterion		-10.43995

Figure 1. Average monthly per capita consumption of cheese and curd, vegetable oil, and butter in Poland, 2000—2015.



Source: GUS (Central Statistical Office). Household budget survey in 2015. Warsaw 2016.

Figure 2. Price reporting regions for butter and curd in Poland.



Legend: I – Northern region; II – Central region; III – Eastern region; IV – Western region

Note: Northern and Central regions are the focus of the study.

Source: http://geo_polska.republika.pl/mapa.gif (accessed January 2018)

Figure 3. Weekly prices of butter in 100 kg blocks in the country and two regions, January 5, 2014- November 5, 2017, in zlotys.

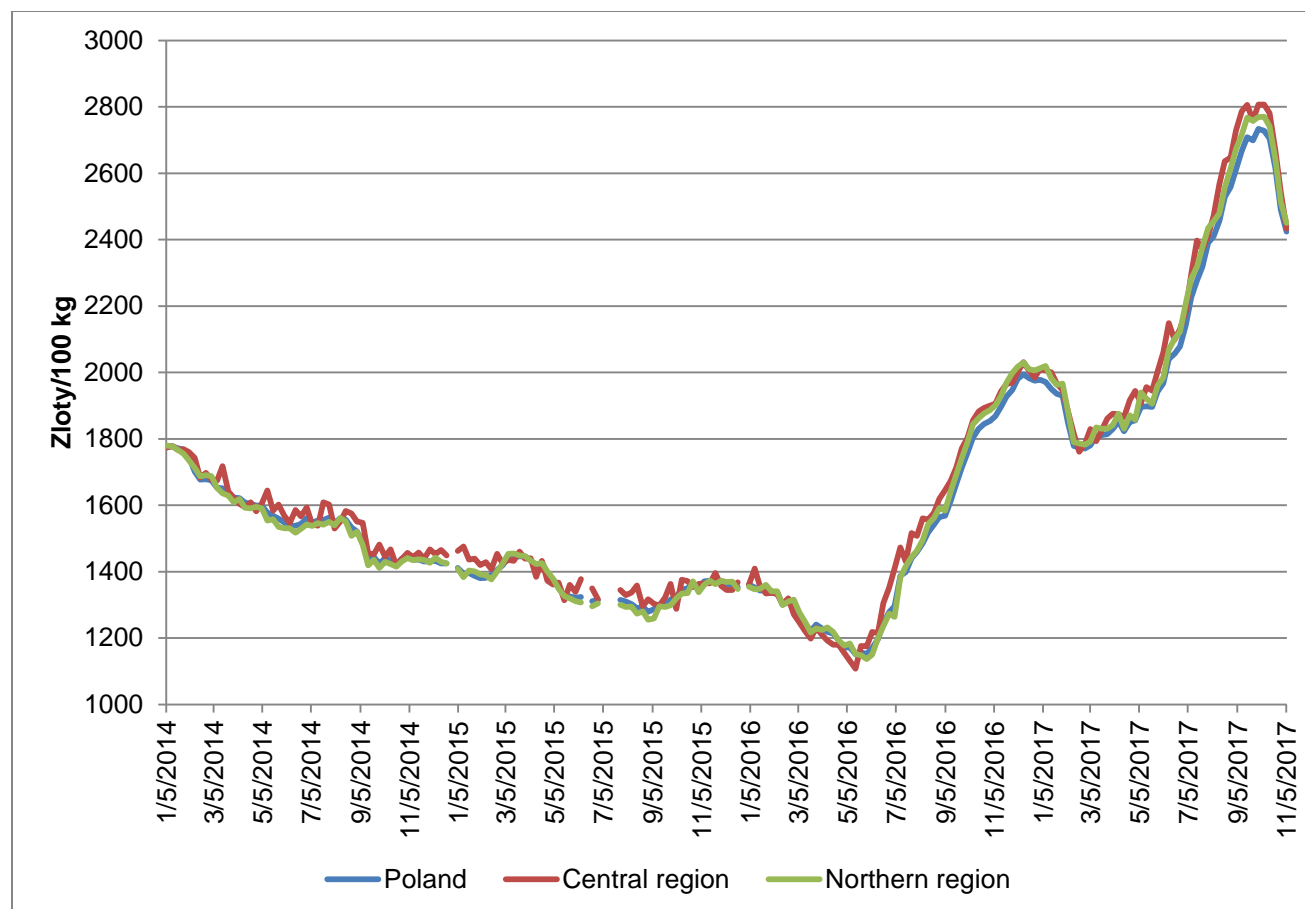


Figure 4. Weekly prices of curd per kg in the country and two regions, January 5, 2014-November 5, 2017, in zlotys.

