p-ISSN 0044-1600
e-ISSN 2392-3458

Problems of Agricultural Economics

www.zer.waw.pl

4(345) 2015, 59-79

DOI: 10.5604/00441600.1184587

MARIUSZ HAMULCZUK
PIOTR SZAJNER
Institute of Agricultural and Food Economics
– National Research Institute
Warsaw

SUGAR PRICES IN POLAND AND THEIR DETERMINANTS

Abstract

The sugar market in the EU is among the most regulated food markets in the world. This regulation is based on production quotas and foreign trade regulations. At the same time, individual links of the marketing chain are characterised by highly varied degree of concentration, which – in the conditions of strong market protection – creates the potential for monopolistic practices and the so-called monopolistic margins. In this context, the paper aims at empirical assessment of changes in sugar prices in Poland and identification of their determinants. The study was based on monthly sugar prices in Poland, the EU and across the world in 2000-2014. Time series models were used to assess correctness. The conducted research indicates that sugar production and prices in Poland and in the EU are largely determined by the market regulation system, while the sugar market reform had little effect on increasing the interrelations between the EU prices and world prices. At the same time, the retail and selling prices are strongly interrelated and these interrelations can be non-linear.

Key words: sugar, market, prices, marketing chain, price transmission, econometric model, price relations

Introduction

Sugar is presently the basic sweetener in the food economy, despite development of the market of other sweeteners (e.g. starch syrups). The sugar industry still has great economic importance and in many countries it is considered as strategic section of the agri-food sector, which is one of the arguments for the analysis of changes in the mechanisms underpinning the changes in sugar prices.

Sugar production has always been supported by protectionist market policy. The sugar market in most of the countries is among the most regulated food markets and sugar industry is characterised by strongly concentrated business breakdown structure. A small number of producers manufacturing a homogenous product create a market structure of a classic oligopoly. Because of the liberalisation of the world trade in agri-food products in 1995-2000, globalisation processes, reform of regulations in 2006-2010 and numerous bilateral agreements with economically developing countries, the EU and the national sugar markets are increasingly more linked to the world market (Szajner and Hryszko, 2013).

With reference to the above, the paper aims to present the mechanisms of price formation in the sugar sector and to conduct an empirical analysis of trends in producer and retail prices in Poland and their interrelations with the prices in the EU and across the world. It is important to attempt to answer the question about the role of economic policy, including sugar market reform, in the process of price formation in Poland and in the EU. The first part of the paper described the economic conditions of sugar market operations and the second, presents results of empirical studies regarding formation of sugar prices in the marketing chain and in the spatial dimension (international).

Institutional and market determinants of sugar prices

Sugar is one of the products that played a significant part in the global economic development. This concerns changes in agriculture, food industry, foreign trade and food demand structure. Sugar cane is among the crops that changed the face of the world (Hobhouse, 2001). Sugar cane cultivation has a long-lasting tradition but the world and European sugar market began to form in the 17th century, when large quantities of cane sugar were imported to Europe (Łuczak, 1981). Sugar sector based, on sugar beets, started in Europe in the 19th century and thus began the competition between cane and beet sugar lasting to this day.

In Poland, sugar sector has a long history, as the first in Europe sugar factory processing sugar beets was built in 1801 in Lower Silesia. Dynamic development of the sector took place in the interwar period supported by statutory market regulations. In the centrally planned economy, sugar sector was among the strategic sections of the economy and sugar industry went under the state's management. The state's monopoly eliminated competition between sugar factories and the inefficiency of the sector (market) was manifested in temporary supply shortages, which were to be tackled by rationing systems and official prices (Wykrętowicz, 1997). In the period of political and economic changes in the 1990s, the sugar sector underwent a process of deep ownership, structural and modernisation changes that can be broken down into several stages. The first stage consisted in ownership transformations and introduction of the market regulation system. The next stage was the EU integration and adoption of the EU market regulation system, reformed in 2006-2010. As a result of

restructuring, the number of sugar factories dropped from 76 in 2001 to 18 in 2009-2015, which are working in the structures of four consortiums. The production potential of the sugar industry amounts to ca. 2 million tonnes and is slightly lower than in 1990s, because the sugar production per one sugar factory increased over fivefold, up to 110 thousand tonnes (Szajner and Hryszko, 2013).

The marketing chain in the sugar market is complex, which follows both from characteristics of sugar as a consumer product and applied market regulations. In Poland, sugar is a sweetener used in the food industry, households and other sections of the economy. As a result, very diverse distribution systems can occur and longer or shorter marketing chains determining the process of price transmission. The supply chains start with cultivation of sugar beets, which are processed under the campaign lasting ca. 120 days in the sugar industry. The supply side is supplemented by white sugar import, which is intended for consumption, and raw sugar import, which is subjected to refining. Sugar distribution from sugar industry is divided into wholesale trade, food industry (understood as sections of secondary food processing) and export. Food industry and wholesale trade can acquire white sugar also from import, which is favoured by free movement of goods in the EU market and preferential import quotas awarded to third countries. The last stage of distribution is retail trade which offers sugar and sugar-sweetened foods to households (Fig. 1). The prices of processed foods containing sugar are not researched by the authors for this paper.

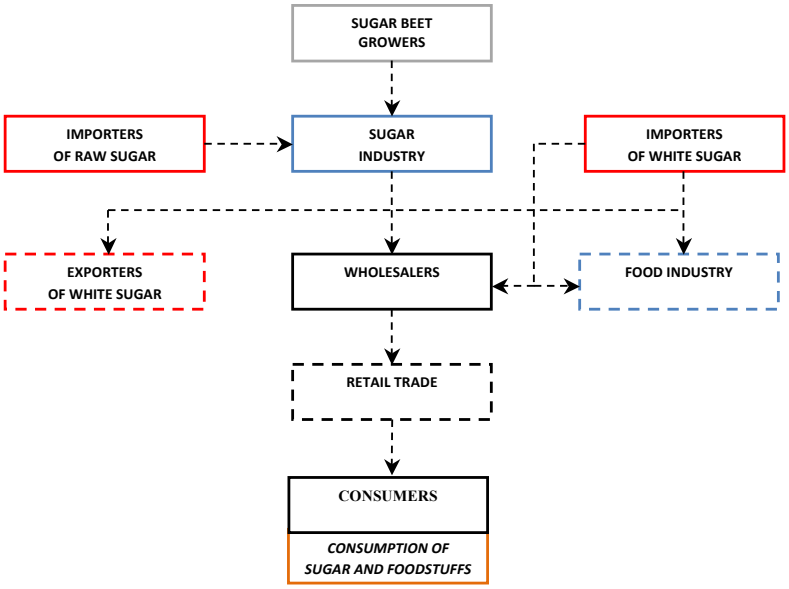

Fig. 1. A scheme of the sugar marketing chain.
Source: own study.

