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LONG-TERM CHANGES OF MAIN INPUT-OUTPUT PRICES IN THE HUNGARIAN BROILER SECTOR

DŁUGOTERMINOWE ZMIANY RELACJI CEN PRODUKTÓW DO CEN NAKŁADÓW W WĘGIERSKIM SEKTORZE PRODUKCJI BROJLERÓW

Key words: feed prices, broiler price, price relations, trend, correlations

Słowa kluczowe: ceny pasz, cena brojlerów, relacje cen, trend, korelacje

JEL codes: Q11, Q13

Abstract. The article presents changes of the main input-output prices in the Hungarian broiler industry over a period of 30 years, and associated correlations. For the processing of long-term data, a linear regression function, correlation and regression analysis were used. The cereal prices correlate and their changes also correspond with a change in compound feed prices. A close correlation can be found between cereal price and broiler price, whilst the correlation shown between the compound feed price and broiler price is very close. During the examined period, the feed prices increased at a higher rate than the broiler price. It was also established that the current feed and energy price significantly affect day-old chick prices which corresponds with an increase in price of the broiler. Furthermore, a close relation can be found between energy and feed compound prices.

Introduction

The Hungarian poultry sector plays a significant role in the national economy, and represented 12.7% of gross agricultural production, as well as nearly 37% of livestock farming in 2014 [HCSO 2015]. According to the data of the Hungarian Poultry Production Board [HPBB 2015], in 2012-2014 the gross production value of the sector together with the poultry industry exceeded HUF 560 billion. The share of broilers was 46.1%, and of turkeys was 20.2%. The role of the additional poultry branches is also significant, ducks provided 13.2%, geese 11.3% and eggs sector 9.3% of the production value [Csorbai 2015]. The Hungarian poultry sector is also characterized by a high self-sufficiency rate (145%) [AVEC 2015], and 55 to 57% of revenue from duck and goose meat derives from export. In the case of turkey meat this rate is at 46-47%, while with chicken 26 to 27% of the revenue comes from export [Csorbai 2015].

Hungary has diverse geographical and natural characteristics conducive to agricultural production. The country has comparative advantages primarily in cereal production. According to Gábor Udovecz [2003], there is a direct correlation between the competitiveness of cereal production and of poultry farming. If cereal production is competitive so is the poultry sector. At the same time, András Szentirmay [2006] – examining the competitiveness of the Hungarian poultry sector – concluded that after Hungary acceded the EU's internal structure of the sector and its different economic processes, a disadvantageous competitive business environment arose for many participants of the poultry industry. The cost and income conditions of integrated poultry industrial activity showed a disadvantageous trend during the decade following the accession, and several enterprises had to terminate their activity.

In each animal breeding sector even a small variation of cost determines the achievable income. In the case of broilers, as with a lot of other livestock, the feed, day-old chick prices and energy represent the highest cost items. In addition to the costs, the income realizable by the

enterprises highly depends on the selling price, the sales revenue, and on the different support funds. At the same time, according to László Szőllősi and István Szűcs [2015], the producers have a very limited possibility to influence these factors. In our opinion the only way to manage the effects deriving from the price changes at plant level is the improvement of efficiency (production parameters).

Andrea Keszi [2005] points to the fact that the selling price strongly fluctuates depending on supply and demand conditions. Other reasons include consumer panic (e.g.: avian influenza) or lack of cooperation. Moreover, the variation of the prices can be highly affected by international trends and the change of pork meat price.

József Popp's [2007] findings, according to which an increase of the feed and energy prices significantly affects the poultry sector, are still valid. The feed prices are significantly affected by the fact that Hungary needs to import protein, and that the surge of the bioethanol production contributed to the increase of maize prices. The OECD-FAO [2015] report referring to the period of 2015-2024 forecasts the further expansion of ethanol and biodiesel. World market changes and the increasing feedstuff demand of several countries of the world (e.g. China, India) are also determinant factors. According to László Szőllősi and István Szűcs [2014], the change of global wheat, maize and soy prices can be followed by changes in feed prices. For this reason they emphasize the significant volatility of the feedstuff raw material prices experienced during the last decade, which will represent a high uncertainty factor for the poultry sector in the future as well.

