

## **VARIABILITY AND CORRELATION OF THE WHOLESALE AND RETAIL PRICES OF APPLES ON THE WARSAW MARKET IN THE YEARS 2003–2013**

Wioleta Sobczak<sup>1</sup>, Lilianna Jabłońska<sup>1</sup>, Grzegorz Klimek<sup>2</sup>

<sup>1</sup>Warsaw University of Life Sciences – SGGW, <sup>2</sup>Research Institute of Horticulture in Skierniewice

**Abstract.** Variability of apple prices on Warsaw market at three levels of the market chain – the producer price of industrial apples and the producer and retail prices of the dessert apples were investigated. In order to assess their mutual connections a comparative vertical and horizontal analysis of changes on the above mentioned markets was performed. The direction and dynamics of price changes were analysed as well as a year to year level of price variability and seasonal variations. What is more, their relations and the power of connection between them as well as the price effect on the shaping of export level were determined. The performed investigations will allow an assessment of the present situation of producers and point out the trends of action in order to keep the position of Poland as an important apple producer.

**Key words:** producer prices, retail prices, price variability, industrial apples, dessert apples

### **INTRODUCTION**

The complexity of the agricultural and food market as well as the presence of many channels of distribution cause the fact that more and more often the notion of price in that business is substituted by the “price system” notion. It includes the prices of purchase of the agricultural produce, prices of the wholesale sale, means of production in that sector and the retail prices of those products [Wysokiński, Jarzębowski 2013]. Prices play an important role in the national economy being the basic factors affecting the producer economical decisions and the consumer decisions concerning the allocation of his income. Generally that role is filled by its informative function by transmitting signals about the supply and demand situation. Prices obtained by producers of agricultural products,

---

Corresponding author – Adres do korespondencji: Wioleta Sobczak, Section of Horticultural Economic, WULS-SGGW, Nowoursynowska 166, 02-787 Warszawa, Poland, e-mail: wioleta\_sobczak@sggw.pl

including horticultural products, are conditioned by the supply and demand relation existing at the outlet while prices paid by consumers are shaped by the supply and demand relation at the level of the retail sale. Price relations on the wholesale and retail market mainly differ due to the fact that producers and consumers are removed from each other by various stages of the system of sale organization [Świetlik 2008]. A highly complicated chain of sales on the fruit market which includes the participation of wholesalers, distributors, manufacturers and commercial enterprises unfavourably affect the flow of stimuli shaping the final price which the consumer has to pay [Vavra, Goodwin 2005]. A significant differentiation of prices at particular levels of distribution of agricultural products may testify to the lack of integration of the above mentioned markets [Serra et al. 2006]. As a result of those occurrences prices do not fulfill their basic function informing about the supply and demand situation using the model of the perfectly competitive market. The transfer of price signals through particular selling levels called the price transmission becomes disturbed. What is more, it may lead to the more and more often observed asymmetry in price transmission which lies in a different price reaction on a certain market to the price increase or price decrease on another market. As a result of that process subjects at the beginning and end of the commercial chain do not get full information which makes it hard to adapt to the situation on the market [Bakucs et al. 2012]. It is important that prices on the fruit and vegetable markets are determined by many factors which both the power and direction of action practically cannot be predicted [Szajner 2013]. Very often there are observed numerous variations, mainly seasonal, of their levels and they are the highest among prices of all the agri-food products [McLaughlin 2004]. The lack of stability in the agri-food products supply is connected with a high price risk which is particularly important for the producers because the time of selling products significantly affects the profitability of production [Just, Śmiglak-Krajewska 2013]. A high price variability in the agri-food sector of production restricts the possibility of their forecasting for the future, thus preventing them from making decisions concerning the direction of production and gaining profits [Apergis, Rezitis 2003]. It is an additional stimulus for a systematic and multidirectional price testing. It is especially vital on the apple market, a most important Polish horticultural product of which our country is the biggest producer in Europe [Wróblewska 2012], and also an important exporter with its share in the international volume of the trade turnover amounting to about 3% [Nosecka et al. 2012]. In the recent years the share of apple harvests comprised 80% of all fruits in the country, amounting to 19–25% of the total harvests of these fruits in the European Union [Makosz 2011]. Analysing the price effect on the Polish apple market will allow to assess the situation of producers on that market thus being an indicator for further activities aiming at limiting the price risk and increasing profitability of farms.