Sugar prices in Poland result from varied factors, both market and institutional ones. Market factors include supply relations (production, import) and demand relations (consumption, export), which – due to progressing openness of the markets – should consider the situation in external markets. The market factors comprise also oligopolistic market structure, including especially the model of oligopoly functioning. The strength and directions of impact of the listed market determinants are largely conditioned by the market policy.

The market is the fundamental category of microeconomy and it is defined as a set of mechanisms leading to mutual agreement of decisions of consumers and producers via prices (Rembisz and Kowalski, 2005). The key role in the aforementioned definition belongs to supply- and demand-side relations manifested in prices. Defining an industry as a group of producers and traders results in identifying it, above all, with the supply-side of the market (Porter, 1992; Png and Lehman, 2013). Market surveys, in particular price analyses, constitute the fundament of the industry's (sector's) economy, which results from four basic market functions in the economy: balancing, informing, income-generating and efficiency (Rembisz and Kowalski, 2005).

Prices in the market economy are, first and foremost, a resultant of the game of demand and supply. In economic reality, prices at individual stages of the marketing chain, including also in the agri-food sector, follow from a lot of factors. This is caused by, often discussed, market inefficiency, also in the area of price determination (Kamińska and Kątowski, 2006). Market inefficiency underpins the introduction of all market policy instruments. One of the main goals of the CAP is "market stabilisation" and it is implemented by the Common Market Organisation. The price formation process interests regulatory policy both on account of theoretical and purely utilitarian aspects (Figiel, 2002; Peltzman, 2000; Rembeza and Seremak-Bulge, 2006).

The sugar market in Poland is a classic oligopoly, because four producers manufacturing a homogenous product are connected to a large number of consumers. The theory of oligopolistic structures identifies two groups of models: collusion (e.g. cartel, trust, syndicate) and interactions between participants. All collusions are illegal because they destroy market competition which is unfavourable to the consumers[1]. Interactions between participants of the oligopoly theoretically refer to the game theory. Four basic forms of interactions between participants of an oligopoly cover: Stackelberg model, price leadership, Cournot model and Bertrand model (Varian, 2010).

The functioning of sugar oligopoly in Poland is determined by the market regulation system. The production quotas are allocated to producers, thus it is rather unlikely to compete in terms of production volume. Moreover, the produ-

[1] The Act of 16 February 2007 on competition and consumer protection, Dz.U. of 2007, no. 50, item 331. Directive 98/27/EC of the European Parliament and of the Council of 19 May 1998 on injunctions for the protection of consumers' interests (L 166/51 of 11.06.1998).

cers have full information on the size of production limits awarded to the competition. The difference in the level of the EU and the global prices and strict provisions on the management of out-of-quota sugar make production profitable only when world sugar prices are very high. Sugar is a product of standardised properties and producers can pursue a strategy of competition highlighting a specific group of recipients or focusing on such a group only to a small extent. The minimum buying-in price of sugar beets and reference price of sugar considerably limit the possibility to compete with the use of prices. The demand for sugar is characterised by low price elasticity (Cubbin, 1973; Tangermann, 2012). When the price elasticity of demand is low, a drop in prices results in a drop in income (Samuelson and Nordhaus, 2004). Consequently, the functioning of the sugar oligopoly best corresponds to the Bertrand model and the competition strategy of its participants is mostly based on cost reduction (Porter, 1992).

The sugar market in the EU is subject to protectionist policy and is strongly regulated. In the EU, supply limits (production quotas) and foreign trade regulations form the grounds for the sugar market regulation[2]. In theory, production quotas can be interpreted as a fixed supply curve. If production quotas are set at a level lower than the current supply, then at stable demand the equilibrium point will shift and the prices will grow (the so-called quota rent) (Bear-Nawrocka and Kiryluk-Dryjska, 2010; Samuelson and Nordhaus, 2004). Following the reform of 2006-2010, the production quotas were reduced and are lower than production and consumption. The production quota in the EU amounts to 13.5 million tonnes per white sugar, including 1.4 million tonnes in Poland. The sugar production in the EU varies in the range of 17.4-19.4 million tonnes, including 1.7-2.0 million tonnes in Poland, and consumption shows a slow upward trend to, respectively, 18 million tonnes and 1.7 million tonnes[3]. Because of restrictive regulations concerning out-of-quota sugar[4] management and production limits lower than consumption, the EU has to export large quantities of out-of-quota sugar and, at the same time, import ca. 5 million tonnes. In Poland, the difference between consumption and quota production is ca. 250 thousand tonnes and this amount of sugar is being imported.

It should be noted that most of the markets do not function under autarkic conditions and business cycle in the external markets has a significant impact on

[2] Regulation (EU) No 1308/2013 of the European Parliament and of the Council of 17 December 2013 establishing a common organisation of the markets in agricultural products and repealing Council Regulations (EEC) No 922/72, (EEC) No 234/79, (EC) No 1037/2001 and (EC) No 1234/2007 (OJ L 347/671 of 20.12.2013).

[3] Rynek cukru. Stan i perspektywy (2015). no. 42, IERiGŻ-PIB, ARR, MRiRW, Warszawa.

[4] Out-of-quota sugar can be exported to third countries without export refunds, used for non-food purposes (e.g. chemical and pharmaceutical industries), counted as quota production for the next season (the so-called transfer) or sold in internal market, but this requires payment of sugar levies of ca. EUR 500 per tonne.

the supply and demand situation. The globalisation and regional integration processes have a huge impact on the functioning of the market mechanism, because local markets integrate into regional markets which then create the global market. These processes are, from the economic perspective, based on elimination or alleviation of the state borders for the market (Szymański, 2004; Pietrzak, 2014).

Because of market integration, understood as elimination of barriers (e.g. trade, transport, etc.), business entities from different countries function in unified (common) market and political conditions. As a result of elimination of barriers in the integrated market, prices of a homogenous good, expressed in a common currency, tends to level out (Pilbeam, 1998). The economic theory terms the above-described phenomenon as the law of one price with two interpretations. The first one considers the law of one price as a trend to unify the prices of similar goods, at the same time, calling for rejection of its absolute version. The second interpretation links the aforementioned law with arbitrage, which is considered to be the driving force behind the theory (Wejner, 2008). Arbitrage is defined as combined exchange transaction of sale and purchase which allows to gain profit not incurring any risk. The essence of arbitrage is to notice the difference in price for the same product in different markets or in the same market, but in different forms. In case when this difference is greater than transaction costs, the investor purchasing the product in a cheaper market and selling it in a more expensive market gains profit and thereby prices are levelled out.

