

## PRODUCER PRICE RISK IN BULGARIAN AGRICULTURE

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**Abstract:** *The objective of this paper is to compare the levels of price risk faced by producers of basic unprocessed agricultural products in Bulgaria based on certain theoretical assumptions. The research covers the period 2009 – 2017. The risk levels have been measured by using the “coefficient of variation” and “lower partial moment” indicators.*

**Keywords:** *Producer price, risk, agriculture*

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### 1. INTRODUCTION

The liberalization of trade and the dynamic competitive environment have resulted in Bulgarian farmers facing the challenge to operate under conditions of uncertainty and risk. Price volatility is a typical phenomenon in agriculture because of the impact of a number of economic, natural and political factors. Unexpected price changes result in uncertainty regarding the financial return on the funds invested and affect the overall well-being of farmers. This makes the issue about the assessment of price risk in agriculture particularly important. The objective of this paper is to compare the levels of price risk faced by producers of basic unprocessed agricultural products in Bulgaria based on certain theoretical assumptions. The research covers the period 2009 – 2017.

### 2. THEORETICAL FRAMEWORK

The concept of price risk in agriculture is usually associated with the uncertainty with respect to the prices of agricultural produce and the likelihood of an unfavourable and unexpected result or loss for the farmers [1]. This concept implicitly covers the following characteristics of price risk in agriculture with respect to its measurement: *First*, farmers take their decisions to invest in the production of certain products based on their expectations regarding the producer’s price levels that will be established on the market at the time when the products will be sold. The price risk is associated with the likelihood of any discrepancy between the actual and the expected result. *Second*, price risk is associated with the likelihood of an *unfavourable* change in the price levels. Farmers evaluate the price as either “favourable” or “unfavourable” based on comparing its actual level with their preliminary assumption. This means that in order to measure the level of price risk, it is important to be aware of the benchmark used by the farmers for comparison in order to evaluate the price as “expected” or “unexpected” and as a “favourable” or “unfavourable”. Researchers who identify price risk based on price volatility assume that farmers set their expectations based on the average prices established over a certain period [2]. In addition, some authors [3] have proven that investors from certain groups determine the success of their investment decisions based on a comparison of the price established on the market with more than one variable. Depending on the cultural and historical characteristics of farmers, the technological progress and the agricultural policy that is currently in force, the variables used by producers for comparison may vary. For instance, Champika

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(2016) [4] established that farmers in some communities formulate their expectations regarding prices and take decisions on the type of products to produce based on the price during the previous year, the costs for production, the resilience of the crop to climate changes, the influence of their colleagues and past experience. Capitani and Mattos (2017) [5] discuss that the expectations of farmers are influenced by the costs for production and by the minimum prices established by the government.

### 3. METHODOLOGY OF THE STUDY

The study on the price risk for producers of unprocessed agricultural products in Bulgaria has undergone two key stages.

*During the first stage*, the following assumptions have been made: First, farmers consider any deviations above the average price during a certain period and any deviations below its level as equally undesirable; second, farmers concentrate on the average value of the prices during the examined period as a benchmark for evaluation of the price as “expected”/“unexpected” and “favourable”/“unfavourable”. Perceiving any eventual deviation of the prices above the average price as unfavourable is reasonable from the perspective of those farmers, who, motivated by the expectation about low prices, have chosen to invest in other agricultural crops. This means that they will face lost profits because of the establishment of prices above the average level. Based on these two assumptions, it is considered that the level of price risk can successfully be measured by using the “coefficient of variation” indicator of the studied dynamic series of prices based on formulas (1).

$$V_{\sigma\%} = \frac{\sigma}{\bar{p}} \cdot 100 \quad (1)$$

where:

$V_{\sigma\%}$ - coefficient of variation.