## MATERIAL AND METHODS

The study presents analysis of the direction and dynamics of apple price changes at the level of the producer, both retail and processing plant and their interdependence on the Warsaw market in the years 2003–2013. Price analysis was preceded by the characterizing of changes of the production area, the volume of harvest and apple consumption

in Poland. The dynamics of changes of particular types of prices and other phenomena was determined with the help of a slope of the trend lines (b), determined for the production years for the absolute and relative values. Descriptive statistics of the time series was presented using the mean price for the analysed period, median, maximum value, minimum value and the coefficient of variation. In order to present the relation between the producer prices and the retail prices the margin level was determined and the share of a wholesale apple prices in the retail price was presented. In order to show the relation between the dessert apple prices at the selling level and retail level the analysis also included the seasonal variations in both links of marketing chain which were presented in two subperiods in order to check how the development of the storage bases affected the seasonal prices of those fruits. In the analysis of a seasonal character the seasonal index was used expressed in per cent of the mean annual price accepted as 100%. This study is the first step in a broader analysis of fruit and vegetable prices different of markets levels, in which the prices transmission analysis will be attempted.

The data obtained in the empirical studies of the Warsaw market were used as a source material. The analysed industrial prices are those which the producer get for apples sold for processing, the wholesale prices concerned the apple prices obtained by producers on the Warsaw Agri-Food Wholesale Market in Bronisze, which should be called the producer prices while the the retail prices were taken from the registration at three types of the retail selling places – two markets, two greengrocer's shops and the supermarket in Warsaw. The registration of prices at each trade turnover stage was performed every week in the years 2003–2013.

## **RESULTS**

### **Changes in production and consumption of apples in Poland**

In the analysed decade the area of apple orchards in Poland was characterized by a growing tendency. In 2013 apple production was carried out on the area of 195 thousand ha, i.e. 22% bigger than in 2003 (Fig. 1). Similar dynamics was characteristic for apple harvests which in 2003 amounted to 2.45 million t and in the analysed decade increased by 20% and in 2013 reached the level of 2.88 million t. The situation is reversed as in the most European countries where the decrease of the cultivation of apple trees as well as apple harvests is observed [Makosz 2010, Jahae 2011]. It is worth noticing that in the case of apple harvest a significant fluctuation of their levels was noted which resulted from the adverse weather condition which significantly decreased crops. It is particularly noticeable in 2007 where crops were smaller by 57% than in the previous year due to the spring frosts. According to Nosecka [2008], they were the lowest for the last 20 years. Similar situation was observed in 2010 when apple crops in Poland were lower by 23% than in 2009. That drop was caused by the low temperatures at the time of tree blooming and directly after it and also in autumn as well as significant floods.

A completely different is the situation in apple consumption by the Polish consumers which despite the production growth has gradually decreased since 2003. In 2003 one resident of our country on the average consumed 23.76 kg apples a year and in 2013 only