In this context, it seems right to ask about the impact of the situation in the world markets on the prices in the EU, and the demand and supply situation in the Community on the prices in Poland. After all, keeping production quotas is justified only in case of protectionist policy of foreign trade in the EU, which is based on high duties and non-duty and quasi-duty barriers. Simultaneously, efficient allocation in the internal market requires uniform regulation. Integration with the EU caused that the sector started to function in a big market, which is characterised by uniform regulations and trade between Member States not limited by barriers. The sector restructuring process covered, above all, ownership transformations that were based on investments of transnational consortia (Chechelski, 2008). Following ownership transformations the sugar industry belongs to the most "globalised" sectors of food processing in Poland, because foreign consortia have ca. 60% of the share in the production quota. Adoption of the EU market regulations in 2004 resulted in the introduction of official prices in Poland, which cover the minimum buying-in price and intervention price of sugar (EUR 631.9 per tonne). As a consequence, conditions for levelling out of national and the EU prices occurred.

Data and methods

The empirical analyses use monthly sugar prices in Poland, the EU and in the world for 2000-2014. The data were captured in PLN per kg (when needed it

was calculated into PLN with the use of average monthly exchange rates of the NBP). Price information was collected from various sources and covered different market categories. In case of the Polish prices the analysis covered:

– retail prices of packed white sugar according to the CSO (Central Statistical Office, Polish: *Główny Urząd Statystyczny*, *GUS*) (sign: ret.pac),
– selling prices of packed white sugar according to the CSO (sel.pac),
– retail prices of loose white sugar according to the CSO (sel.lse or white.sel.PL).

The following categories were considered for the European and world prices:

- world prices of white sugar – quotes for the Contract no. 5 for white sugar in London (sign: white.world);
- average prices of white sugar in the EU – from 2006 given by the European Commission (the so-called ex-work prices), up to 2006 own estimation based on indices of prices given by the Eurostat (white.EU);
- prices of industrial sugar in the EU – average prices of out-of-quota sugar in the EU given by the European Commission (industrial.EU);
- intervention prices of white sugar according to the European Commission (white.int.EU);
- reference prices of white sugar according to the European Commission (white.ref.EU);
- negotiated prices of raw sugar imported to the EU, the CIF prices for the ACP according to the World Bank (raw.imp.EU).

The empirical analysis covers the period from January 2000 to December 2014. Taking into account the significant impact of Poland's accession to the EU, econometric analyses were held for a shorter period, i.e. from January 2005.

The empirical research uses a number of statistical methods aimed at formulation of conclusions on the dynamics of prices and interrelations between them. A two-stage TRAMO-SEATS method was used to assess the structure of time series. It is a method of time series decomposition under which components of a time series are separated based on appropriately selected ARIMA models. This enabled to determine the characteristics of abnormal observations and significance of seasonal adjustments (Gomez and Maravall, 2001).

To assess stationarity of time series the ADF-GLS test was used, which is a modification of the ADF test conducted by Elliott, Rothenberg and Stock (1996). It is a two-step procedure in which the data series yt, first, captures a deterministic component (constant and trend) with the use of a generalised method of least squares and, only then, the residuals of the equation (ytd) are used as grounds for testing with the use of the ADF equation:

$$\Delta y_t^d = \rho y_{t-1}^d + \sum_{i=1}^{p} \Delta y_{t-p}^d + \varepsilon_t \tag{1}$$

where: ρ , γ – model parameters, εt, – random component, p – maximum delay levelling the autocorrelation. The value of the parameter ρ , significantly different from null, makes it possible to reject null hypothesis (H0), telling about the presence of a unit root in a time series y_t.

To determine the interrelations between prices, both in the marketing chain and in international terms, the VAR and VECM models were used. The vector error correction model VAR is used for stationary (or brought to stationarity) variables and covers a set of equations, in which each of the variables is explained by its past observations and past observations of other variables (Kusideł, 2000; Lütkepohl and Krätzig, 2007):

$$\mathbf{x}_t = \mathbf{A}_0\mathbf{d}_t + \sum_{i=1}^{r}\mathbf{A}_i\mathbf{x}_{t-i} + \mathbf{e}_t \tag{2}$$

while the VECM is its transformation enabling to capture long-term interrelations:

$$\Delta\mathbf{x}_t = \mathbf{\Psi}_0\mathbf{d}_t + \mathbf{\Pi}\mathbf{x}_{t-1} + \sum_{i=1}^{r-1}\mathbf{\Pi}_i\Delta\mathbf{x}_{t-i} + \boldsymbol{\varepsilon}_t \tag{3}$$

where:

$\mathbf{x}_t$, $\Delta\mathbf{x}_t$ – are vectors of observations at the current values of variables and their increases,

$\mathbf{d}_t$ – is a vector of deterministic components of equations,

$\mathbf{A}_0$, $\mathbf{\Psi}_0$ – is a matrix of parameters at variables of vector $\mathbf{d}_t$,

$\mathbf{A}_i$ $\mathbf{\Pi}_i$ – is a matrix of parameters at delayed variables of vector $\mathbf{x}_t$ or $\Delta\mathbf{x}_t$, where the order of delay is equal to r and while, $\mathbf{\Pi} = \sum_{i=1}^{k}\mathbf{A}_i - \mathbf{I}$ a $\mathbf{\Pi}_i = \sum_{j=i+1}^{k}\mathbf{A}_j$,

$\mathbf{e}_t$, $\boldsymbol{\varepsilon}_t$ – are vectors of residuals of equations of individual models.

Nonstationary time series are cointegrated if their linear combination is stationary *I(0)*. It is called the long run equilibrium path. The Π matrix is termed as long run equilibrium matrix and it consists of the matrix of cointegration vectors β and the matrix of adjustments to long run equilibrium α, which can be put as follows $\Pi=\alpha\bullet\beta$. The Π_i is a matrix of short-term parameters and just like A_i allows for formulation of conclusions about short-term causality (Osińska, 2008).