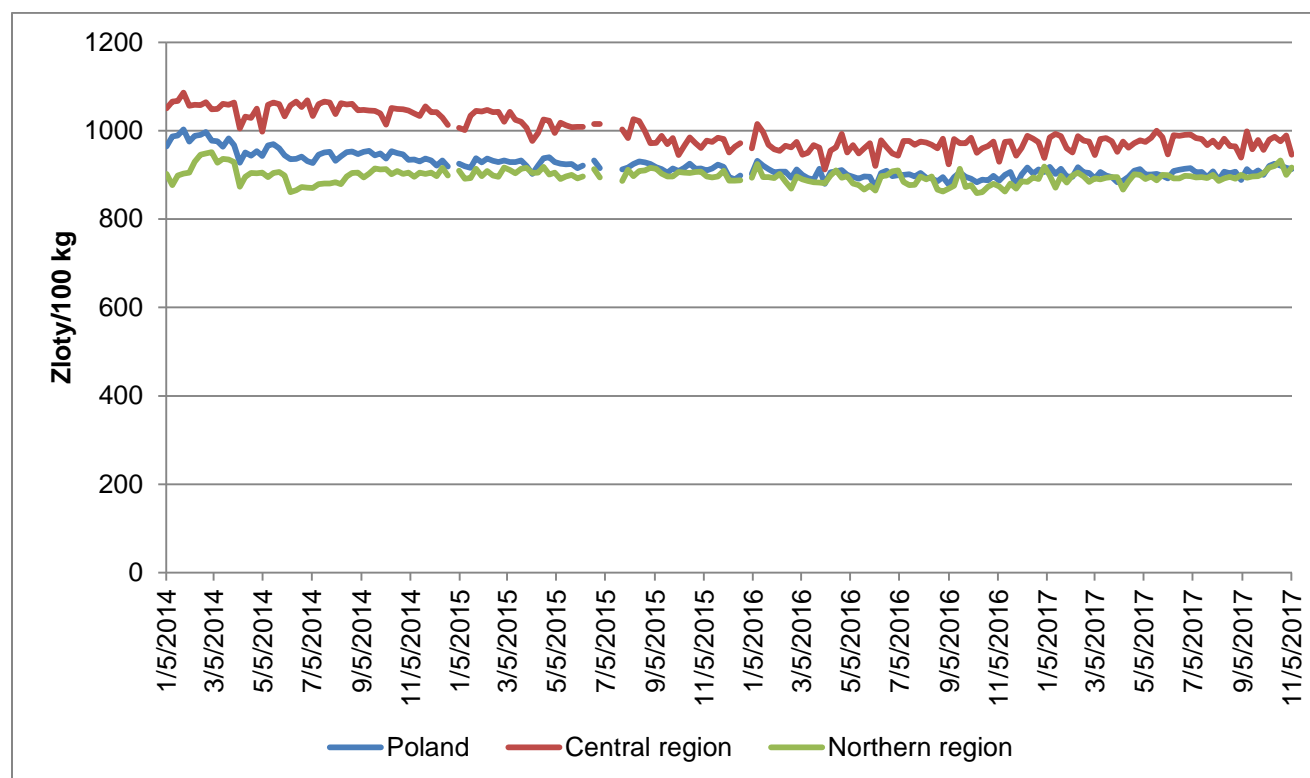
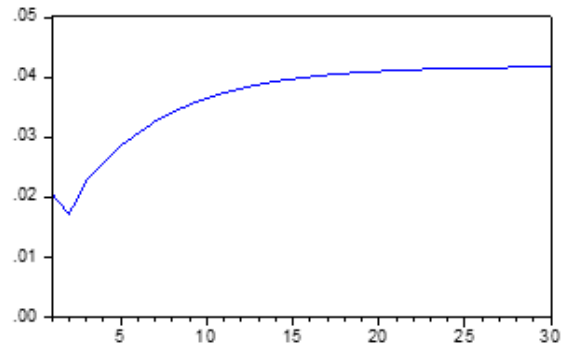
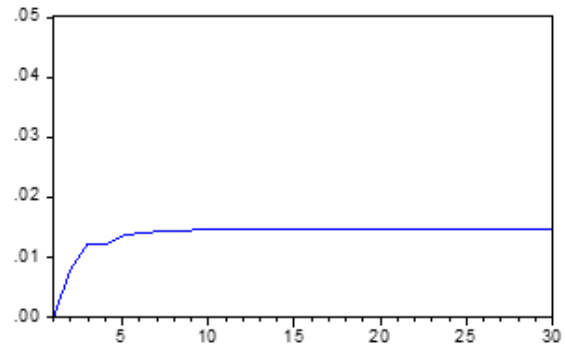


Figure 5. Impulse response estimates for butter in blocks prices in Central and Northern region, Poland, January 5, 2014-November 5, 2017.