$\bar{p}$ - average price level during the studied period

$\sigma$  – standard deviation calculated based on formula (2)

$$\sigma = \sqrt{\frac{\sum_{i=1}^n (p_i - \bar{p})^2}{n}} \quad (2)$$

where:

$p_i$  - price level at the moment  $i$

$n$  – number of price levels studied

The “coefficient of variation” indicator is useful for achieving comparability of the dispersion of prices of the studied products. A relatively low coefficient of variation means that the prices are grouped very closely to one and the same price (the average price) and therefore the price risk is relatively low. If this indicator is high, this means that there are great deviations from the average price and, consequently – high level of price risk.

*The second stage* of the analysis is based on the assumption that farmers perceive price risk as a deviation below a certain benchmark, particularly – the average price level for the producer during the previous year. In order to address the study to the left part of the dispersion of price levels, which includes negative returns or losses from price changes, the lower partial moment (LPM) indicator has been used. LPM only accounts for deviations below a certain threshold, which constitutes failure to meet a certain expectation regarding the price levels. This indicator is calculated based on the following formula:

$$\text{LPM}\alpha(r; B) = \int_{-\infty}^B (r - B)^\alpha dF(r) \quad (3)$$

where:

$r$  - series of returns;

$B$  - the potential return at the average value of the product price during the previous year (the year preceding the return generated)

$F(r)$  - the cumulative function of dispersion.

$\alpha$  - level of LPM

One of the possible criteria for selection of the LPM power ( $\alpha$ ) is the level of the investor's tolerance to risk. A number of studies [6], [7] provide empirical evidence that farmers are generally risk-averse. The specialized literature [8] recommends risk-averse investors to raise the deviation from the benchmark ( $r - B$ ) to the second power ( $\alpha=2$ ) when calculating this indicator. In this report we assume that most farmers in Bulgaria are risk-averse and adopt the commented criterion for selection of the power ( $\alpha$ ).

Quarterly data about producers' prices for the period 2009 – 2017 and information about the average yearly producers' prices during the period 2010 – 2016 have been used. The data were obtained from the official database of the National Statistical Institute.

#### 4. SELECTION OF PRODUCTS FOR THE IMPLEMENTATION OF THE STUDY

The criterion for selection of unprocessed agricultural products for implementation of the study on the price risk in the Republic of Bulgaria is their contribution to the formation of the value of the final products in the agricultural sector. Table 1 presents the unprocessed products with the greatest contribution in the formation of the value of the final products in the agricultural sector during the study period.

Table 1: Agricultural products with greatest contribution in the formation of the final products in the agricultural sector in Republic of Bulgaria in base prices, 2009-2017.

<i>Products</i>	<i>Average yearly value (million BGN)</i>	<i>Relative share in the products from the agricultural sector in 2017 (%)</i>
Soft wheat	1325	18.7
Sunflower	1041	14.1
Milk	773	8.3
Grain	632	8.1
Poultry	345	3.6
Pigs	287	3.6

Source: own calculations based on data from NSI, Bulgaria

The value of the products presented in *table 1* constitutes more than 56% of the value of the final products from the agricultural sector in 2017. Sunflower, wheat, corn and poultry have been the top products exported from Bulgaria over the past few years [9]. Based on these data, the analysis of price risk in agriculture in Republic of Bulgaria focuses primarily on the prices of producers of soft wheat; corn; sunflower seeds; pigs; poultry, broilers up to 6 months old (the manufacturing of chicken meat is of significant importance for the industrial production of poultry in Bulgaria [9]) and raw cow's milk (most of the animal milk produced in Bulgaria is cow's milk - 89.2% in 2015 [9]). This report has analyzed the price risk related to the market sale of other agricultural products in order to obtain a more precise comparative evaluation.

## 5. RESULTS

The price risk, analyzed as the level of volatility of prices above and below the average price for the period during each individual quarter (fig 1), is relatively high for the analyzed products of the plant breeding sector, i.e. wheat, corn and sunflower. The highest level of risk among these three crops has been observed in sunflower. The risk associated with the sale of raw cow's milk exceeds the risk for most animal products, with the exception of pigs weighing up to 20 kg. The remaining animal products have manifested relatively low risk levels, with the price risk for broilers exceeding the one associated with pigs weighing between 20 and 50 kg and pigs weighing between 80 and 110 kg.