The study of cointegration in the Johansen procedure uses the Π matrix rank, which equals in number to the independent cointegration vectors. This regularity is used, e.g., in the Johansen's Trace Test (the core of the *L-max* own value test is similar), which aims to determine the number of cointegration vectors (Kusideł, 2000):

$$LR_{trace} = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i), \quad (4)$$

where: LR_{trace} – test statistics, T – number of observations, λ_i – own values of the Π matrix. The trace test is used to test the null hypothesis that the number of cointegration vectors is equal to or lower than r. The alternative hypothesis assumes that this number is greater than r.

Retail prices versus selling prices in Poland

Selling and retail prices in Poland are highly variable over time (Fig. 2a). The growing long-term trend is accompanied by seasonal adjustments (4-year cycles). Seasonal adjustments are rather insignificant – significant seasonality is noted only for retail prices (amplitude only 3pp). Selling prices are not characterised by statistically significant seasonality in the light of tests covered by the TRAMO-SEATS procedure. This can attest to the fact that seasonality is determined by demand and not supply.

In 2004 and 2011, the sugar market experienced some abrupt changes in the level of prices. In 2004, ca. 100% price growth rate is attributable to accession to the EU (more extensively discussed in the next chapter), followed by ca. 20% adjustment in minus. Adoption of the EU market regulation system resulted in the introduction of official prices in Poland, which cover the minimum buying--in price for sugar beets[5] and intervention price of sugar (EUR 631.9 per tonne). In 2004, the average buying-in price of sugar beets was by 50.6% higher than a year ago and the selling and retail prices of sugar grew by ca. 47% against 2003. In 2011, a surge in retail and selling prices of packed sugar was a response to low production in the 2010/2011 campaign and a high price growth in the global market. This growth was similar to a panic response (speculative bubble), because there were no grounds for such a high rise in prices. An important factor stimulating price growth at that time was inadequate response of individual consumers (households) who were buying sugar forward. Retail prices in Poland were then higher than prices in neighbouring countries (e.g. Germany), despite free access to the EU market, where the drop in supply was lower. It should be noted that the case was different for selling prices of loose white sugar intended for industrial recipients. Probably these are threshold effects consisting in information accumulation at a given period (with no greater market responses) and next a sudden response of market participants, when the amount of information reaches a certain critical level. It should be emphasised that the effect of the 2006 sugar reform in the EU is practically undiscernible in the progress of prices considering the scale of variation of time series (Fig. 2).

[5] In 2004, the minimum buying-in price of sugar beets of standard sugar content at 16% amounted to: for production of A quota sugar: EUR 47.67 tonnes (intended for supply to the internal market) and B quota sugar: EUR 32.43 tonnes (intended for subsidised export).

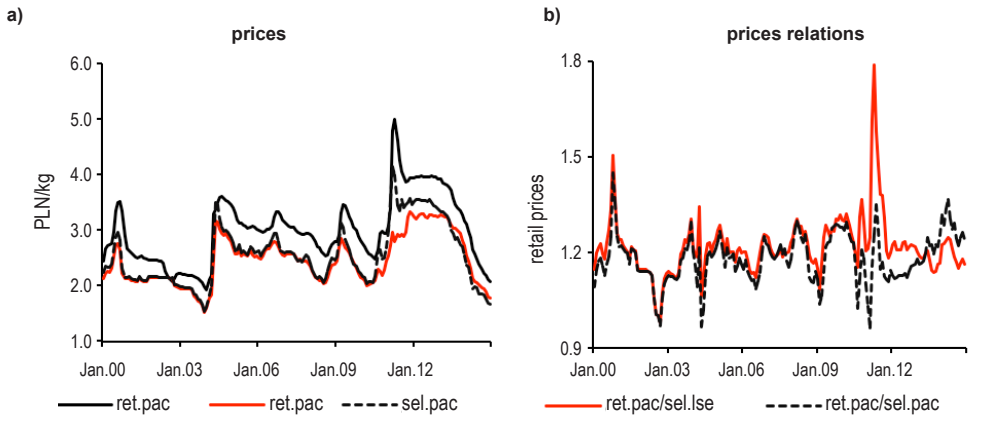

Fig. 2. Formation of sugar retail and selling prices in Poland and relations of retail to selling prices in 2000-2014.

Source: own study based on the CSO data.

From the analysis of Fig. 2a there comes a conclusion on a strong relation between retail prices and selling (producer) prices. The relation between retail and selling prices in the analysed period is ca. 1.2 (Fig. 2b). Variations from the average values are most often below 10%. However, there are periods when the behaviour of prices towards each other is rather atypical. This is especially evident in two periods: in the mid-2000 and in March 2011 which resulted from delayed responses of retail prices to changes in the producer prices. In both cases this happened in the period of sharp price movements, which may bear evidence to the risk premium.

It should be noted that the quotations of selling prices of loose and packed sugar up to 2010 were strongly correlated. As of 2011 the relation significantly weakened. This was caused by changes in the demand structure. The demand for loose sugar creates secondary food processing, which grows dynamically, and is predetermined by growing export of foods. At the same time, the sugar consumption in households showed a downward trend because of changes in the consumption model and dropping population figures (emigration, demographic situation). Another reason could be refining of raw cane sugar in the summer period, which can be pursued by new Member States as of 2010.

Next, it was attempted to assess the model presenting interrelations between retail (ret.pac) and producer (sel.pac) prices. The models were based on log values. Given the change in the sectoral policy, resulting from Poland's accession to the EU, the analysis covered the period from January 2005. Thus, a uniform sample was used as a basis. At the beginning, the properties of time series were analysed from the perspective of their stationarity with the use of ADF-GLS

test. The test results show that the null hypothesis on non stationarity of time series of selling and retail prices of sugar should be rejected (test statistics, respectively, at: -1.13 and -1.42). Only the first differences proved to be stationary (for test statistics, respectively, at: -5.64 and -3.27).

For non stationary series it is standard to test the occurrence of long-term interrelations (the so-called cointegration relationship). To this end, Johansen procedure was used and trace test and own value test (*L-Max test*) related thereto. Such relation was expected due to a strong correlation between variables and no product modifications between the selling and retail link. Considering that the cointegration tests are rather sensitive to the specification of models, the tests were carried out in several variants for different delays and different specifications of the intercept. According to the information criterion AIC and BIC the best delay (of the model at levels) is 4, while according to the SIC criterion optimum delay is 2. In this case, considering the progress of time series of producer and retail prices, the considered models were models with limited and unlimited intercept at delays from 2 or 4.

Table 1 includes results of the trace test (conclusions from the own *L-Max* value were identical). In three out of four cases the results pointed to the presence of long-term interrelation suggesting to base further research on the VECM model. Inclusion of one pulse dummy variable into the model for outlier observations (for March 2011) causes that in four cases H0, stating that there is no long-term relation (more precisely on cointegration at 0), is rejected.

