Analysis of the development of the wheat price as an important agricultural commodity

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Abstract

Wheat is a key commodity that is traded on all exchange in the world. After corn, it is the second most cultivated crop in the world. In the V4 countries, it is one of the main crops included in rotation of crops because it doesn’t require a higher need of human labour of special agrotechnical procedures, and its price can cover production costs. This paper is about analysis of the development of wheat prices in the V4 countries from 2011 to the present. Price is one of the important attributes that affects the production or profitability of this commodity. Market prices in countries are based on the Marché à Terme International de France (MATIF). Among the important factors that affect the price of wheat are weather forecasting in the world, which significantly affects the harvest, the exchange rate of the euro to the dollar, the price of oil-seed rape, the prediction of the harvest from the corresponding institutions, world production, consumption and stock affecting the demand and supply of the given commodity, singing and terminating contracts, trade agreements, etc. In the years 2011 - 2014, the minimum price of wheat was at the level of €176.50/t. During the year 2021, a new price maximum was recorded, when wheat cost €313.5/t in November, which was affected not only by inflation, but also by the increase in energy prices. The conflict between Russia and Ukraine contributed to new price records, when in March 2022 the price reached the level of €450/t. From the point of view of the V4 countries, the average price for the analysed period was the lowest in Slovakia (€168.20/t) and the highest in Poland (€178.03/t). The price premium represents the difference between prices on the MATIF and physical prices on the market. Based on the quantification, we conclude that the highest average price premium among the V4 countries was in Slovakia (€28.59/t) and the lowest in Poland (€16.60/t). The price of wheat mainly affects the price of flour, where 70 – 80% of production costs are consisting of the price of wheat. Support schemes are one of the compensations for the high prices of raw materials and energy.

Keywords: price, price premium, V4 countries, wheat

JEL Classification: Q02, Q10, Q11
1. Introduction

The agriculture in Slovakia has undergone significant changes, not only in terms of its position in the national economy, but also in terms of its importance at the regional level. The agricultural subsidies are an essential aspect of agriculture and play an important role in international trend (Kravčáková Vozárová & Kotulič, 2016). Grains are the mainstay of crop production in Slovakia. Their share in gross agricultural and gross crop production is increasing every year. In the years 2017-2019, they participated in the gross agricultural production on average 27.4% and in the gross production of crop production 44.7%. The decisive commodity is wheat, the share of which reached an average of 21.8% of gross crop production. It is grown in all production areas and regions in Slovakia, the most productive region is the Nitrian region (Jamborová, 2021). The harvested area of wheat in Slovakia reached 387.1 thousand ha in the economic year 2020-2021. The average yield per ha of wheat was 5.51 tons. The average prices of all grains decreased by 2020 compared to 2019, the average price of food wheat was 152.26/t € and industrial wheat 137.30/t €. Grains are further processed by the mill, malting, distillery, starch, and feed industries. The produced products are sold on for processing to the food industry, trading companies and final consumers (Grains – Situation and Outlook Report, 2021).

Grain production is one of the most crucial branch of Polish agriculture. Poland has a second place in the EU in grain production. For years, national demand for grains oscillated between 26-28 mil. tons. (Gorlach et al., 2018). Hungary is traditionally an agricultural country, and the agricultural sector is still a dominant one in the economy. On a global scale wheat is one of the most important grain products both globally and in Hungary as well. During the past years wheat has the second biggest volume after corn on the local market (Szerb & Csima, 2016). The area used for wheat production purposes occupies 22-26 % of Hungarian arable land. The other crucial component of production is yield, which has increased significantly, by almost 45 % over the last 11 years (2010-2020) (Mizik & Máté Rádai, 2021). Wheat production reached 4,902.5 thousand tones in 2020. Even in the Czech Republic, wheat is the dominant crop on the cereal market, accounting for 60.3% of all grains. In the economic year 2020/21, the area planted with wheat was 798.6 thousand ha. The average total yield was 6.14 t/ha (Grains- Situation and Outlook Report, 2020).

