

Modelling and Factor Analysis of Pricing Determinants in the State-Regulated Competitive Market: The Case of Ukrainian Flour Market

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Abstract

The aim of the study is to implement a factor analysis of the determinants of pricing in a state-regulated competitive market using economic and mathematical modelling methods and to develop ways to improve the pricing environment of the market under study. The purpose of the work defines the main objectives:

- (i) to investigate the features of the competitive model of the Ukrainian flour market;
- (ii) to analyse the current price conjuncture of the flour market and the dynamics of the main determinants of pricing;
- (iii) to develop ways of improving the price situation on the flour market on the basis of the factor analysis on the results of economic and mathematical modelling.

In order to ensure the reliability and validity of the research results, the following methods were applied: the logical-dialectical method of scientific knowledge in the study of the main theoretical aspects of flour market functioning, the method of logical generalisation and synthesis, comparison, factor analysis, correlation and regression analysis, the graphical method, etc.

It has been shown that pricing in a state-regulated competitive market has its own characteristics. For example, in the flour market the price of goods cannot be influenced by producers (sellers) by any methods, therefore determinants of pricing by indirect influence have been taken into account. The five-factor power model of wheat flour price has been constructed. It was substantiated that the price of wheat flour in Ukraine is mostly influenced by consumer price index (0.92 %). The received complex model of wheat flour price may be used also for medium-term forecasting and working out the ways of price formation optimization in the flour market.

Key words:

Price, Economic and Mathematical Modelling, Variable, Correlation, Value.

1. Introduction

As a rule, the state regulates competitive markets for strategically important products. Government regulation is mainly indirect administrative and is implemented by

restricting exports, granting tax exemptions, or imposing additional taxes (e. g. excise or duties), etc. The market remains competitive, that is, pricing is not influenced by either producers or consumers. The flour market can be considered as such in Ukraine. The flour industry is an important part of Ukraine’s agro-industrial production. It is one of the most socially significant industries, as it provides the production of basic foodstuffs. It also plays a leading role in meeting the needs of the population and other food industry sectors with the necessary products.

The Ukrainian flour market can be classified as a state-regulated competitive market. In Ukraine, for example, the mechanism of de facto export restriction through quotas is used to regulate grain prices [1]. The total amount of the annual export quota is primarily influenced by: market conditions; the volume of grain production; available grain stocks at the end of the previous year; the level and dynamics of domestic consumption of grain and processed products, etc.

Practice shows that the vectors of state influence are concentrated mainly on the administrative pricing of flour and bread. This ignores the urgent problems of restoring domestic demand for flour, stimulating exports of grain products with higher added value, and ensuring expanded reproduction of resources in the flour market sectors, primarily production and consumption. Consequently, there is a need to develop reproductive mechanisms for the development of the flour market.

The identification of a competitive market involves determining a number of its basic characteristics, namely: product, territorial (geographical) and temporal boundaries, capacity and structure, the composition of economic entities in the sectoral breakdown, the level of concentration, etc., which are based on the Methodology for determining the monopoly (dominant) position of economic entities on the market [2].

The Ukrainian flour market can be categorised as a competitive, state-regulated market in terms of the features that define its territorial boundaries. This conclusion is

supported by the market openness indicator for international trade (Table 1). The product boundaries of the market may vary depending on the aims and objectives of the study, the scope of the information base, and so on.

Table 1: Territorial (geographical) and product boundaries of the flour market

Boundaries	Classification characteristics	Species characteristics
Territorial	Ability to transfer (demand, supply)	State-regulated market (international trade openness <40%)
Commodity	Types of cereals processed into flour	wheat flour; meslin (wheat and rye) flour; flour from cereals other than wheat.
	Areas of industrial use of wheat flour	soft wheat flour for bakery and floury confectionery; durum wheat flour for pasta products.
	Wheat baking flour indicators (national standard)	high-grade flour; grade A flour; grade B flour; low-grade flour; granular flour.

Source: Summarized from data given in [3, p. 61].

In the structure of flour production on 2019, 90.65 % is wheat or meslin flour, 4.01 % is rye flour, 4.68 % is cereal flours (excluding wheat or meslin), 0.66 % is other types of flour (corn flour, rice flour, barley flour, buckwheat flour, oat flour, and other cereal flour). At the same time, Ukraine constantly imports durum wheat flour for the pasta industry due to the low profitability of this grain production and the lack of effective incentive mechanisms for farmers [4].