Table 1

Cointegration tests between series of logarithms of selling prices of packed sugar and retail prices – trace test

Delays (for VAR)	Max rank	Limited intercept		Unlimited intercept	
		statistics	p	statistics	p
2	0	33.866	0.000	33.392	0.000
	1	1.701	0.828	1.387	0.239
4	0	17.107	0.130	16.560	0.033
	1	2.429	0.694	1.956	0.162

Source: own study on the basis of the CSO data.

Table 2 presents estimations of VECM models with unlimited intercept and two delays at the levels of variables (at first differences the delay is 1). The conclusions from the other specifications were similar to the selected one. Seasonal variables were not included into the model because none of them was statistically significant. The first model was estimated without additional exogenous variables. The beta coefficient of cointegration relation was 0.87, indicating that 1% change in selling prices is accompanied by 0.87% change in retail prices. The adjustments to the long-term relations (EC) are present on the side of retail prices (a significant coef-

ficient at the level of -0.44). The second coefficient has also a negative sign, which indicates that the selling prices do not adjust to the long-term relation. It could be even stated that they present a significant instability. In this context, it can be concluded that the selling prices are exogenous to retail prices, thus the supply situation and regulatory policy determine the level of sugar prices in the country at long and short periods. Short-term causality in the Granger sense is two-sided (Table 2).

Table 2

Estimations of the VECM model

Model 1					
Dependent variable: d_l_ret.pac			Dependent variable: d_l_sel.pac		
Independent variable	Coefficient	Statistics of student's t-test	Independent variable	Coefficient	Statistics of student's t-test
const	0.117	5.857	const	0.098	3.169
d_l_ret.pac_1	0.040	0.581	d_l_ret.pac_1	-0.399	-3.757
d_l_sel.pac_1	0.302	3.305	d_l_sel.pac_1	0.353	2.474
EC	-0.436	-5.946	EC	-0.374	-3.275
Cointegration relation: l_ret.pac -0.896* l_sel.pac					
Doornik-Hansen test: = 957.32 (p=0.000), Ljung-Box test: Q1=18.25 (p=0.108), Q2=21.57 (p=0.043)					
Model 2					
Dependent variable: d_l_ret.pac			Dependent variable: d_l_sel.pac		
Independent variable	Coefficient	Statistics of student's t-test	Independent variable	Coefficient	Statistics of student's t-test
const	0.101	9.236	const	0.097	3.035
d_l_ret.pac_1	0.041	1.138	d_l_ret.pac_1	-0.395	-3.776
d_l_sel.pac_1	0.201	4.119	d_l_sel.pac_1	0.309	2.185
d.2011.03	0.245	17.240	d.2011.03	0.089	2.153
EC	-0.377	-9.646	EC	-0.359	-3.172
Cointegration relation: l_ret.pac -0.886*l_sel.pac					
Doornik-Hansen test: = 33.41 (p=0.000), Ljung-Box test: Q1=10.66 (p=0.558), Q2=14.27 (p=0.284)					

Source: own study on the basis of the CSO data.

It should be emphasised that model 1 does not meet the assumption on normal distribution of the residual component as a result of occurrence of outliers (statistics for the Doornik-Hansen test amount to 957.4). It is a derivative of structural changes emerging in individual time series and their relations (Fig. 4 and 5), and atypical values in price increases. The second equation ($Q2$=21.57) also shows autocorrelation of residuals.

In order to mitigate the impact of nonlinearity linked to atypical observations, it was decided to introduce in the next model an unlimited zero-one variable for March 2011 (model 2, Table 2). Thus, when estimating the model at increases it

partly alleviates the impact of a sharp price change that took place in the period. Because of this it was possible to lower the statistics of the Doornik-Hansen test by 30 times (even though it failed to get the normal distribution of the residuals of the model, mainly in the case of the equation of retail prices) and improve the residual values as regards autocorrelation. Conclusions from this model are similar to the conclusions from model 1. The long-term relation is practically the same. The coefficient at the cointegration relations EC decreased slightly (primarily in the equation of retail prices).

Analysis of decomposition of errors in forecasts in structuring the above model, assuming that the retail prices are a derivative of changes in selling prices, is quite similar. It indicates that in the long term, selling prices determine retail prices in 75% (model 1) and 90% (model 2). Differences between the two models suggest that probably adjustments to long run equilibrium depend on the scale of disequilibrium. If deviations from the equilibrium are slight, then the adjustments are slow, and when the scale of disequilibrium grows then the pace of return to equilibrium increases. A more precise recognition of these mechanisms would be possible, e.g., with the use of threshold TVAR and TVECM models. At this point, only a graphic presentation of this type of relation (Fig. 3) will be included which assumes that TAR model is at its basis (Enders and Siklos, 2001).

Average value of the cointegration relation EC in the VECM model with an unlimited intercept is 0.27 (according to model 1, horizontal axis, Fig. 3). It can be seen that adjustments to the long-term relation are negligible in the range of 0.20-0.35. The strength of adjustments, illustrated by the gradient of matching lines (third-degree polynomial and local regression LOESS) (Cleveland, Devlin and Grosse, 1988), significantly grows after crossing the above values. In other words, if the deviations from the long run equilibrium do not exceed +/-7%, adjustments practically do not exist. Only after exceeding this level (probably these are the costs of menu) adjustment mechanisms are triggered.

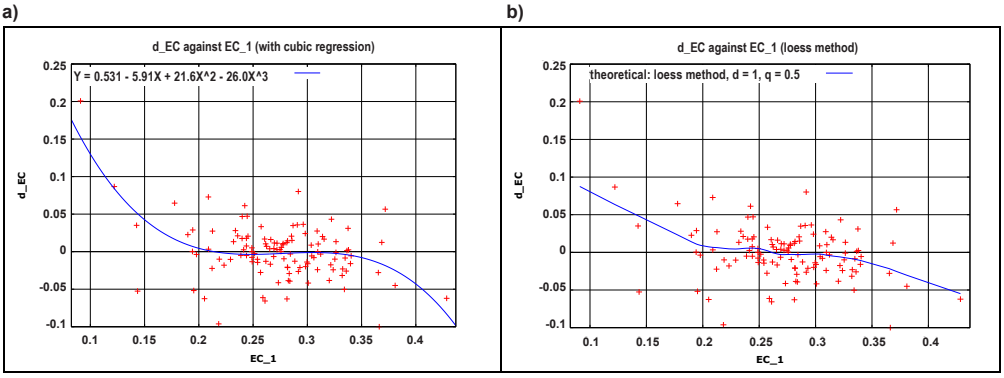

Fig. 3. Adjustments of retail and selling prices to long run equilibrium.
Source: own study on the basis of the CSO data.