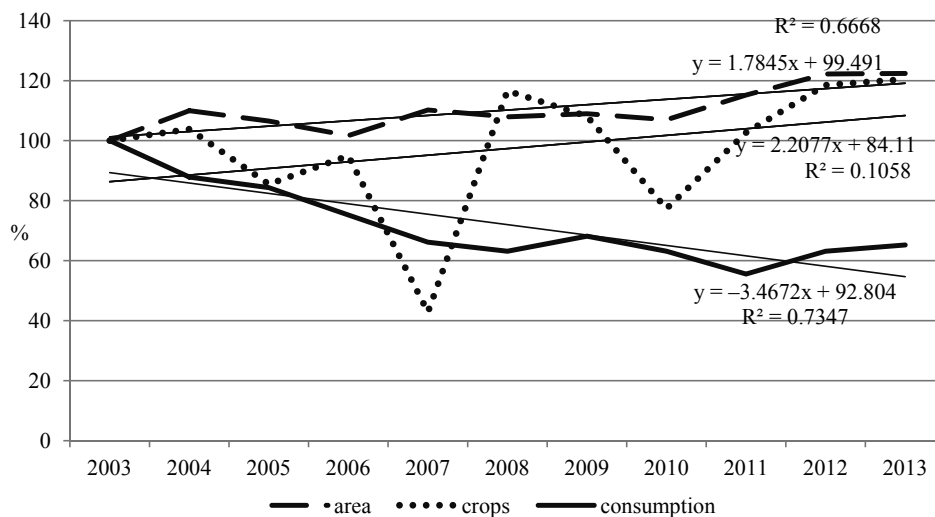


Fig. 1. Changes of the production area, crops and consumption of apples in Poland in the years 2003–2013 (2003 = 100%)

Source: Own elaboration on the basis of the GUS and IERiGŻ-PIB.

15.5 kg. Thus the consumption of those fruits decreased by 35%. From the point of view of a producer it is an unfavourable fact which means the decreasing demand for those fruits. The causes of such a situation could be found in the increased accessibility of other fruits, mainly because of the increasing import. In such a case the condition of development or even holding on to the production at the present level is the development of its sale on the foreign markets.

### Changes of apple prices in a long term

The performed analysis of changes of the mean annual apple prices in the production year 2003/2004 to the production year 2012/2013 showed that prices of all three types were characterized by their growing tendency. However, there were differences in the dynamics level of their growth. In the case of dessert apples the producer prices grew a little quicker than the retail prices. The producer price increase amounted to 3.46% in relation the many year average but it was only 0.06 PLN per 1 kg a year more. The mean apple price in the analysed period received by the producer on the wholesale market was 1.74 PLN per 1 kg and the maximum price for a kilogram of apples obtained on the wholesale market was 2.59 PLN in 2007/2008 and minimum price was 1.28 PLN in 2009/2010. However, the yearly average of the retail prices grew by 3.34% as compared to the many year average which in the absolute values amounted to 0.11 PLN per 1 kg. The average apple price at that period in the retail sale amounted to 3.38 PLN per 1 kg (Table 1). In the relative values the biggest changes were observed in the industrial apples, which on the average increased even 4.91% in relation to the many year average but in the absolute values it was a yearly growth of only 0.02 PLN per 1 kg. The average which producers received for apples sold with the help of the market chain was only 0.39 PLN, however,

Table 1. Descriptive statistics of the time series of apple prices (2003–2013)

Specification	Directional index of the tendency line (b) <sup>a</sup>		Standard deviation	Average	Median	Maximum value	Minimum value	Coefficient of variation	Directional index of the tendency line (b) <sup>b</sup>
	PLN·kg <sup>-1</sup>	%							
Dessert apples									
Producer price	0.06	3.46	26.42	1.74	1.75	2.27	1.28	20.64	3.09
Retail price	0.11	3.34	20.03	3.38	3.23	4.21	2.68	15.97	3.12
Industrial apples									
Buying price	0.02	4.91	43.47	0.39	0.37	0.60	0.16	38.20	5.79

a – for production years, b – for calendar years.

Source: Own investigations.

the difference between the highest (2007/2008) and the lowest (2009/2010) price was the biggest, here because it amounted to even 3.7 fold.

The situation is different when price changes are presented for calendar years in which the average year apple price results from the shaping of fruit prices from two harvests. In that case the growth of retail prices is quicker. Thus depending on the formula of the average price various conclusions can be drawn. However, due to the production cycle ending at the moment of selling the entire production it is more correct to use the production years.

The presented differences between the maximum and minimum price reveal a significant differentiation of apple prices between particular years of the analysed period which is confirmed by the coefficient of variation. It results from a great variation of crops which is presented in Figure 1. A very low crops in 2007 and 2010 contributed to a significant increase of prices in the production years 2007/2008 and 2010/2011, respectively. Assuming that an average price for the investigated many year period is 100%, then prices of the dessert apples, both producer and retail prices, and industrial apples amounted to 152, 138 and 164% in the production year 2007/2008 and to 80, 91 and 47% in the following year 2008/2009 (Fig. 4). Similar situation was observed in t 2010/2011 when the prices amounted to 133, 129 and 156%, while in 2011/2012 – 105, 106 and 140%. It should be noticed that the highest variability resulting from the crop fluctuation is characteristic for industrial apples. In the case of dessert apples their prices show smaller variability and as it is revealed by the value of standard deviation and variability coefficient, variability of the wholesale prices is greater than retail prices. That diversity of the degree of variability means that the changes of prices at the producer level are not fully reflected in the retail prices.