Figure 1: Coefficient of variation (%) and lower partial moment of quarterly producers' prices, 2009 – 2017.

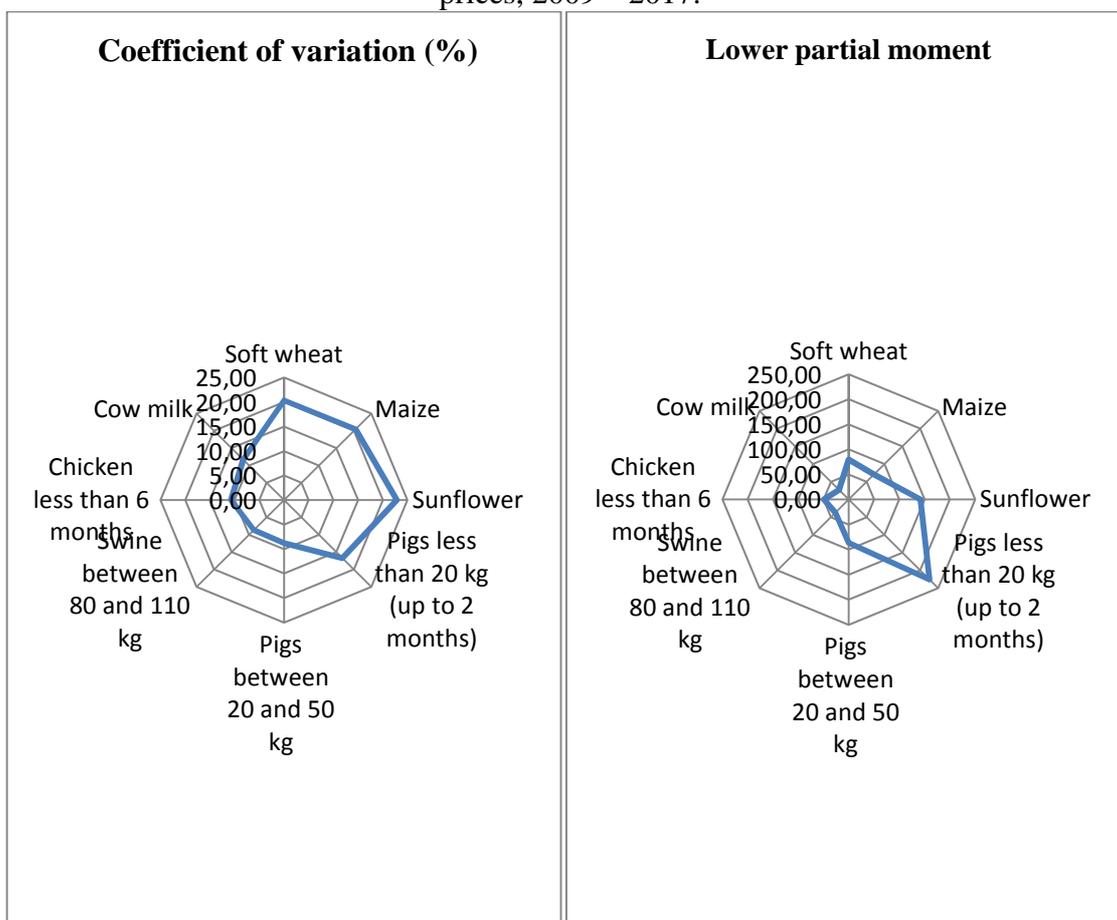
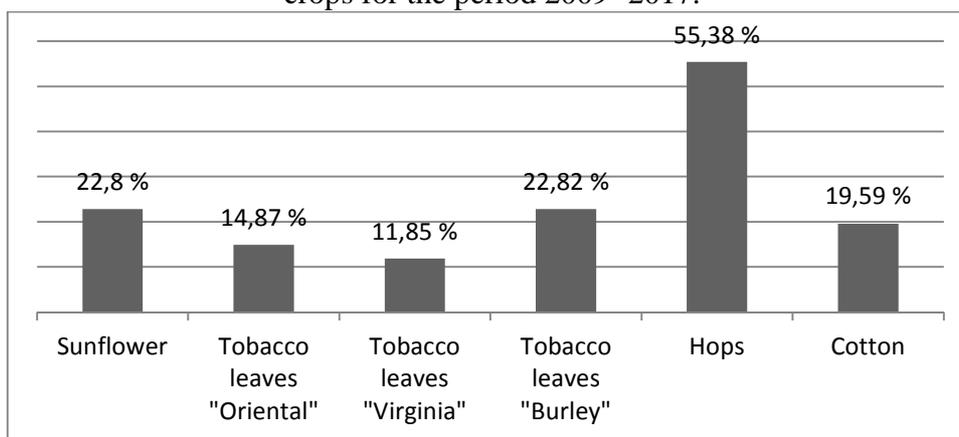