Prices in Poland versus prices in foreign markets

In the light of the discussions in the former chapter, the sugar prices in Poland are determined mainly by supply factors. This chapter presents the formation of sugar prices in Poland at the background of world and European prices, simultaneously, pointing to the impact of the Common Market Organisation in this field. Firstly, the paper refers to the relations between white sugar prices in the EU and market prices of sugar across the world. A brief graphic analysis (Fig. 4) indicates that for many years the sugar prices in the EU (white.EU) were much above the world prices (white.world). This followed from a strong tariff protection, high intervention prices (white.int.EU), production quotas and subsidies to sugar export. By 2006, market prices of sugar producers in the EU were above the intervention prices (EUR 631.9 per tonne). It could be stated that practically by 2006 or even by 2008 there was no correlation between the prices in the Community and the world prices.

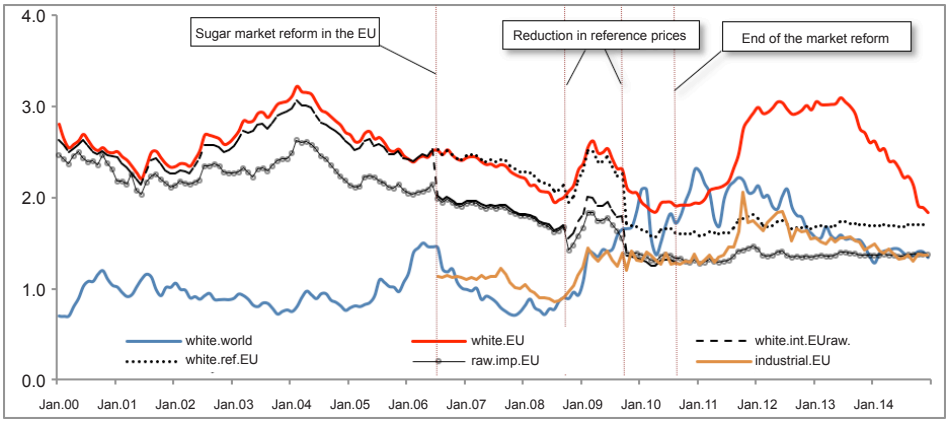

Fig. 4. Prices of sugar producer in the EU and worldwide against the EU intervention, reference and import prices in 2000-2014 (PLN per kg).

Source: own study based on the data from the USDA, the World Bank, the European Commission and the National Bank of Poland.

Along with a reform in the sugar market in 2006, intervention prices started to lose weight (they were decreased to the null level in 2010, upon completion of the intervention purchases). Reference prices appeared in their place (white.ref.EU), whose level was lowered two times and now it is at EUR 404.4 per tonne. By the end of intervention purchases (end 2009), market prices were rather similar to reference prices. From 2010, interrelations between market prices of sugar in the EU and the reference price are not that strong. Given the high prices of sugar in the world markets, the reference prices in the EU in 2010-2014 were lower than the market prices and in 2010-2012 they were even lower than the world prices.

When the intervention in the sugar market finished, reasons appeared for correlation between the prices of white sugar in the EU (white.EU) and the world prices (white.world) (Areté, 2012). Statistical analyses do not show any concentration of the changes (no long-term interrelations) both for the entire sample and for different subperiods (from 2006 or from 2010). The Johansen tests also do not allow to consider that the equilibrium is long-term in the three-variable system: the world prices, the EU prices and the Polish prices. It should be emphasised that the out-of-quota sugar prices (industrial.EU) seem to be more correlated with the world prices than the sugar prices of white sugar (quota). And the relations were weakened in 2010-2011 – at that time prices of industrial sugar reflected the process of negotiations of the prices of raw sugar from developing countries (LDC, ACP). It should be highlighted that in 2010-2011, the world prices were very high USD 700-800 per tonne and, at the same time, prices of quota sugar in the EU were low.

The negotiated prices of imported raw sugar in the EU (raw.imp.EU) up to 2009 were correlated with the prices in the internal market and with the intervention and reference prices. As of 2010 there is no relation between import prices and market prices of quota sugar (Fig. 4).

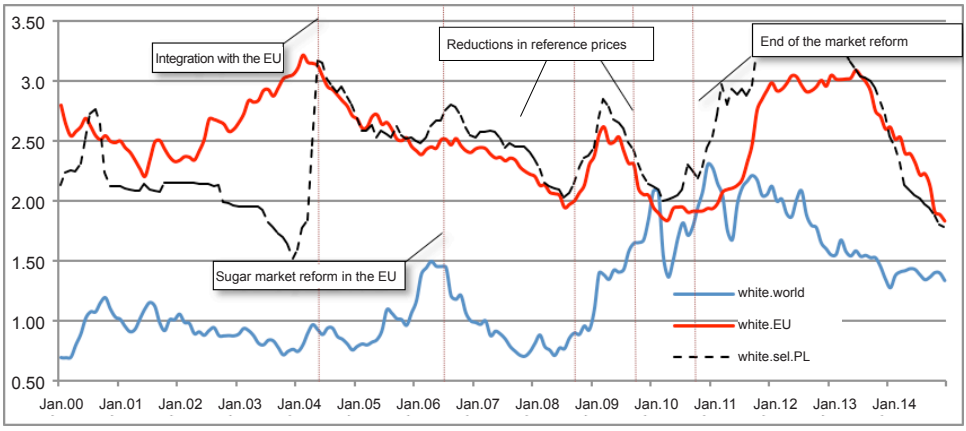

Fig. 5. Selling prices of sugar in Poland against sugar prices in the EU and worldwide in 2000-2014 (PLN per tonne).

Source: own study based on the data from the USDA, the World Bank, the European Commission and the National Bank of Poland.

National conditions (supply and stocks) played the main role in the formation of sugar prices in Poland, until integration with the EU. The level of national prices was twice higher than the world prices. There was also no greater relation between prices in Poland (white.sel.PL) and prices in the EU countries (Fig. 5).

Along with integration, the selling prices of sugar in Poland doubled over three months reaching an average level of the prices in the Community. This was an important structural change in the progress of prices. From that moment, along with covering the national market with the Community regulations, a strong convergence of national and the average EU prices started to be evident. It should be noted that the prices in Poland were slightly higher than prices in the EU (but the data are not exactly comparable). Only recently these relations started to change (Fig. 6).