According to Péter Zoltán [2010], today competitive broiler production cannot be imagined without a very good understanding and effective use of the factors affecting it. That means that due to the fierce market competition there is a need for the continuous examination of the factors affecting competitiveness, developments at farm level and optimization of the factors, which can be directly influenced by the enterprises. Ultimately, that inspires the producers to continuously improve the efficiency parameters in the interest of the reduction of the production cost. Katarzyna Utnik-Banaś's [2016] results shows same context in Poland. An essential condition of the efficient production is the application of the best genotypes during the production stage. However, that establishes the possibility only for the increase of efficiency, the requirements of the genetic background under the actual macroeconomic conditions must be fully met by additional resources used during production including barns, technology, feedstuff, human resources, etc.

The objective of the study is to present the development of the main input-output prices of Hungarian broiler fattening based on long term findings, and to disclose the statistically demonstrable correlations between these factors. Taking into consideration the objective, the following questions were raised: 1) What kind of correlation can be demonstrated between broiler feedstuff and cereal prices? 2) How did the main input-output prices vary in the broiler sector in Hungary during the last 30 years, and what kind of correlation can be demonstrated between these factors? My research hypotheses are the following: H1: The broiler feed and cereal prices are in correlation with each other, and a variation in cereal prices correlates with a change in broiler feed prices H2: During the last 30 years, the increase of the input prices were not fully reflected in the selling price of the broiler.

Research material and methodology

The secondary data required for the examination were provided by the Hungarian Poultry Production Board [HPBB 2015] and the Market Price Information System of the Hungarian Research Institute of Agricultural Economics [MPIS 2017]. Trends in time periods were analysed, for the description of which linear trend functions (linear regression) were used. For the examination of the correlation among the processed data, correlation and regression analysis were used. During the analyses, I looked for the answer to the following questions: Is there any correlation among the variables? How close is that correlation? How can we conclude from the variation of one of the variables the variation of the other variable? In order to quantify the

strength and direction of the correlation among the variables the Pearson correlation coefficient (r) was used. The coefficient value between 0.0-0.4 indicates slight, between 0.4-0.7 moderate, between 0.7-0.9 a close, and over 0.9 a very close correlation [Mészáros 1981].

Research results

Based on the monthly data of MPIS [2017] (fig. 1), during the period of 2004-2013 the price of wheat varied between 17.7 (07.2005) and 75.7 HUF/kg (03.2011), on average it amounted to 42.6 HUF/kg. Based on the linear function describing the data (y=0.177x+28.669, R^2=0.316), considering the trend, an annual average of 2.1 HUF/kg price increase can be found. During the same period, as far as maize was concerned, the lowest value was 19.8 (01.2005), while the highest value was 64.0 HUF/kg (01.2013) and the average was 39.5 HUF/kg. Considering this trend, the annual average price increase was 1.7 HUF/kg (y=0.144x+28.190, R^2=0.289). At the same time, in addition to the trend a significant fluctuation can be seen in the case of both cereals.

Among the compound feeds the price of the starter feed varied between 52.6 HUF/kg (12.2005) and 120.9 HUF/kg (10.2012), and on average was 84.0 HUF/kg during the given period. In case of the rearing (grower) feed it varied between 49.6 HUF/kg (07.2005) and 113.3 HUF/kg (10.2012) (78.3 HUF/kg on average), while in the case of withdrawal (finisher) feed the price varied between 45.2 HUF/kg (01.2005) and 108.2 HUF/kg (11.2012) (74.2 HUF/kg on average). In case of the linear models describing the price variations much higher R^2 values were experienced in comparison with the cereals and that can be explained by the smaller variances of prices. The function describing the price of the compound feed in the case of the starter feed is: y=0.349x+56.607 (R^2=0,742); with rearing feed it is: y=0.319x+53.258 (R^2=0.711); while with withdrawal feed it is: y=0.334x+47.970 (R^2=0.723). Based on these data, the price of the compound feed increased annually by HUF 3.8-4.2 per kilogram during the period of 2004-2016, which exceeds the price increase experienced in the case of cereals.
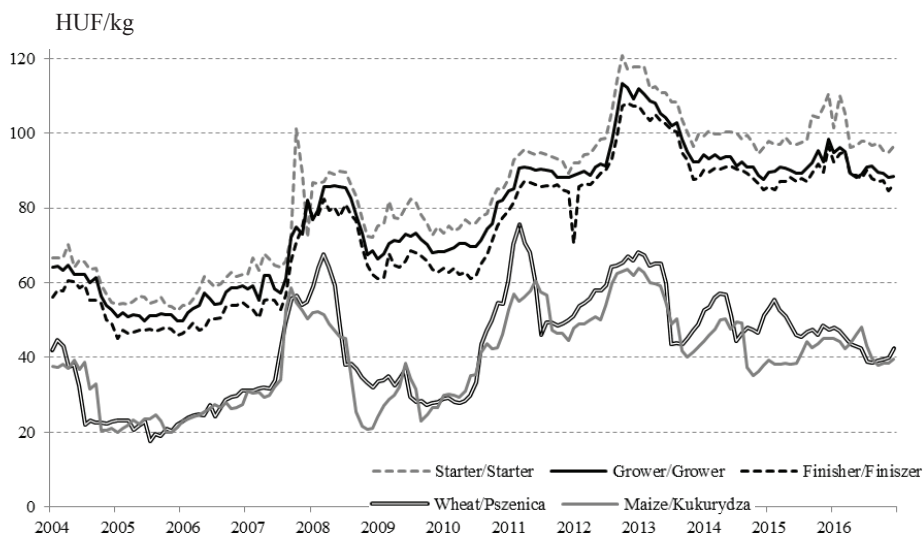