The EU is a major player in the global wheat market. Paper of authors Dawson et al. (2017) examine the pricing behaviour of EU wheat exporters using a pricing to-market (PTM) analysis. Over the last decade, commodity prices have registered substantial booms and busts marked by extreme volatility. Wheat in particular, one of the main nonoil commodities, has registered a roller coaster in price levels which seems to be inconsistent with supply and demand fundamentals (Algieri, 2014). According to the latest FAO-AMIS (Agricultural Market Information System) outlook, agricultural commodity markets have been volatile in light of this year, with prices reaching record highs due to low global grain stocks, but also due to geopolitical risks (military conflict in Ukraine). Dry weather, high energy and transport prices also have a negative impact. The current price of wheat on the 7/10/2022 MATIF Paris exchange was €351.25/t (Cereal Growers Association). Shaping of prices of agricultural raw materials results from the impact of wide range of factors that influence prices in different links in the marketing chain. Political changes, especially sudden ones, which abruptly changed farming conditions, were on of the reasons for the asymmetry in price transmission (Kusz, Kusz & Hydzik, 2022). However, the prices of commodities are influenced by the set of different variables, i.e., supply and demand factors. The empirical results indicate that the main price drivers of wheat are crude oil prices, exchange rate and stock of wheat lagged one period (Alekneviciene & Bendoraityte, 2015). The results of grain production have a significant impact on the volume and profitability of the whole agricultural sector and, consequently, on the performance of the national economy (Vincze et al., 2022).
2020). The analysis, using a two-sector econometric model, indicates that output and stock-holding of major exporters like USA, Canada and Australia hold large implications for the stability of world wheat markets (Sekhar, 2003). The warming of the climate and shrinking freshwater resources pose serious challenges to European agriculture. However, a major part of the Mediterranean and the Carpathian-Balkan regions and Eastern Europe recorded the driest soils over recent decades. Summer half-year moisture declined across almost the entirety of Eastern Europe, threatening the reproductive stage of wheat and maize vegetation period (Pinke et al., 2022).

Climate change poses complex impacts on the global wheat supply and demand chain. The impacts of climate change on average wheat yields are reasonably well studied. Zhang, et al. (2022) show that future global wheat prices will exhibit steeper spikes at 2°C global warming despite a 1.7% increase in production given that CO2 fertilization benefits crops. Such economics stresses could be abated by trade liberalization with lower prices. In modern wheat management it is necessary to harmonise the agroecological, biological and agrotechnical elements to increase the yield quantity, quality and stability, and to decrease the harmful environmental effects (Pepo, 2001).

2. Data and Methods

The main goal of the contribution is price analysis on the MATIF market, analysis on local markets in countries V4 with evaluation of price premiums, analysis of the impact of fundamentals on the price. Research is made in the period of 2011 to year 2020, i.e., in a ten-year period. Due to the need for a lot of data, the information is drawn from several secondary sources. These are data from Research institute of agricultural and food economics, Statistical office of V4 countries, EUROSTAT. Mainly mathematical-statistical methods, synthesis, analysis for the needs of describing changes in indicators during the monitored period as well as the method of comparison are used to evaluate the price development. Due to the timeliness of the data and the need for specific information, specialist monthly articles were used from professional databases available online and websites from relevant sources, whose content is also in line with the topic addressed. The graphs and calculations were made using the platform of portal investing.com.

- simple individual indexes, namely basic and chain:

\[ i_{j/0} = \frac{q_j}{q_0} \text{ or } \frac{p_j}{p_0} \]

\[ i_{j/j-1} = \frac{q_j}{q_{j-1}} \text{ or } \frac{p_j}{p_{j-1}} \]  \hspace{1cm} (1)

- variation ranges for expressing the difference between the maximum and the minimum

- absolute changes to determine the differences between individual years:

\[ \Delta y_t = y_t - y_{t-1} \quad t = 2, ..., n \]  \hspace{1cm} (2)

- moving averages used to determine the trend:

\[ MA = \frac{(P_1+P_2+...+P_n)}{n} \]  \hspace{1cm} (3)

- price premium indicator in €:

\[ CP = \text{stock-exchange value - price on the market} \]  \hspace{1cm} (4)