It should be stressed that the growth in sugar prices in Poland in 2011 happened earlier than in other EU countries, which probably followed from greater sensitivity of national prices to world prices. Weaker relations between prices in Poland and prices in the EU can be also linked to elimination of the market intervention (now there are no intervention prices and there is no intervention buying-in).

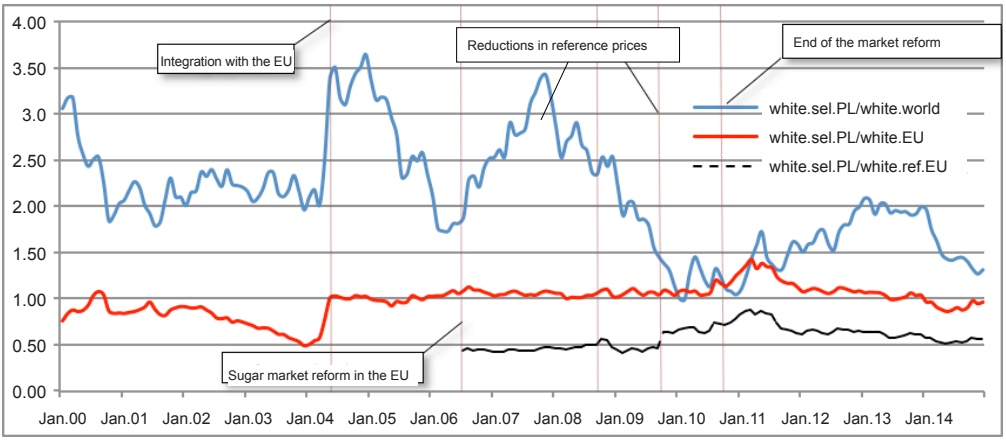

Fig. 6. Relations of selling sugar in Poland to world and European prices.

Source: own study based on the data from the CSO, the USDA, the European Commission and the National Bank of Poland.

Analysing the relations between prices in Poland and prices in foreign markets (world and the EU) the authors of the paper attempted to clarify their nature. Research was limited to the data of 2005-2014; hence, only the period after the integration. The analysis has a certain defect – namely, when calculating the average prices in the EU the Polish prices are also considered (but we do not know what is the their formula of calculation and source). Therefore, we are dealing with the effect of nesting. These were the only data at the authors' disposal, though.

In the first place, the properties of time series were assessed using the ADG--GLS. In this light, it turned out that all the time series are integrated to the first

degree I(1). When it comes to the study of long-term interrelations the results were inconclusive. As already mentioned, it was determined that there are no long-term interrelations between the world (white.world), the EU (white.EU) and the Polish prices (white.sel.PL). Thus, further analyses covered only the system of two variables: the Polish and the EU prices. In the simple Engle-Granger model (both with and without an intercept) there were no grounds to reject the H0 stating that residuals from the cointegration relation are characterised by unit root. This stands for a lack of long-term relations between prices in Poland and average prices in the EU. The Johansen test (the model without the intercept and the model with a limited (insignificant) intercept) point to one cointegration vector. Whereas the Johansen test, based on the model with an unlimited intercept (significant), points to the full rank of a matrix, i.e. that individual variables are already stationary.

Looking at price relations in Poland, compared to the average prices in the EU (Fig. 6), it is apparent that they changed during the membership in the EU. Initially two time regimes are visible. By 2010 the long-term relation was strong (stationary relations). After that period, along with the end of intervention, the interrelations weakened (relations characterised by a trend). Thus, it is difficult to use the VECM model here, which would describe the character of long-term adjustments in two different time regimes.

In view of that, the analysis was limited to the VAR model estimated for the first increases of variables. Two VAR models were estimated: one for the Polish prices and one for the average EU prices, the second one considers also the world prices. In their light, it is possible to recognise two-sided causality in the Granger sense between prices in Poland and in the EU. Simultaneously, it was stated that there is no (in the sense of direction and strength) interrelation between prices in Poland and in the EU, and the world prices. These conclusions were not changed when assessing the model for 2011-2014. Thus, it can be inferred that the sugar reform had no significant impact on intensification of price relations between Europe and the world. It is caused by the extended market regulation system (protectionist market policy), which is based on production quotas and strong tariff protection. Import is possible (profitable) only under preferential quotas. Strict supply policy (production quota), including in particular as regards out-of-quota sugar, results in interrelation between the EU market and the world market, but these interrelations are not very clear.

Conclusions

The links of the marketing chain of the sugar market in Poland are characterised by much differentiated level of cointegration. First (agricultural producers) and final (consumers) links of the chain are characterised by very high number of participants and potentially the weakest bargaining power. The greatest level of cointegration takes place in the sugar industry which is a typical oligopolis-

tic structure. Thus differentiated structure with strong market protection creates potential conditions for monopolistic structures and the so-called monopolistic margins.

Sugar production and prices in Poland and in the EU are largely determined by the market regulation system. Regulations cover production quotas and strong tariff protection. The sugar market reform only slightly influenced the intensification of price relations between the EU and the world in the analysed period. The reform resulted in a decrease in the relation between the Polish and the EU prices to the world prices (which coincided with a growth in world prices of sugar) and, at the same time, there is a clear increase in the long- and short--term relations.

The selling prices of sugar in Poland are interrelated with the prices in the EU as of May 2004 and their level is not much different than the average prices in the Community. This relation was a little weakened along with the end of the sugar market reform in the EU and the nature of the long-term relation (price relation) will change. The stronger interrelations are present between the retail and selling prices in Poland. Time series of these prices are cointegrated and selling prices are exogenous to retail prices which indicates that supply and regulatory policy determines the level of sugar prices in Poland in long and short periods. At the same time, the strength of price adjustments to the long run equilibrium increased along with a growth in differences between prices at various links of the marketing chain, which points to probable occurrence of the so-called menu costs in the vertical price transmission mechanism.

Literature:

Areté (2012). *Study on price transmission in the sugar sector*: Draft final report. AGRI-2011--EVAL-03, European Commission.

Bear-Nawrocka, A., Kiryluk-Dryjska, E. (2010). Konsekwencje zniesienia kwot mlecznych dla polskiego rolnictwa z uwzględnieniem zróżnicowania regionalnego (wyniki symulacji modelowych). *Zagadnienia Ekonomiki Rolnej*, *no*. 2, pp. 62-74.

Chechelski, P. (2005). Zasięg procesów globalizacji w Polskim przemyśle cukrowniczym. *Komunikaty Ekspertyzy Raporty*, *no*. *506*, Warszawa: IERiGŻ-PIB.