In a competitive flour market, a company’s marketing pricing policy should be based primarily on market conditions. The effectiveness of the marketing pricing policy depends directly on the reliability of the assessment of current and future trends in product prices. In this connection, economic and mathematical modelling as well as factor analysis of the determinants of pricing are relevant in market pricing in the state-regulated competitive flour market.

2. Theoretical Consideration

Scientists’ work on the theoretical and applied problems of pricing in the flour market can be divided into two areas. The first area concerns researches on the competitive status of the flour market, the specifics of analysis of its conditions, state regulation, and the impact of the flour industry on food security in various countries, and is represented by papers [5]–[10]. The second line of research is represented by [1], [11]–[17], which analysed

the influence of competitive patterns and markets, government regulation, grain production, etc. on flour price formation. However, the problem of analysing the main factors influencing market pricing of flour under conditions of a state-regulated competitive market in Ukraine, which is a continuation of previous work by the authors [18]–[23], remains out of sight of other researchers.

The need to theoretically substantiate and methodologically provide a process of factor analysis of the determinants of pricing and multi-factor modelling of flour prices in a state-regulated competitive market makes this study relevant.

The production sector of the integrated flour market has more than 300 permanently operating industrial enterprises, producing 87–89 % of production. Intermittent enterprises, the backbone of which is formed by mini-workshops, account for almost 10% of the national production. The industrial plants are represented by both individual flour mills and by the components of bakery complexes.

The results of a comparative analysis of the qualitative characteristics of the flour market in Ukraine with the characteristics of perfect and monopolistic competition markets are shown in Table 2.

Table 2: Qualitative characteristics of the flour market attributes

Structural characteristics	Monopolistic competition	Pure or perfect competition	Flour market
1. Entry-exit barriers	Missing	Low	Almost absent
2. Type of products	Standardized	Differentiated	Standardized
3. Influence on price	Missing	Some, but limited	Missing
4. Opportunity for non-price competition	Missing	Orientation to advertising, trademarks, brands	Missing

Source: Formed by the authors.

The main features of a competitive market are many producers (sellers) and consumers (buyers). Flour is non-exclusive basic commodity. Its price cannot be significantly influenced by anyone except the government. There are also no barriers to entry-exit for new competitors and each competitor has equal access to all kinds of information.

Determine the concentration of the flour market according to the Herfindahl-Hirschman Index (HHI) [24]:

$$HHI = \sum_{i=1}^N S_i^2, \tag{1}$$

where S is the market share of the company, N is the number of largest companies.

The *HHI* can take values from 0 to 1.0 (or from 0 to 10,000). It is calculated as the sum of the squares of the market shares of all companies in a given industry, and a higher value of the *HHI* will mean a more concentrated market (hence less competition and more risk for customers). The U.S. Department of Justice and the Federal Trade Commission determine the degree of market concentration as follows: the *HHI* is below 0.1 (or 1,000) to be a competitive concentrated marketplace, the *HHI* is from 0.1 to 0.18 (or from 1,000 to 1,800) to be a moderately concentrated marketplace, the *HHI* above 0.18 (or 1,800) to be a highly concentrated marketplace, the *HHI* is more than 2.5 (or 2,500) to be a highly concentrated marketplace [24].

The largest flour producers and their market shares are summarized in Table 3.

Table 3: 10 largest flour producers of Ukraine in 2019

Enterprise	Produced products, thousand tons	Market share (S_i), %	S_i^2
1. Vinnytsia Bread Factory #2	151.68	10.67	113.85
2. Dnipromlyn LLC	94.86	6.67	44.49
3. Stolychnyi Mlyn LLC	94.13	6.62	43.82
4. Roma Commercial and Production Firm LLC	69.27	4.87	23.72
5. Khmelnytsk-Mlyn LLC	64.36	4.53	20.52
6. Novopokrovsky GPP LLC	54.60	3.84	14.75
7. Krolevetskyi GPP subsidiary	45.43	3.20	10.24
8. Enlil LTD	43.71	3.07	9.42
9. Zernary Trade House	41.58	2.93	8.58
10. Vasylykivkhlipoproduct LLC	30.82	2.17	4.71
Produced by TOP-10	690.44	48.57	294.10
Total in Ukraine	142,157	100.0	10,000

Source: Generated and calculated according to the data given in [25].