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3. Results and Discussion

In the case of analyzed countries, the harvested area of wheat depends significantly on the size of the country's territory, as due to localization, the countries have relatively similar conditions for its cultivation. Thus, we record the highest harvesting areas in the case of Poland, where wheat areas occupy an average of 2,336.63 thousand hectares over the course of ten years. It is a significantly higher value, which is why a second vertical axis is also used in the in Figure 1 to describe the values. Hungary is the second largest country among the V4 countries by area, and for that reason, wheat areas in Hungary occupy an average of 1004.18 thousand hectares, which is 1332.23 thousand hectares less than in the case of Poland. In the Czech Republic, the area of cultivated wheat is spread over an area of 830.32 thousand hectares, and in the case of the Slovak Republic it is approximately 2.3 times less, where the average area of wheat is located at 358.94 thousand hectares. In the case of Poland, also due to the size of the hectare areas, we record the highest average year-on-year increase in the harvesting area by 23.65 thousand hectares. It is an average year-on-year change of 1.1%. Evidence of the increase is also given by the linear trend line, which clearly shows a progressive development. During the period, the areas in Poland increased by 212.85 thousand hectares, which is a change of 9.42% compared to the initial year. The relatively stable development of areas is measured in the Slovak Republic, where the average year-on-year growth during the period shows a growth of 230 hectares per year. However, the difference between the initial and final year is not large, as the value in 2020 is higher by 2.04 thousand hectares. The highest year-on-year increase in areas is observed between the first and second analyzed years, when the areas increased by 26,590 ha. We recorded the highest year-on-year decrease between 2016 and 2017, when wheat areas decreased by 43,190 ha.

Figure 1: Development of wheat harvesting areas in V4 countries

Source: own processing (Eurostat)
The figure below shows the development of monthly wheat prices on the MATIF exchange with the opening, closing, lowest and highest prices for the analyzed period. Commodities are very volatile assets, as reported by the standard deviation of average monthly prices at the level of 38.46. According to the analyses, the development of wheat prices is developing progressively based on the average month-on-month price increase of 1.06 €/t, which represents an increase of 0.6%. During the period, prices increased by 141.63 €/t. However, high average monthly prices were achieved both in the initial period of the analysis and in the final period of the analysis. Therefore, if we analyze the average minimum and average maximum value from the file, we find that the difference is 263.63 €/t. If the average values are omitted, the difference between the maximum and the minimum in the set is 310.5 €/t. In the Figure, it is possible to observe the development of the moving average over 12 periods, in our case over a year. The indicator is in the growth phase 55% of the analysed time, based on which we can state a progressive price development.

**Figure 2: Development of the moving average indicator for monthly wheat prices**

Source: own processing (investing.com)