As it has already been mentioned the falling tendency of apple consumption forces the producers to look abroad for markets. It is particularly evident in the years of high crops and resulting price drop on the wholesale markets. Figure 2 shows that in the year of the lowest prices the volume of export grows. The Pearson coefficient for those values and the dependence of price on the crop takes the negative values at the level of  $-0.70$ .

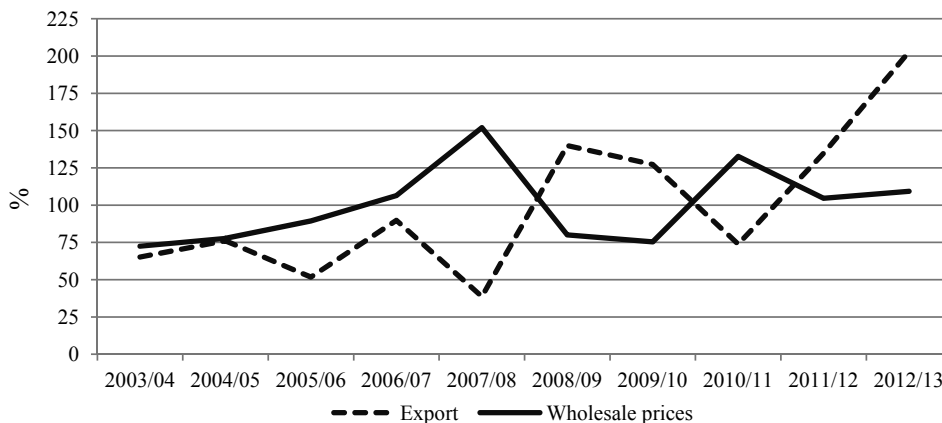


Fig. 2. Changes in the export level and wholesale prices in Poland in production years from 2003/2004 to 2012/2013 (many year average = 100%)

Source: Own investigations.

### Relation of apple prices on the Warsaw market

Comparative analysis of prices obtained by producers for dessert apples on the wholesale market and retail prices showed clear fluctuations of the share of producer prices in consumer price. That share to a large degree is connected with the level of fruit supply in a given production year. In the years 2004–2007 the crop dropping tendency was accompanied by the growth of the share of producer price in retail price. After a very low crops in 2007 that share amounted to 56% in the production year 2007/2008 (Fig. 3). In turn, high crops in 2008 and 2009 caused a relatively drop of producer prices in relation to consumer prices in the production years 2008/2009 and 2009/2010. The producer obtained only 45.07 and 44.03% of the retail price, relatively. The fall of crops in 2010 resulted in another increase of the share of producer price in consumer price which in the production year 2010/2011 amounted to 53%. The last two years again show a decrease of that share caused by the increase of crops, however, it was not a significant drop because only to 51 and 52%. Thus, generally, with lower crops the share of producer price in retail price increased while with higher crops decreases.

Considering a high correlation between producer prices and retail prices and at the same time their variable relation a conclusion can be drawn that an elastic system of price margins functions on the retail market. It is confirmed by the analysis of changes of both types of prices and margins in the subsequent years. It shows a clear connection between the margin level and price level on the wholesale market. When the producer prices grow the margin increase is smaller causing a relatively lower drop of retail price. For example, in the production year 2007/2008, a year of a small crop, the wholesale price grew by 52% and retail price by 39% (Fig. 4). That year the margin level was higher only by 22% thus constituting 78% of producer price. On the other hand, in the production year 2003/2004 with the wholesale price lower by 30% as compared to the many year average, the margin was lower only by 20%, thus causing the drop of retail price by 25% as compared to the average. Thus the retailers making the most of high supply and the