Based on the calculations in Table 3, the numerical value of the Herfindahl-Hirschman Index is 294.1. This indicates that there is little concentration in the flour market and confirms the preliminary conclusions that it is competitive. Fig. 1 shows that flour production in Ukraine has fallen by 39 % over the last 17 years.

In addition, there is an increasing trend in the consumption of flour by the population for home baking (the volume of flour purchased by retailers in 2019 amounted to 6.5 % of total production). Consumption of flour by chain retailers with their own cooking shops, fast food outlets, etc. is also increasing.

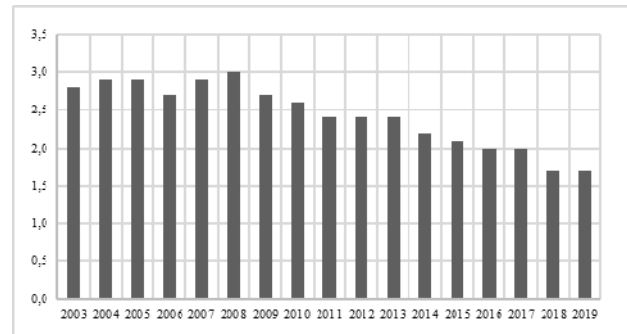


Fig. 1 Dynamics of flour production in Ukraine for 2003–2019, mln tons. Source: Generated and calculated according to the data given in [4].

In general, consumption of processed cereal products (bread and bread products in terms of flour; flour, cereals, pulses) per person per year exceeds the recommended norm of consumption (101 kg), but tends to decrease. The minimum norm of consumption of cereals and bread in terms of flour on average per person in the adjustment of needs with a constant population structure is respectively 125.3 kg and 93.8 kg [26, p. 39].

Flour, unlike bread and bakery products, has the advantage of being able to travel long distances and, if properly stored, does not lose its consumer properties. To ensure its quality, it is necessary to create conditions for effective cultivation and storage of grain in proper conditions. Ukraine has 740 certified elevators, which can store 31 million tons of grain at a time, but almost all oblasts have a shortage of warehouses where grain can be stored for more than 5 months [26, p. 39]. Lack of infrastructure leads to higher costs and loss of quality.

Flour prices are regulated by local executive authorities by setting marginal levels of profitability and trade margins [27]. In addition, the Ministry of Agrarian Policy and Food of Ukraine sets maximum and minimum interventions of 1 ton of wheat and wheat-rye flour. In general, flour prices depend on seasonality, the volume of products that are present in the market, the grain market in the foreign and domestic markets, the activities of the Agrarian Fund and the State Reserve.

Thus, a factor analysis of the influence of the main determinants on the weighted average price of bread should be carried out for the flour mills in the course of implementation of the pricing policy. For the factor analysis of the independent variable, the average monthly price of 1 kg of wheat flour for 2017–2020 was taken, whose share in the volume of flour production is more than 92 % (Fig. 2).

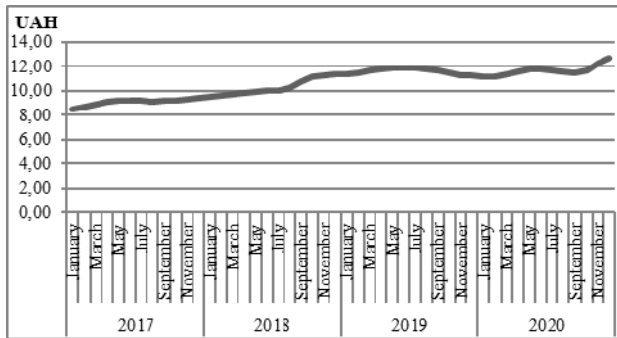


Fig. 2 Dynamics of the average monthly price of 1 kg of wheat flour in Ukraine in 2017–2020.

Source: Formed according to the data given in [4].

Thus, the flour market in Ukraine is competitive and state-regulated (flour prices are regulated by local executive authorities). Ukraine has a large raw material potential to meet the needs of the domestic market for flour and to increase its exports. During 2003–2019, flour production in Ukraine decreased by 39%. The average monthly price inflation of 1 kg of wheat flour during 2017–2020 was 100.8%.

3. Experimental Consideration

3.1 Generating Baseline Data for Factor Analysis

In a competitive market, a company's marketing pricing policy should be based primarily on market conditions. The flour market is internally oriented, which is the reason for the rather fierce competition and high sensitivity to fluctuations in consumer demand and raw material prices. Consequently, the profitability of industrial enterprises is considerably reduced by the constant competition with mini-mills, which sell flour at prices lower than those of large producers.