In the initial years of the analysis, i.e., in the years 2011-2014, monthly wheat prices moved in one price channel, which formed the minimum price at the level of 176.5 €/t and the maximum price at the level of 283 €/t. We can observe the resistance level in Figure 3 labeled 2. The resistance was reached in February and May 2011 and in November 2012, while the maximum price was also reached in these periods. On the contrary, the support level from October to December in 2011 and also in August 2013. The support level is marked with the number 1 in the picture. As you can see, the change occurs in July 2014, when the support line was cut and there was a downward trend with recoveries until March 2016. A significant decrease occurs between May and September in 2014, when the average monthly price of wheat decreased by 42.75 €/t. However, from October to
December 2014, the price recovered by 31.63 €/t. Between January and May, respectively May and July 2015, price variability occurs downwards, but also upwards. However, the changes between July 2015 and September 2016 are significant, when the price per ton decreased by 67.25 €/t. Very low prices have been reached since September 2015, which are marked in the Figure with the label 3. In September 2016, the price minimum for the entire set was reached, when wheat was traded on the MATIF exchange at a price of 139.5 €/t. During this analyzed period, prices were mainly influenced by the amount of wheat production in the world, when it was possible to achieve record growing results several times in a row. In particular, based on this, we could observe a downward trend. The slight recovery during this period was mainly caused by the Russian-Ukrainian conflict and also the introduction of an export tax on crops in Russia, which is a major exporter of wheat. From the price minimum in 2016, it is possible to state a growing trend of development until the end of the analysis. It is obtained by deduction, when the picture shows a growing trend of significant minimum prices in individual periods. The minimum price in September 2017 was 147 €/t, in September 2019 it was 151.25 €/t, in March 2020 it was 170 €/t and in July 2021 196.25 €/t (the development is shown in Figure 3). During the development of the period, a new support and resistance line formed by lines 3 and 4 was also formed. We can notice that the minimum prices in 2017 and 2019 are located near this line, while the downward trend in these periods turned in favor of growth. Also, line 4 extends from the period from 2014 to 2020, when after approaching the lines, the trend turned into a downward phase. The crossing of line 4 is recorded only in 2021, when the resistance line became a support line. Wheat prices started in 2017 with a positive trend that was carried throughout the entire three-quarters of the year. During this period, the minimum wheat price differed from the maximum by 17.75 €/t. However, in the fourth quarter, under the impression of strong harvests in the main regions of the world (especially a record harvest in Russia), the price of wheat weakened significantly and returned to the lows from the beginning of the year. On a monthly basis, the minimum differed from the maximum by 32.5 €/t, so a more significant decrease can be noted. From the beginning of 2018, the price increased again until the summer, but this time more significantly. The variation margin was 65.5 during this period, so it was 47.75 higher than the previous year. In the period of nine months in 2019, prices decreased by 56 €/t, which was caused by favorable production in the EU, above-standard production in Ukraine and also decent results in Russia. A more significant price drop was recorded in March 2020, which was caused by the pandemic. However, this slump was not long-lasting, and the response of the food supply of the countries and the people raised the wheat prices again in the pre-harvest period. After a slight drop in prices during the beginning of the pandemic, the price of wheat entered an upward trend, when the variation range between March 2020 and January 2021 was 70.25 €/t, which indicates a high increase in prices during this period. In the period during the beginning of 2021, there was a crossing of line 4 and the resistance became a support line from which prices reflected upwards.
As mentioned, wheat prices on the markets of individual European countries are strongly influenced by price developments on the French MATIF exchange. The proof is shown in the Figure 4, which shows the development of average market prices for individual years from the beginning of the analysis in 2011 to the end of the analysis in 2021. The graph shows a similar course of prices in the analyzed markets, while the individual prices in the markets are not the same. If we proceed to the analysis, we will find that the highest average prices for the analyzed period are in Poland at the level of 178.03 €/t, in Hungary at 174.11 €/t, in the Czech Republic at 172.38 €/t and the lowest are in Slovakia at the level of 168.20 €/t. Compared to Poland, prices in Slovakia are on average 9.83 €/t lower, which puts Slovak farmers at a significant disadvantage in terms of economic results. We recorded the highest volatility of prices in Hungary, when the standard deviation was at the level of 26.87, resulting in the highest variation margin at the level of 79.9. The lowest standard deviation is measured in Slovakia at the level of 24.66 with a variation range of 70.27. However, the lowest range of variation was not in Slovakia but in the Czech Republic, where the measured value was 68.3.
Below we can see the price development on the MATIF exchange compared to the monthly average prices on the markets in the V4 countries. We can observe significant trend copying from the MATIF exchange, noting the price differences between market and exchange prices. To prove the dependence of the prices of the V4 countries with the prices on the stock exchange, we calculated the correlation coefficient for individual countries. The highest dependence is observed in Hungary (91.4%), Poland (91.03%), Slovakia (85.78%) and the Czech Republic (84.26%). Based on the calculation, we can state a high dependence between stock exchange and market prices. The aforementioned difference between the prices on the MATIF exchange and the price on the market is called the price premium. The price premium is made up mainly of transport costs. The highest is precisely during the harvest when the storage units are filled the most. For each country, this indicator is different, while it depends on the location of the state, the level of consumption and the level of exports of the given state. Therefore, if the state is a priority exporter, this will be reflected in the amount of transport costs and the price premium is higher. Throughout the period, exchange prices appear to be higher than domestic market prices. When studying in more detail, we see that there are periods when market prices in countries are close to stock exchange prices or even subtly exceed them. These periods mainly occur with a sharp drop in prices on the stock exchange when domestic market prices react later to stock market developments.
Based on the calculations, we conclude that the highest average price premium is in Slovakia (28.59 €/t), the Czech Republic (24.41 €/t), Hungary (22.68 €/t) and Poland (16.60 €/t). The difference in premiums between Slovakia and Poland is 12 €/t. The difference between exchange prices and prices on the domestic market is subject to considerable seasonality during the year, which emerged from the analyses. The price premium is the least advantageous immediately after the harvest, when there is enough commodity on the domestic market, while this premium is gradually adjusted in favor of the farmer. We show seasonality in Figure 6, in which we capture the average values of price premiums in individual months for the period from 2011 to 2021. The highest average values are reached in the month of November, when the average price premium for that month in Slovakia is 38 €/t. The maximum values are also reached in the Czech Republic at the level of 33.6 €/t. In Hungary and Poland, the maximums are reached during the summer months. Hungary – July (36.2 €/t), Poland – August (28.7 €/t). Already according to the maximum values, the order of the states can be seen, in which are arranged based on the amount of the price premium. At the same time, it is possible to observe a decrease in the price premium approaching the minimums reached in the pre-harvest period, when warehouses are the emptiest. Based on the average values in individual years, the lowest values of the difference between exchange and market prices are reached in June 17 €/t in Slovakia, 12.6 €/t in the Czech Republic and 8.8 €/t in Poland. In Hungary, the lowest average values of the price premium were reached in March at the level of 13.3 €/t. From the point of view of the development of the amount of the price premium, it is worthwhile for the farmers to keep the harvest in the warehouses, if possible, in order to achieve the best possible economic result. However, this can be problematic in terms of the need for finance for further operation or in terms of storage costs.
Figure 6: Comparison of price premiums in V4 countries based on average values achieved in the months from 2011 - 2021