Figure 1. Development of cereal and broiler feedstuff prices (2004-2016)
Rysunek 1. Ceny pasz zbożowych i brojlerów (2004-2016)
Source: own calculation based on [MPIS 2017]
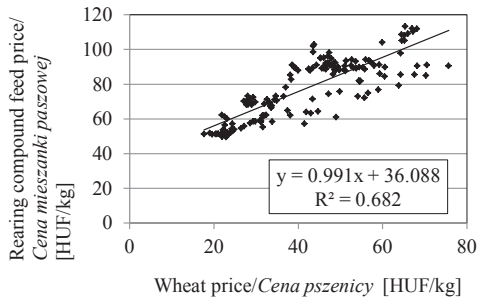*Źródło: obliczenia własne na podstawie [MPIS 2017]*

Figure 2. Correlation between the wheat and rearing compound feed prices (2004-2016; n=156)
Rysunek 2. Korelacja między cenami pszenicy i mieszankami grower (2004-2016; n = 156)
Source: own calculation based on [MPIS 2017]
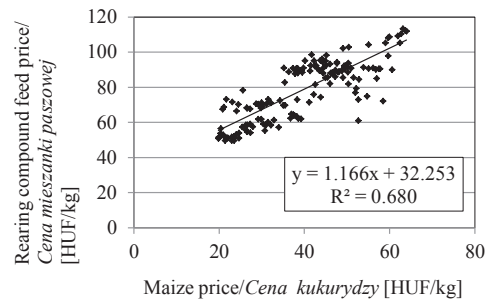*Źródło: obliczenia własne na podstawie [MPIS 2017]*

Figure 3. Correlation between the maize and rearing compound feed prices (2004-2016; n=156)
Rysunek 3. Korelacja między cenami kukurydzy i mieszankami grower (2004-2016; n = 156)
Source: own calculation based on [MPIS 2017]
Źródło: obliczenia własne na podstawie [MPIS 2017]

It can be proved statistically that the price of wheat and maize correlate with each other (R=0.914, p<0.05), and their change can be observed in the development of the compound feed prices, and a positive and close (R>0.8) significant (p<0.05) statistical correlation can be demonstrated between the prices of the examined cereals and of the broiler compound feeds (fig. 2 and 3). The maize price increase of 1 HUF/kg resulted in an increase of 1.22 in the starter feed price, of 1.17 in the rearing feed price, while a 1.2 HUF/kg increase in the case of the withdrawal feed. The wheat price increase of 1 HUF/kg resulted in an increase of 1.04 in the starter feed price, of 0.99 in the rearing feed price, and a 1.02 HUF/kg increase in the case of the withdrawal feed during the examined period.

In addition to the change of compound feeds prices, we cannot disregard the trend of the buying-in prices of broilers and the correlation between them. According to the monthly data of MPIS [2017] referring to the period of 2004-2016, the buying-in price of broilers varied between 162.8 (12.2005) and 302.3 HUF/kg (03.2013), the average buying-in price was 228.9 HUF/kg. In this tendency we can observe an annual average price increase of 9.4 HUF/kg (y=0.784x+167.391, R^2=0.747).