In order to form prerequisites for statistical and quantitative support of factor analysis, let us take the average monthly price of 1 kg of wheat flour in Ukraine (see Fig. 2) as an dependent variable. The main determinants of pricing in the flour market are: consumer prices, producer prices of industrial products, sales prices of crop products, energy prices and average monthly salary of one employee, whose monthly chain indices for 2017–2020 are shown in the Appendix. During 2017–2020 there was a significant increase in energy prices by 36 times, and the average monthly wage by 2.4 times.

The consumer price index affects the price of flour in the retail sector, for example, with rising prices for bakery products, consumers will buy more flour for home baking, which will increase the demand for flour and its price. Rising prices for industrial products, crop products, and energy will increase the cost of flour and, accordingly, increase its price. The average monthly wage per

employee is a non-price factor in the demand for wheat flour and also has an indirect direct effect on its price.

These 5 indicators are taken as independent variables in an economic and mathematical modelling and factor analysis of the determinants of pricing in a state-regulated competitive market. In order to implement ways to improve the price situation in the flour market in Ukraine, it is advisable to conduct a statistical assessment of the impact of the main determinants on the dynamics of the price of 1 kg of wheat flour. Before starting factor analysis, which is based on multivariate modelling, one should decide on the form of the stochastic interaction. Given the non-linear development of a market economy, the interaction between the dependent variable, the flour price, and the independent variables, the chain indices of consumer prices, producer prices of industrial products, sales prices of crop products, energy prices and average monthly salary of one employee, should also be non-linear.

In multivariate modelling, the most popular is a power model of the form:

$$\bar{Y}_X = \beta_0 \cdot X_1^{\beta_1} \cdot X_2^{\beta_2} \cdot \dots \cdot X_n^{\beta_n}, \quad (2)$$

where \bar{Y}_X is the theoretical value of the dependent variable;

X_1, X_2, \dots, X_n are the independent variables introduced into the model;

$\beta_1, \beta_2, \dots, \beta_n$ are the regression equation parameters or elasticity coefficients reflecting the percentage change in the dependent variable when the respective independent variable increases by 1%;

β_0 is the constant, i. e. the value of the dependent variable when the independent variables are equal to 0.

In logarithmic form, formula (2) looks like this:

$$\ln \bar{Y}_X = \ln \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \dots + \beta_n \ln X_n. \quad (3)$$

Consequently, in order to implement modelling and factor analysis of the determinants of price formation in the flour market in Ukraine, the indicators were converted into natural logarithms (Table 4). Based on the data in Table 4, a multivariate modelling and factor analysis of the price of flour was carried out, with the following steps being implemented:

- (i) construction of a matrix of pairwise correlation coefficients to identify multicollinearity between the independent variables introduced into the economic and mathematical model;
- (ii) selection of factors between which the correlation is loose;
- (iii) multivariate correlation and regression analysis using Excel;
- (iv) economic interpretation of modelling results;
- (v) statistical assessment of the model significance.

Table 4: Natural logarithms of pricing determinants in the wheat flour market in Ukraine