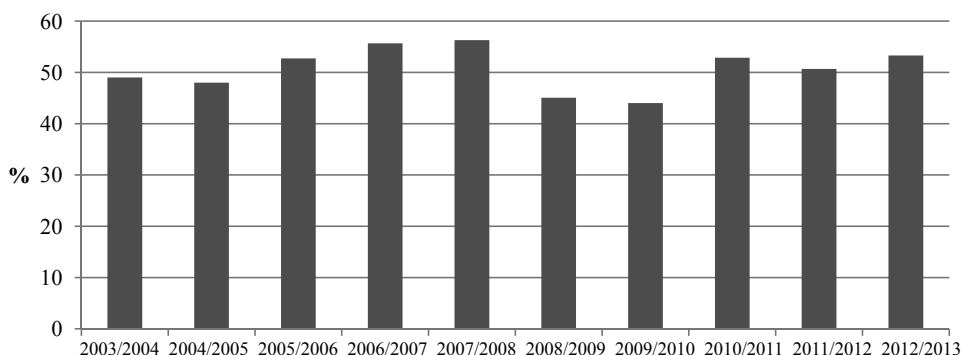


Fig. 3. The share of producer price in retail price on the Warsaw market in the years 2003–2013  
Source: Own investigations.

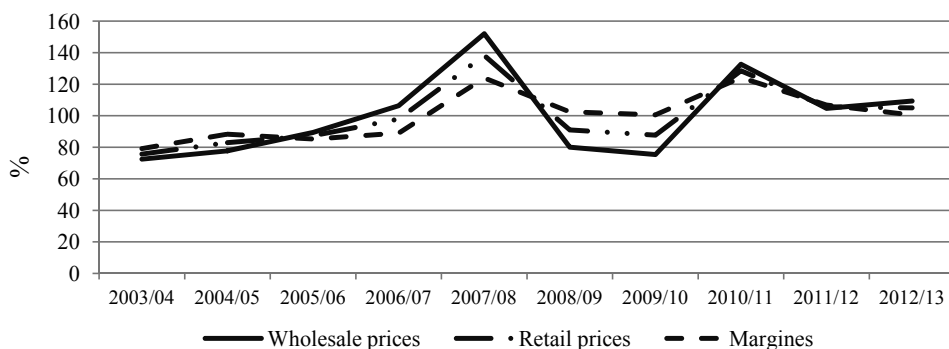


Fig. 4. Fluctuations of wholesale prices, retail prices and margins on the Warsaw apple market in the years 2003–2013 (many year average = 100%)  
Source: Own investigations.

increase of competition, put the producers lower prices and using higher margins compensate themselves the profits lost in the years of a low supply and high producer prices. That leads to a greater price stability on the retail market. However, at the same time the consumer does not get full information about supply and in the situation of its high level gets smaller profits from it. With the proportional transfer of the producer price fall on the retail price the demand for apples could increase. In reality that demand in Poland is not flexible, the market for apples became saturated and consumption stays at the same level for a number of years. Thus the aim of the retailers is maintaining that stable level and at the same time limiting their own risk.

### Seasonal nature of apple prices

In the years 2003–2013 apple prices showed bigger or smaller seasonal fluctuations, depending on the crop volume. Generally these prices were at their highest in July, i.e. at the time when apples from the last year harvest are in a small quantities and the harvest has not yet begun. From August, when the summer cultivars start to bear fruits, there is

a gradual price fall and that tendency is observed until December. From January apple prices start to grow. The performed analyses show that the producer prices are characterized by slightly higher seasonal nature than retail prices. In the production years from 2003/2004 to 2007/2008 the lowest seasonal indicator of the producer prices was 81% and the highest 135% while the indicator of retail prices 88 and 124% (Table 2). In the years 2008/2009 – 2012/2013 these indicators in the case of producer prices stayed at the level of 79 and 162% and in the case of retail prices – 87 and 146%. These values also show that no decrease in the seasonal nature of apple prices was observed although the cold storage base significantly increased [Makosz 2010] as well as the scale of the shared sale by producer groups and organisations [Sobczak et al. 2013]. However, it should be stressed that those two changes contributed to the relative price fall in June which is advantageous for a consumer. An intensive price growth in the second subperiod resulted from a logical action of producers and not storing apples until July when they lose the competition with a big assortment of seasonal fruits.