On the whole, the rearing feed amount, which can be purchased for the price of 100 kg of broilers representing the input-output price ratio and a significant fluctuation during the examined period (min = 250.7 (10.2012), max = 338.8 (06.2005), average = 295.5 kg/100 kg) can be characterized by a downward trend (y=-0.223x+312.976, R^2=0.322). The rate of decrease was 2.7 kg/100 kg annually, showing a clear decline in terms of trade, which adversely affected the cost-income relations of the sector.

The variation of feed prices was examined over a longer period of time (1986-2014) – figure 1. The trend of compound feeds price saw an annual average increase of 3.3-3.6 HUF/kg, (start feed: y=3.616x-5.018 R^2=0.933, rearing feed: y=3.421x-4.705 R^2=0.927, withdrawal feed: y=3.292x-6.251, R^2=0.927). At the same time the trend of broiler price (y=8.864x+18.731, R^2=0.941) showed an annual increase of 8.9 HUF/kg. During the period of 1986-2014 the broiler price increased from 30.6 HUF/kg to 275.16 HUF/kg, amounting to approximately a factor of nine, the price of the rearing feed increased from 7.7 HUF/kg to 90.9 HUF/kg, which is close to a factor of twelve. This resulted in a significant decline of the input-output price ratio (y=-8.344x+498.298, R^2=0.647), especially when comparing the period before 1997 and after 1997.
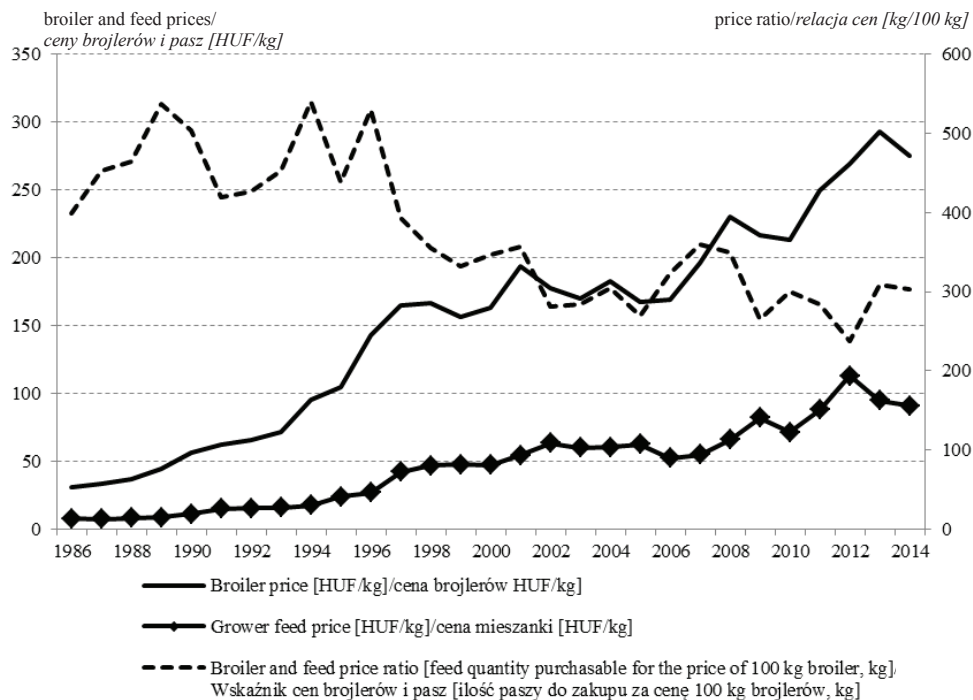
Figure 4. Development of broiler and feed prices (1986-2014)
Rysunek 4. Ceny brojlerów i pasz (1986-2014)
Source: own calculation based on [HPBB 2015]
Źródło: obliczenia własne na podstawie [HPBB 2015]

As far as the price of cereals and broilers was concerned, a statistically close (R=0.8, p<0.05) correlation was observed, while between the price of compound feed and broiler a very close (R=0.97-0.98, p<0.05) correlation can be demonstrated. Based on the linear regression models describing the correlation between the cereal and broiler prices, a 1 HUF/kg increase of the wheat and maize prices resulted in an increase of 2.2 and 2.6 HUF/kg of the broiler price during the period of 2004-2016 (fig. 5 and 6). In the case of the compound feeds that meant a price increase of 2.2-2.3 HUF/kg (fig. 7).