Period of time		Natural logarithms of chain indices:					
		Prices of 1 kg of wheat flour (WFP), %	Consumer prices (CP), %	Producer prices of industrial products (PIIP), %	Sales prices of crop products (SPCP), %	Energy prices (EP), %	Average monthly salary of one employee (AMSE), %
2017	January	0	0	0	0	0	0
	February	0.017432	0.009950	0.030529	0.032467	-0.116534	0.032955
	March	0.029514	0.017840	0.034401	0.030529	-0.033557	0.083839
	April	0.015539	0.008960	0.015873	0.025668	0.005982	-0.013869
	May	0.007680	0.012916	-0.013085	-0.025318	-0.015114	0.026818
	June	0.001092	0.015873	-0.006018	-0.017146	-0.012073	0.073272
	July	0.001091	0.001998	0.017840	-0.014099	0.055435	-0.002800
	August	-0.005467	-0.001001	0.003992	-0.050241	0.017840	-0.031195
	September	0.007646	0.019803	0.015873	-0.028399	0.006976	0.032772
	October	0.002174	0.011929	0.022739	0.045929	0.005982	0.003531
	November	0.011873	0.008960	0.017840	0.016857	0.013903	0.013732
	December	0.012793	0.009950	0.016857	0.031499	0.039221	0.160036
2018	January	0.011585	0.014889	0.043059	0.036332	0.097127	-0.129487
	February	0.010417	0.008960	0.011929	0.020783	0.098940	0.015059
	March	0.009283	0.010940	0.002996	0.035367	0.129272	0.068379
	April	0.005120	0.007968	0.000000	0.050693	0.123986	0.011624
	May	0.009151	0.000000	0.007968	-0.013085	0.154436	0.028482
	June	0.011072	0.000000	0.010940	-0.043952	0.195567	0.046577
	July	0.004993	-0.007025	0.015873	-0.011061	0.252314	0.003167
	August	0.018747	0.000000	0.012916	-0.022246	0.264669	-0.021272
	September	0.048651	0.018822	0.011929	-0.004008	0.258511	0.007215
	October	0.032970	0.016857	0.002996	-0.014099	0.229523	0.019278
	November	0.012534	0.013903	0.016857	0.016857	0.270027	-0.006203
	December	0.008857	0.007968	-0.004008	0.002996	0.260825	0.143348
2019	January	0.001762	0.009950	0.009950	0.043059	0.053541	-0.136603
	February	0.012249	0.004988	0.009950	0.011929	0.095310	0.022090
	March	0.012100	0.008960	-0.010050	-0.024293	0.042101	0.082219
	April	0.005996	0.009950	-0.015114	0.011929	-0.017146	0.003121
	May	0.009350	0.006976	0.020783	-0.028399	0.036332	-0.002926
	June	0.000846	-0.005013	-0.027371	-0.021224	-0.056570	0.051767
	July	0.000845	-0.006018	0.035367	-0.008032	0.095310	0.017285
	August	-0.008482	-0.003005	-0.007025	-0.074724	0.086178	-0.040363
	September	-0.007696	0.006976	-0.015114	-0.098716	0.087095	0.014135
	October	-0.015571	0.006976	-0.012073	0.009950	0.112435	0.003736
	November	-0.016704	0.001000	-0.030459	0.018822	0.039221	-0.004485
	December	-0.005333	-0.002002	-0.036664	0.027615	-0.057629	0.138389
2020	January	-0.010753	0.001998	0.024693	0.040182	0.077887	-0.133910
	February	0.007181	-0.003005	0.001000	0.068593	0.056380	0.011144
	March	0.014210	0.007968	0.017840	0.023717	0.113329	0.053722
	April	0.022669	0.007968	0.001000	0.137150	0.113329	-0.092958
	May	0.012848	0.002996	-0.006018	-0.049190	0.137150	0.010655
	June	0.003398	0.001998	-0.020203	0.015873	0.064851	0.093828
	July	-0.010230	-0.006018	0.003992	-0.026344	0.048790	0.019323
	August	-0.008606	-0.002002	0.022739	-0.023269	0.044973	-0.030822
	September	-0.012174	0.004988	0.016857	0.073250	0.011929	0.047130
	October	0.015625	0.009950	0.037296	0.067659	0.025668	0.014513
	November	0.058545	0.012916	0.019803	0.093490	0.032467	-0.015497
	December	0.031190	0.008960	0.017840	0.052592	0.038259	0.167965

Source: Formed and calculated according to the data given in Appendix by the [4].

3.2 Implementing Factor Analysis Based on Economic and Mathematical Modelling

In order to check the density of the relationship between the independent and dependent variables, a matrix of

pairwise correlation coefficients or correlation matrix was constructed (Table 5).

Table 5: Matrix of pairwise correlation coefficients between wheat flour price (dependent variable) and pricing determinants (independent variables)

	CP	PIPI	SPCP	EP	AMSE	WFP
CP	1					
PIPI	0.253	1				
SPCP	0.255	0.273	1			
EP	-0.036	0.072	-0.155	1		
AMSE	0.051	-0.265	-0.081	-0.115	1	
WFP	0.540	0.348	0.319	0.218	0.127	1

Source: Calculated using Excel according to the Table 4 data.