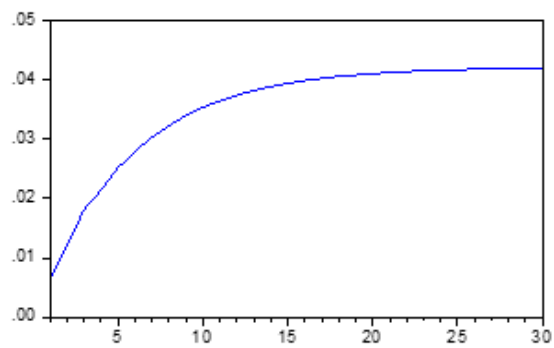
a. Response of butter prices in Central region to region's lagged butter prices



b. Response of butter prices in Central region to lagged prices in Northern region



c. Response of butter prices in Northern region to lagged prices in Central region



d. Response of butter prices in Northern region to region's lagged prices

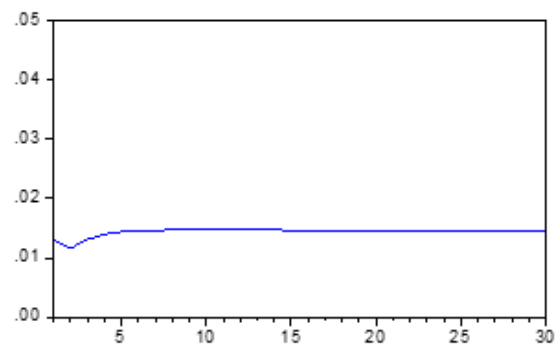
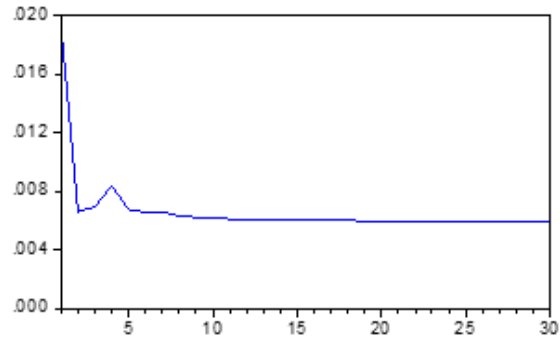
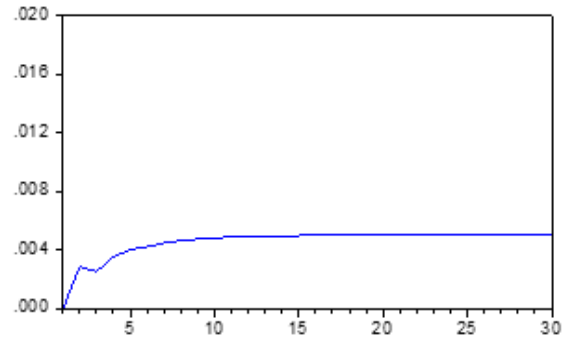


Figure 6. Impulse response estimates for curd prices in Central and Northern region, Poland, January 5, 2014-November 5, 2017.

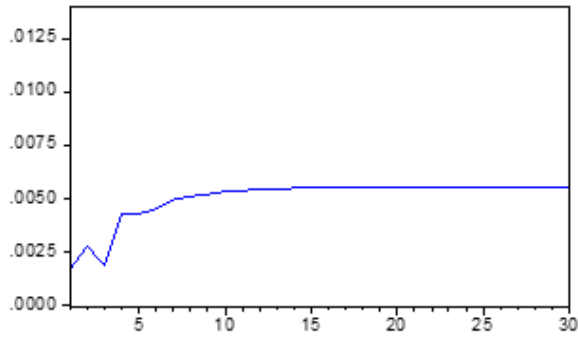
e. Response of curd prices in Central region to Region's lagged butter prices



f. Response of curd prices in Central region to lagged prices in Northern region



g. Response of curd prices in Northern region to lagged prices in Central region



h. Response of curd prices in Northern region to region's lagged prices