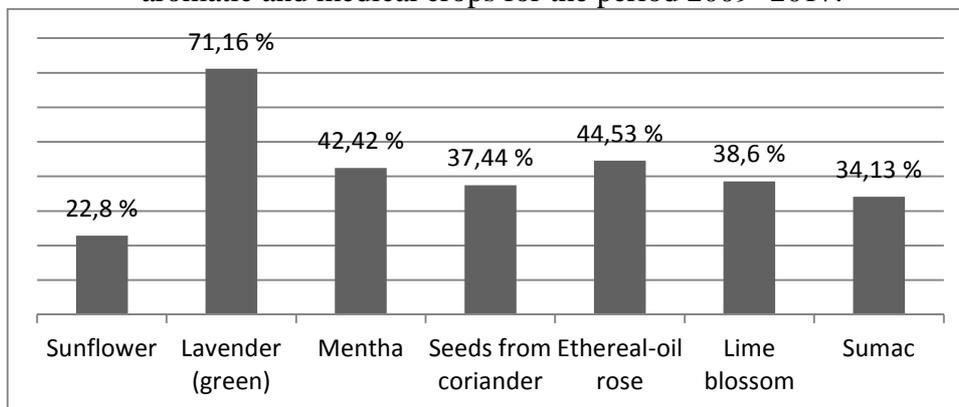
Fig. 1 presents the results from studying the levels of price risk based on the two indicators – coefficient of variation and lower partial moment (LPM) for price variability below previous years' prices based on producers' quarterly prices.

Figure 2: Coefficient of variation of the prices of producers of primary industrial and fiber crops for the period 2009 -2017.



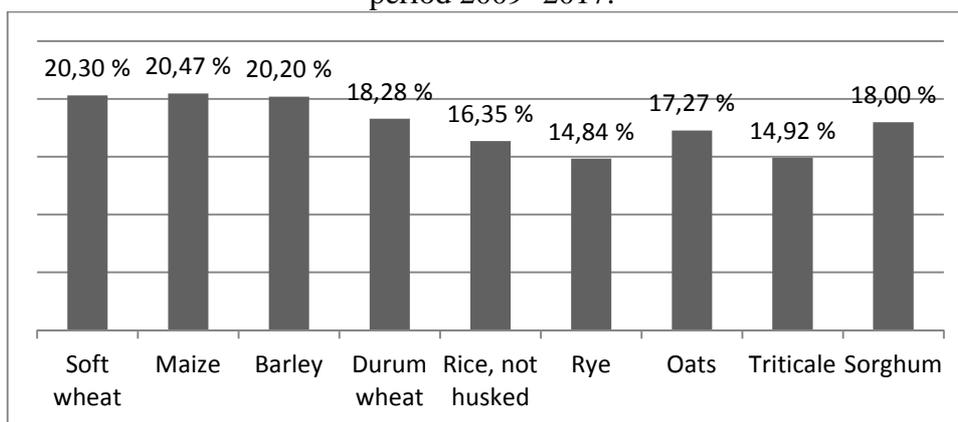
There is higher variation in the prices of sunflower (and, respectively, the price risk is higher), as compared to the value of this indicator for primary industrial crops and technical fibre plants (oriental tobacco, “Virginia” tobacco and cotton) and lower as compared to the same indicator for hops (fig.2). The risk associated with the production and sale of sunflower is lower than the one associated with the primary aromatic and medical crops grown on the territory of Republic of Bulgaria (fig. 3)

Figure 3: Coefficient of variation of the prices of producers of sunflower and primary aromatic and medical crops for the period 2009 -2017.