Table 2. Indicators of seasonal nature of dessert apple prices in the production years from 2003/2004 to 2012/2013 (%)

Price	Months											
	VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI
2003/2004 – 2007/2008												
Producer	130	118	81	85	87	81	84	86	92	103	126	135
Retail	119	118	95	89	92	87	88	89	90	99	115	124
2008/2009 – 2012/2013												
Producer	162	120	87	84	85	79	81	90	88	103	126	126
Retail	146	112	91	92	87	87	87	90	88	96	111	123

Source: Own investigations.

## CONCLUSIONS

The performed investigations showed that the dessert apple prices on the Warsaw market showed a growing tendency in the years 2003–2013. However, it differed at particular levels, namely the dynamics of the wholesale price increase was slightly higher than in the case of retail prices. A poor increase of retail prices with their simultaneously smaller variability in particular years and lesser seasonal fluctuation show that the price changes at the producer level are not fully transferred to the retail market. It may indicate to the disturbances in the price transmission on those markets. They result from the activities of the retailers stabilizing the consumer market by establishing higher margins with the lower level of producer prices and lower with higher prices. Despite the existing divergences in the price information flow still there is a strong connection between prices at both stages of apple distribution. There is also a strong connection between producer prices of dessert and industrial apples but only in relation to the annual prices and those latter increased more intensively in the calendar years although at the lowest absolute level. Prices of the industrial apples also show the greatest variability from year to year. Low industrial fruit prices and their great variability make the producers to introduce into their orchards the newest production technology which will increase fruit quality quali-



fyng them as the dessert apples for direct consumption thus limiting the amount of the industrial fruit. Despite introducing these solutions in many cases it will be impossible if only due to the occurrence of the adverse atmospheric conditions such as hailstorms, which would decrease the quality of the produced apples. A slight increase of dessert apple producer prices and the simultaneous decrease of their consumption make the gardeners to undertake actions aiming at the expansion to new markets and the increase of export. Its level increases in the years of high supply and low prices on the home market.

## REFERENCES

- Apergis N., Rezitis A., 2003. Agricultural rice volatility spillover: the case of Greece. *European Review of Agricultural Economics* 30(3), 389–406.
- Bakucs Z., Falkowski J., Ferto I., 2012. What causes asymmetric price transmission in agro-food sector? Meta-analysis perspective. Paper presented at the 86th Annual Conference of Agricultural Economic Society, University of Warwick, UK, 16-18 April 2012.
- Jahae L., 2011. The future of the Polish fruit industry. *Mat. XXXI Międzynarodowe Seminarium Sadownicze „Prognoza wielkości zbiorów, potrzeby i opłacalność produkcji owoców w kraju w najbliższych latach”*, Limanowa, 95–98.
- Just M., Śmiglak-Krajewska M., 2013. Pomiar zmienności cen na rynku ziarna roślin strączkowych uprawianych w Polsce oraz rynku śruty sojowej [Measurement of price volatility for the grain of legume plants grown in Poland and for the soy cake]. *Zeszyty Naukowe Szkoły Głównej Gospodarstwa Wiejskiego w Warszawie. Problemy Rolnictwa Światowego* 13(28), 1, 58–69.
- Makosz E., 2010. Problemy jakości owoców w krajowym sadownictwie z uwzględnieniem środków pomocowych PROW na lata 2007-2013 [Quality fruit problems in domestic horticulture with taking into account support measures RDP 2007-2013]. *Mat. Konf. „Jakość owoców. Wymagania prawa i rynkowa konieczność”*, Uniwersytet Przyrodniczy w Lublinie, 11–16.
- Makosz E., 2011. Wielkość zbiorów i opłacalność produkcji jabłek, gruszek, wiśni i czereśni [Volume of the harvest and the profitability of apples, pears and cherries production]. *Mat. XXXI Międzynarodowe Seminarium Sadownicze „Prognoza wielkości zbiorów, potrzeby i opłacalność produkcji owoców w kraju w najbliższych latach”*, Limanowa, 37–49.
- McLaughlin E.W., 2004. The dynamics of fresh and vegetable pricing in the supermarket channel. *Preventive Medicine* 39, 81–87.
- Nosecka B., 2008. Aktualny stan rynku owoców i ich przetworów w Polsce (sezon 2007/08 i 2008/09) [The current state of fruit market and their products in Poland (season 2007/08 and 2008/09)]. *Mat. Konf. „Rynek owoców w Polsce i na świecie, chwilowa dekonjunktura czy głęboki kryzys?”*, ISiK w Skierniewicach, 5–24.
- Nosecka B., Bugała A., Paszko D., Zaremba Ł., 2012. Sytuacja na światowym rynku wybranych produktów ogrodnich i jej wpływ na polski rynek ogrodniczy [The situation on the global market the selected of horticultural products and its impact on the Polish horticultural market]. *Instytut Ekonomiki Rolnictwa i Gospodarki Żywnościowej – Państwowy Instytut Badawczy* 39.
- Serra T., Gil J.M., Goodwin B.K., 2006. Local polynomial fitting and spatial price relationships: price transmission in EU pork markets. *European Review of Agricultural Economics* 33, 415–418.
- Sobczak W., Jabłońska L., Olewnicki D., 2013. Stopień zorganizowania producentów owoców i warzyw w Polsce [The degree of fruit and vegetables producers' organization in Poland]. *Zeszyty Naukowe Szkoły Głównej Gospodarstwa Wiejskiego w Warszawie. Problemy Rolnictwa Światowego* 13(28), 1, 119–127.