The data from the matrix presented in Table 5 is used to detect multicollinearity between the independent variables according to the algorithm proposed in [28, pp. 634–635]:

$$4.057 = \frac{r^2}{1-r^2} \cdot \frac{47-1-1}{1} = \frac{45r^2}{1-r^2};$$

$$45r^2 = 4.057 \cdot (1-r^2);$$

$$45r^2 = 4.057 - 4.057r^2; \tag{4}$$

$$29.057r^2 = 4.057;$$

$$r^2 = 0.1396;$$

$$r = \sqrt{0.1396} = \pm 0.374,$$

where r is a pairwise correlation coefficient; $4.057 = F.INV(0.95;1;45)$ in Excel is the F-test critical value.

From formula (4), there is no multicollinearity between the independent variables if the value of the pairwise correlation coefficient between them is in the range of values:

$$r \in [-0.374; 0.374]. \tag{5}$$

If, however, the value of the pairwise correlation coefficient does not fit into the area represented by formula (5), there is multicollinearity between the independent variables and it must be eliminated.

As can be seen from Table 5, all values of pairwise correlation coefficients between independent variables fall within the range of formula (5). Thus, there is no multicollinearity between the independent variables entered into the multivariate power correlation and regression model.

The results of correlation and regression analysis are illustrated in Fig. 3.

The modelling results in the following regression equation:

$$WFP = 0.996CP^{0.92} PPIP^{0.182} SPCP^{0.072} EP^{0.045} AMSE^{-0.049}. \tag{6}$$

SUMMARY OUTPUT

Regression statistics	
Multiple R	0.679904
R Square	0.462269
Adjusted R Square	0.396692
Standard Error	0.011605
Observations	47

ANOVA

	df	SS	MS	F	Significance F	t
Regression	5	0.004747	0.000949	7.049264	0.000078	5.936861
Residual	41	0.005522	0.000135			
Total	46	0.010269				

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-0.003751	0.002833	-1.324298	0.192740	-0.009472	0.001969
CP	0.919507	0.260198	3.533881	0.001030	0.394027	1.444987
PIPI	0.182176	0.106002	1.718615	0.093228	-0.031899	0.396252
SPCP	0.072097	0.042512	1.695918	0.097483	-0.013758	0.157952
EP	0.045179	0.019289	2.342184	0.024108	0.006224	0.084135
AMSE	0.048783	0.027743	1.758401	0.086142	-0.007245	0.104810

Fig. 3 Results of the five-factor correlation and regression analysis of the average monthly price index of wheat flour in Ukraine.

Source: Modelled using Excel according to the Table 4 data.

The formula (6) allows for an economic interpretation of the resulting regression equation and the following results of the factor analysis:

- (i) a 1 % increase in the chain average monthly consumer price index is accompanied by a 0.92 % increase in the average monthly price of wheat flour. This factor has the highest level of influence on the price of wheat flour in Ukraine;
- (ii) a 1 % increase in the chain average monthly producer price index leads to a 0.18 % increase in the average monthly price of wheat flour;
- (iii) a 1 % increase in the prices of the chain average monthly sales price index for crop products leads to a 0.07 % increase in the average monthly price of wheat flour;
- (iv) the average monthly price of wheat flour increases by 0.05 % for a 1 % increase in the prices of energy products. This factor has the lowest level of influence on the price of wheat flour in Ukraine;
- (v) a 1 % increase in the average monthly wage of an employee could lead to a 0.05 % increase in the average monthly price of wheat flour.

If all factors increase by 1 %, the average monthly price of wheat flour could increase by 1.27 %.

Statistical assessment of the model significance consists in comparing the obtained statistical coefficients (see Fig. 3) with their critical values. Thus, the t-statistic level ($t = 5.94$), exceeds its critical value by 3.5 times, which confirms the statistical significance of the multiple correlation coefficient $R = 0.68$. The F-statistic level ($F = 7.05$), exceeds its critical value by 2.9 times, which confirms the statistical significance of the multiple determination coefficient $R^2 = 0.46$. The standard error level was 1.2 %. Similarly, the statistical significance of the obtained 5 parameters of the power model is checked by comparing the corresponding values of the t-statistics with the critical level 1.68. As can be seen from the data in Fig. 3, all parameters are statistically significant. So, overall, the statistical quality of the model is high and it can be used for further research.

Thus, in the state-regulated competitive flour market, the influence of producers (sellers) on the price of goods is minimal; therefore, in the factor analysis carried out, secondary determinants of price formation were taken into account by means of economic and mathematical modelling. It has been proved that the monthly dynamics of the wheat flour price in Ukraine is maximally influenced by the consumer price index, as the coefficient of price elasticity by the level of consumption inflation is the largest and amounts 0.92 %.