Referring to the HPBB [2015] for the period of 1986-2014, it can be also proved statistically that there is a very close correlation between the price of compound feeds and broilers (R>0.96, p<0.05). During this period a unit of price increase of the compound feeds led to a broiler price increase of 2.4-2.6 HUF/kg.

After the feed, the second most important cost item is the day-old chick. Until the beginning of the 1990s a relatively stable day-old chick price of 10 HUF/pc and a hatching egg price of 5-6 HUF/pc were characteristic in Hungary. By 2014, these values approached 100 HUF/pc (hatching egg 45-50 HUF/pc), in its trend (y=3.483x-1.266, R2=0.963) an annual average increase of 3.5 HUF/pc can be seen.

From the aspect of production, another important cost item is the energy price. During the period of 1996-2014, prices of energy sources showed a significantly increasing trend. In comparison with 1996, by 2014 the price of electrical power increased by 4.4 times, diesel fuel price by 3.8 times, while the natural gas price increased by 6.6 times [HCSO 2017]

$y = 2.240x + 133.606$
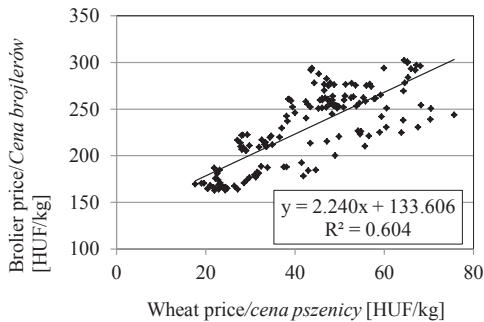$R^2 = 0.604$

$y = 2.603x + 126.189$
$R^2 = 0.588$

Figure 5. Correlation between wheat and broiler prices (2004-2016; n=156)
Rysunek 5. Korelacja między cenami pszenicy i brojlerów (2004-2016; n=156)
Source: own calculation based on [MPIS 2017]
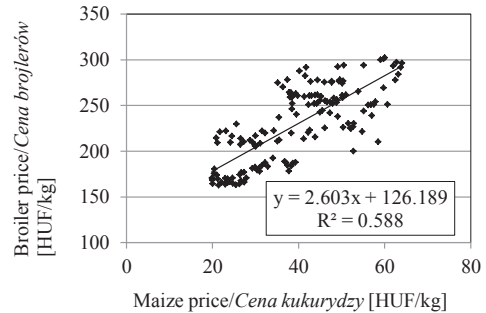*Źródło: obliczenia własne na podstawie [MPIS 2017]*

Figure 6. Correlation between maize and broiler prices (2004-2016; n=156)
Rysunek 6. Korelacja między cenami kukurydzy i brojlerów (2004-2016; n=156)
Source: own calculation based on [MPIS 2017]
Źródło: obliczenia własne na podstawie [MPIS 2017]
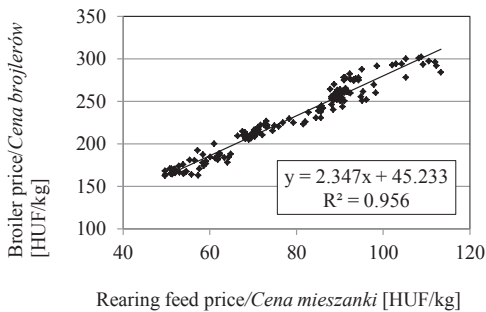

$y = 2.347x + 45.233$
$R^2 = 0.956$

Figure 7. Correlation between rearing feed and broiler prices (2004-2016; n=156)
Rysunek 7. Korelacja cen mieszanek grower i cen brojlerów (2004-2016; n=156)
Source: own calculation based on [MPIS 2017]
Źródło: obliczenia własne na podstawie [MPIS 2017]

It can be established that the increase of average price of day-old chicks is highly affected by the actual feed and energy prices. The day-old chick price shows a very close correlation ($R>0.9$, $p<0.05$) with both the feed and energy prices. During the period of 1986-2014, at a unit increase of the rearing feed price, the day-old chick price increased by HUF 0.96 ($y=0.96x+5.99$, $R^2=0.934$, $p<0.05$). During 1996-2014, alongside the increase of electrical power by 1 HUF/kWh the day-old chick price increased by HUF 1.3 ($y=1.28x+28.15$, $R^2=0.921$, $p<0.05$), while in case of natural gas such an increase (1 HUF/m³) meant an increase of HUF 0.4 ($y=0.37x+44.82$, $R^2=0.834$, $p<0.05$).