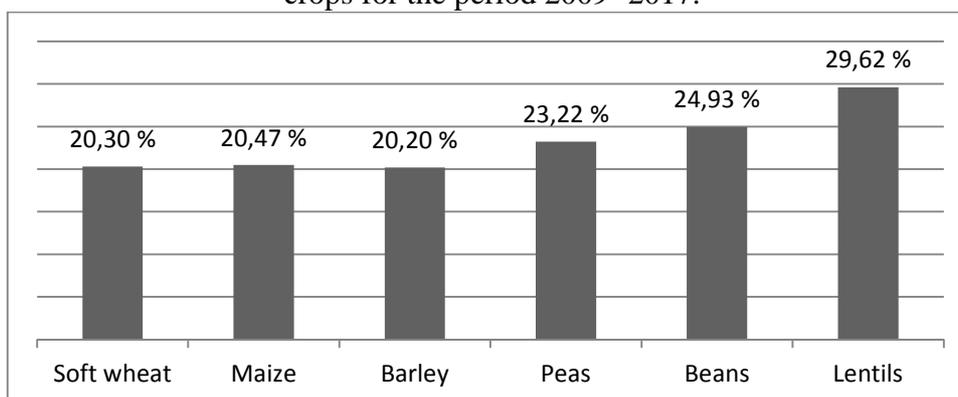
The marketing of grains and wheat crops that contribute less to the formation of the value of the final products in agriculture (such as durum wheat, rye, oats, husked rice and tritcale and sorghum grains) is associated with lower price risk as compared to the production of soft wheat and corn grains (fig. 4).

Figure 4: Coefficient of variation of the prices of producers of some cereals crops for the period 2009 -2017.



The primary grain and legume crops produced on the territory of Bulgaria (such as beans, peas and lens) bear higher risk as compared to the grains and wheat crops (fig.4 and fig.5).

Figure 5: Coefficient of variation of the prices of producers of some cereals and industrial crops for the period 2009 -2017.



The other price risk indicator – LPM, which in this report measures the likelihood that the market price will settle below the average price during the previous year, shows different results. The risk of unfavourable changes in the prices of sunflower identified and measured in this way is also relatively high, however, the risk level is higher for the production of younger pigs weighing up to 20 kg (fig. 1). The level of risk associated with animal products from pigs weighing up to 50 kg is higher than the risk levels associated with the prices of wheat and corn (fig.1). The price risk associated with pigs weighing between 80 and 110 kg and chicken is also relatively low based on this indicator and is similar to the results from the measurement of risk by using the coefficient of variation. Among the studied products that contribute most to the formation of the value of the final agricultural products, the lowest risk level observed, measured as the likelihood of deviation of the price below the average market price from the previous year, is the one associated with cow's milk.

## 6. CONCLUSION

The products that have the highest contribution to the formation of the value of the final products from the agricultural sector in Republic of Bulgaria are wheat, corn, sunflower, pigs, broiler chickens and cow's milk. Based on the price volatility indicator, the price risk is relatively higher with respect to sunflower, wheat, corn and pigs weighing up to 20 kg and

relatively low with respect to cow's milk, broilers, pigs weighing between 20 and 50 kg and pigs weighing between 80 and 100 kg. In contrast to this conclusion, the results from measuring risk as the likelihood of settlement of a lower price than the average producer's price reported during the previous year indicate that corn producers face a relatively lower price risk, whereas the risk of unfavourable changes in the prices of pigs from the lowest age group is relatively high. The risk assessment depends on the assumptions of the researchers regarding the method, in which farmers set their expectations about the price level and the benchmark used for comparison by the farmers in order to identify the price as a "favourable" or "unfavourable". Therefore, the assessment of the price risk levels should take place based on a combination of indicators.

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