- Szajner P., 2013. Wpływ zmienności światowych cen cukru na sytuację ekonomiczno-finansową sektora cukrowniczego [Impact of world sugar prices volatility on financial standing and economic performance of the sugar sector]. *Zeszyty Naukowe Szkoły Głównej Gospodarstwa Wiejskiego w Warszawie. Problemy Rolnictwa Światowego* 13(28), 1, 137–145.
- Świetlik K., 2008. Ceny żywności w procesie rynkowych przemian polskiej gospodarki (1994-2004) [Food prices in the market transformation of the Polish economy (1994-2004)]. *Studia i Monografie, IERiGŻ-PIB, Warszawa*.
- Vavra P., Goodwin B., 2005. Analysis of price transmission along the food chain. *OECD Food, Agriculture, and Fisheries Working Papers* 3.
- Wróblewska W., 2012. Zmienność cen na polskim rynku owoców w latach 2002-2011 [Price variability on the polish fruit market between 2002 and 2011]. *Roczniki Naukowe SERiA XIV*, 1, 556–560.
- Wysokiński M., Jarzębowski S., 2013: Kształtowanie się cen mleka w gospodarstwach o różnym stopniu koncentracji produkcji [The development of milk proces in farms characterized by different level of production concentration]. *Roczniki Naukowe SERiA XV*, 1, 231–237.

### ZMIENNOŚĆ I WSPÓLZALEŻNOŚĆ HURTOWYCH I DETALICZNYCH CEN JABŁEK NA RYNKU WARSZAWSKIM W LATACH 2003–2013

**Streszczenie.** W pracy badano zmiany i współzależność cen jabłek na rynku warszawskim na trzech poziomach łańcucha marketingowego – cen producenta jabłek przemysłowych, cen producenta i cen detalicznych jabłek deserowych. Aby ocenić ich wzajemne powiązania, dokonano pionowej i poziomej analizy porównawczej zmian w cenach jabłek na wspomnianych rynkach. Analizowano kierunek i dynamikę ich zmian, poziom ich zmienności z roku na rok, wahania sezonowe. Określono również siłę związku między nimi, a także wpływ poziomu cen na kształtowanie się poziomu eksportu na poszczególnych powyższych etapach dystrybucji. Przeprowadzone badania pozwolą na ocenę obecnej sytuacji i wskazanie kierunku działań dla utrzymania pozycji Polski jako liczącego się producenta jabłek.

**Słowa kluczowe:** ceny producenta, ceny detaliczne, zmienność cen, jabłka przemysłowe, jabłka deserowe

Accepted for print – Zaakceptowano do druku: 02.09.2014