Source: own processing (statistical offices of V4 countries)

4. Conclusion

Agricultural production is therefore one of the jobs, with the most specific productions in national economy and at the same time is one of the most important productions ever outputs from it are an integral part of meeting the needs of the population, without which the company would not be able to function properly. Amount of production in individual years it does not depend only on the amount of production factors or on their quality, but also on the factors on which man does not have the reach and abilities to influence them, such as climate conditions that have a very high diversity in Slovakia. It is also important biological nature of agricultural production, when individual processes can be carried out only at a certain specific time depending on the change of seasons.

In conclusion, it is essential to mention that we are experiencing high price volatility, which is caused by pandemic-related measures that have increased inflation. In such periods, investors try to protect their capital from depreciation, and it goes precisely to commodities, which pushes prices upwards. It is also important to note that a new price maximum was recorded during 2021, when wheat cost 313.5 €/t in November. Not only inflation, but also the sharp increase in energy prices contributed to the record increase in commodity prices, as many of them are linked to the production of biofuels. We should also not forget the exchange rate of the euro against the dollar, when it strengthened the dollar against the euro and that helped European wheat, which was cheaper. After the highs in November, there was a downward trend until January 2022. However, prices do not only respond to technical analysis, but also to fundamental analysis, which determined the next price trend. Russia and Ukraine account for 29 percent of the world’s wheat exports, so their conflict contributed to new price records, when the price of one ton of wheat increased by 72% in one month. A new price record was thus achieved, when the maximum was reached in March 2022 at the level of 450 €/t. Due to the unclear situation on the market, further price development is questionable and will depend

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mainly on the development of individual partial foundations. If it weren’t for the current war situation in Ukraine, wheat prices would probably go down, since inflation is at its peak and individual central banks should soon suppress inflation with a stricter monetary policy, and this would lead to a decrease in prices. However, with significant restrictions on Russia, expect that Russia will not be very willing to export wheat to the world. The harvest in Ukraine is also at risk due to the delay in spring work, which is complicated by the war. If the war continues during the year, the world can expect a significant reduction in production in Ukraine, which could lead to further price increases in the event of a lower wheat harvest in the world.

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