Similarly to the compound feeds, the day-old chick price increase is also reflected in the increase of the broiler price. The correlation between these two factors is very close statistically ($R=0.97$, $p<0.05$), and according to the linear regression model describing the correlation ($y=2.497x+24.409$, $R^2=0.94$, $p<0.05$) a unit of day-old chick price increase was accompanied by a broiler price increase of 2.5 HUF/kg during the examined period.

A close statistically demonstrated correlation can be observed between the electrical power and rearing feed prices, at ($R=0.871$, $p<0.05$). Alongside a 1 HUF/kWh increase of electrical power price an increase of 1.5 HUF/kg of the compound feed price can be observed during the period of 1996-2014. The compound feed price is also in correlation with the natural gas price ($R=0.903$, $p<0.05$), and with an increase of 1 HUF/m³, a feed price increase of 0.5 HUF/kg can be seen.

Conclusions

During the period of 2004-2016 the annual average price increase of wheat and maize was 2.1 and 1.7 HUF/kg, and alongside that an increase of broiler compound feeds was 3.8-4.2 HUF/kg. Cereal price variation occurs with changes of compound feed prices, as well. During the examined period, a unit increase of the price of maize resulted in an increase of 1.17-1.22 HUF/kg in the price of compound feeds. The unit increase of the wheat price led to a price increase of 0.99-1.04 HUF/kg. Based on the above my hypothesis H1 is accepted saying that "The broiler feed and cereal prices are in correlation with each other, and a variation in cereal prices correlates with a change in broiler feed prices". The disclosed correlations can be considered as being appropriate for the preparation of future forecasts.

Between the cereal and broiler prices a close, whilst between the compound feed and broiler prices a very close correlation is demonstrated. At the same time, during the period of 1986-2014 the feed prices increased at a higher rate (nearly 12-fold) than the broiler price (about 9-fold). That is also supported by the price ratio development of the feed and broiler, which can be characterized by a decreasing trend, showing a decline in terms of trade. During the period of 1986-2014, a unit increase of the compound feeds resulted in a broiler price increase of 2.4-2.6 HUF/kg. It can be also established that during the same period the day-old chick price showed a tenfold increase, and also a significant increase can be observed in electrical power prices, during 1996-2014. Based on the above, my hypothesis H2 is accepted in which it is stated that "During the last 30 years, the increase of the input prices were not fully reflected in the selling price of the broiler."

It was also established that the actual feed and energy (electrical power and natural gas) prices significantly affected the day-old chick price. A unit increase of the rearing feed price was followed by an increase of the day-old chick price by HUF 0.96. During the period of 1996-2004 alongside the increase of the electrical power price for each unit the day-old chick price increased by HUF 1.3, while in the case of natural gas the increase was HUF 0.4. Moreover, a very close statistical correlation was demonstrated between the day-old chick and broiler prices. The increase of the day-old chick price by a unit was accompanied with a broiler price increase of 2.5 HUF/kg during the period of 1986-2014. Additionally, a statistically close correlation was demonstrated between the energy and compound feed prices, as well.

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Streszczenie

Przedstawiono kształtowanie się nakładów i cen produktów w węgierskim sektorze brojlerów w ciągu ostatnich 30 lat oraz korelacje pomiędzy tymi czynnikami. Do przetwarzania danych z długich okresów zastosowano funkcję trendów liniowych (regresji liniowej) oraz analizę korelacji i regresji. Ceny poszczególnych zbóż zmieniały się równomiernie, ponadto kształtowały je zmiany cen mieszanek paszowych. Zaobserwowano ścisłą korelację pomiędzy cenami zbóż i brojlerów oraz bardzo dużą korelację pomiędzy cenami mieszanek paszowych i brojlerów. W badanym okresie ceny pasz wzrastały szybciej niż ceny brojlerów. Stwierdzono również, że bieżące ceny pasz i energii miały znaczący wpływ na ceny jednodniowych piskląt, co również wpływało na kształtowania się cen brojlerów. Stwierdzono także ścisłą korelację pomiędzy cenami energii i mieszanek paszowych.

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