Cleveland, W.S., Devlin, S.J., Grosse, E. (1988). Regression by Local Fitting, *Journal of Econometrics*, *37*, 1988.

Cubbin, J. (1973). Estimating the Elasticities of Demand for Sugar. *Journal of Agricultural Economic*s, *vol*. *24, issue 2*, May.

Elliott, G., Rothenberg, T.J., Stock, J.H. (1996). Efficient tests for an autoregressive unit root, *Econometrica*, 64.

Enders, W., Siklos, P.L. (2001). Cointegration and threshold adjustment. *Journal of Business & Economic Statistics*, *vol*. *191*.

Figiel, S. (2002). *Cenowa efektywność rynku towarowego zbóż w Polsce*. Olsztyn: Wydawnictwo Uniwersytetu Warmińsko-Mazurskiego.

Gomez, V., Maravall, A. (2001). Seasonal Adjustment and Signal Extraction in Economic Time Series. In: R.S. Tsay (ed.) *A Course in Time Series Analysis*. New York: J. Wiley and Son.

Hobhouse, H. (2001). *Sechs Pflanzen verändern die Welt: Chinarinde, Zuckerrohr, Tee, Baumwolle, Kartoffel, Kokastrauch*. Stuttgart: Klett-Cotta Verlag.

Kamińska, T., Kątowski, T. (2006). *Nieefektywność rynku*. *Teoria i praktyka*. Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego.

Köster, U. (2010). *Grundzüge der landwirtschaftlichen Marktlehre*, München: Verlag Franz Vahlen.

Kusideł, E. (2000). *Modelowanie wektorowo-autoregresyjne VAR*. *Metodologia i zastosowanie w badaniach ekonomicznych*. Łódź: Absolwent.

Lütkepohl, H., Krättzig, M. (2007). *Applied Time Series Econometrics*. Cambridge University Press.

Łuczak, C. (1981). *Dzieje cukrownictwa w Polsce*. Poznań: Uniwersytet im. Adama Mickiewicza.

Łyszkiewicz, W. (2000). *Industrial Organisation*. *Organizacja rynku i konkurencja*. Poznań: WSHiFM.

Osińska, M. (2008). *Ekonometryczna analiza zależności przyczynowych*. Toruń: Wydawnictwo Naukowe UMK.

Peltzman, S. (2000). Prices rise faster than they fall. *Journal of Political Economy, vol*. *108, no*. *3,* pp. 466-502.

Png, I., Lehman, D. (2013). *Ekonomia menadżerska*. Warszawa: Oficyna a Wolters Kluwer Business.

Pietrzak, M. (2014). Problem geograficznego zakresu rynków/sektorów w dobie globalizacji i regionalizacji. *Zagadnienia Ekonomiki Rolnej*, *no*. *1*, pp. 3-21.

Pilbeam, K. (1998). *International Finance*. New York: Palgrave.

Porter, M.E. (1992). *The competitive advantage of nation*s. London, Basingstoke: The Macmillan Press Ltd.

Rembeza, J., Seremak-Bulge, J. (2006). Asymetria w transmisji cen na rynku mleka i jego przetworów. *Zagadnienia Ekonomki Rolnej, no. 3*, pp. 110-123.

Rembisz, W., Kowalski, A. (2005). *Rynek rolny i interwencjonizm a efektywność i sprawiedliwość społeczna*. Warszawa: IERiGŻ-PIB.

Samuelson, P.A., Nordhouse, W.D. (2004). *Ekonomia*, *vol. 1*. Warszawa: PWN.

Scherer, F.M. (1970). *Industrial market structure and economic performance*. Chicago: Rand McNally College Publishin Company.

Szajner, P., Hryszko, K. (2013). *Sytuacja na światowym rynku cukru i jej wpływ na możliwość uprawy buraków cukrowych w Polsce*. PW 2011-2014, Warszawa: IERiGŻ-PIB.

Szymański, W. (2004). *Interesy i sprzeczności globalizacji. Wprowadzenie do ekonomii ery globalizacji*. Warszawa: DIFIN.

Tangermann, S. (2012). Preisanstieg am EU-Zuckermarkt: Bestimmunsgründe und Handlungsmöglichkeiten der Marktpolitik. *Diskussionspapiere, No. 1203*, Universität Göttingen.

Varian, H.R. (2002). *Mikroekonomia*. Warszawa: PWN.

Wejner, P. (2008). *Parytet siły nabywczej jako wyznacznik realnego kursu walutowego. Ewolucja w kierunku nieliniowych modeli autoregresyjnych*. Warszawa: NBP.

Wykrętowicz, S. (1997). *Najnowsze dzieje cukrownictwa w Polsce (1944-1998)*. Poznań: Muzeum Narodowe Rolnictwa i Przemysłu Rolno-Spożywczego w Szraniewie.

MARIUSZ HAMULCZUK
PIOTR SZAJNER
Instytut Ekonomiki Rolnictwa
i Gospodarki Żywnościowej – PIB
Warszawa

CENY CUKRU W POLSCE I ICH DETERMINANTY

Abstrakt

Rynek cukru w UE należy do najbardziej uregulowanych rynków żywnościowych, a podstawę regulacji stanowią kwoty produkcyjne i regulacje handlu zagranicznego. Równocześnie ogniwa łańcucha marketingowego charakteryzują się zróżnicowanym stopniem koncentracji, co przy silnej ochronie rynku stwarza potencjalne warunki dla praktyk monopolistycznych oraz uzyskiwania tzw. marż monolitycznych. W tym kontekście celem opracowania była empiryczna ocena zmian cen cukru w Polsce oraz wskazanie ich determinant. Badania oparto na miesięcznych cenach cukru w Polsce, UE i na świecie, w latach 2000-2014. Do oceny prawidłowości wykorzystano modele szeregów czasowych. Przeprowadzone badania wskazują, że produkcja i ceny cukru w Polsce i UE są w przeważającym stopniu uwarunkowane systemem regulacji rynkowych, zaś przeprowadzona reforma rynku cukru w niewielkim stopniu wpłynęła na wzrost powiązań cen w UE z cenami światowymi. Równocześnie mamy do czynienia z silnymi współzależnościami między cenami detalicznymi i cenami zbytu w Polsce, które mogą przybierać charakter zależności nieliniowych.

Słowa kluczowe: rynek cukru, ceny, łańcuch marketingowy, transmisja cen, model ekonometryczny, relacje cenowe

Accepted for print: 10.12.2015.