Then, taking into account the equation of multifactor regression given in formula (6), both domestic and foreign flour producers may forecast wheat flour price with a significant reliability by having the current information about the dynamics of consumer prices, producer prices of industrial products, sales prices for crop products, energy prices and dynamics of the average monthly salary of one employee. This will provide flour producers with an opportunity to adjust or formulate marketing pricing strategies in a competitive market, develop financial and sales plans, as well as determine the levels of planned profitability/cost of production and sales. The obtained price model may be used for medium term forecasting of demand for wheat flour in Ukraine.

The suggested methodological support is universal for using in factor analysis at other competitive markets. The constructed multifactor power model of wheat flour price is suitable for use in forecasting and working out the ways of optimization of pricing.

4. Conclusion

The flour market is a state-regulated, competitive, integrated market with a full reproductive cycle, the stable development of which is a prerequisite for sustainable economic growth in the country. The main strengths of the flour market are the strong production potential of both agricultural and milling enterprises, the environmental purity and safety of their products; weaknesses include the presence of “underground” subsectors, imported flour supplies, and the investment unattractiveness of the market.

Prospective directions for flour market development include meeting domestic demand by organising the production of high-quality and innovative products and developing foreign sales markets. Ukraine has a large raw material potential to meet the needs of the domestic market for flour and increase its exports. During 2003–2019, the flour production volume in Ukraine has decreased, and the volume of flour production in the country has been growing. The volume of flour production in Ukraine has decreased by 39 %. Total price inflation of 1 kg of wheat flour during 2017–2020 was 149 %.

In the flour market, the influence of producers (sellers) on the price of goods is minimal, so the study took into account the determinants of price formation of

indirect influence. According to the results of factor analysis, it was proved that the basic price index of wheat flour in Ukraine is maximally influenced by the consumer price index, because the coefficient of price elasticity by the level of consumption inflation is the largest here (0.92 %). The cumulative impact of the other factors (producer prices of industrial products, sales prices of crop products, energy prices, and average monthly salary of one employee) was only 0.35 %.

The obtained complex five-factor power model of the average monthly wheat flour price index can also be used for medium-term forecasting and development of This direction is the prospect for further research by the authors.

References

- [1] A. Henry, Q. Feng, and Y. Zheng, “How do export controls affect price transmission and volatility spillovers in the Ukrainian wheat and flour markets?,” *Food Policy*, vol. 62, pp. 142–150, June 1997, doi: 10.1016/j.foodpol.2016.06.002.
- [2] Antimonopoly Committee of Ukraine. (2002, March 5). *Order No. 49-p, On approval of the Methodology for determining the monopoly (dominant) position of economic entities on the market* (in Ukrainian). [Online]. Available: zakon.rada.gov.ua/laws/show/z0317-02/print.
- [3] O. Nikishyna, “Criteria assessment and diagnostics of the Ukrainian flour market,” (in Ukrainian), *Food Industry Economics*, vol. 3, pp. 60–67. Sept. 2011.
- [4] State Statistics Service of Ukraine. (2021). *Statistical Information* [Online]. Available: <http://www.ukrstat.gov.ua>.
- [5] C. S. Kim, C. Hallahan, G. Schaible, and G. Schluter, “Economic analysis of the changing structure of the U.S. flour milling industry,” *Agribusiness*, vol. 17, no. 1, pp. 161–171, Jan. 2001, doi: 10.1002/1520-6297(200124)17:1%3C161::AID-AGR1008%3E3.0.CO;2-0.
- [6] L. Mncube, “On market power and cartel detection: The South African flour cartel,” *Studies in Economics and Econometrics*, vol. 37, no. 3, pp. 41–60, Dec. 2013, doi: 10.1080/10800379.2013.12097259.
- [7] C. C. Ofonyelu, “Strategic capacity utilization and competition: An analysis of competitions in Nigerian flour industry,” *Issues in Business Management and Economics*, vol. 2 (10), pp. 186–192, Oct. 2014, doi: 10.15739/IBME.2014.005.
- [8] F. D. Wet, I. Liebenberg, “Food security, wheat production and policy in South Africa: Reflections on food sustainability and challenges for a market economy,” *The Journal for Transdisciplinary Research in Southern Africa*, vol. 14, no. 1, a407, Jan. 2018, doi: 10.4102/td.v14i1.407.
- [9] K. F. Binti, M. M. Mehedi, S. Md. Khaled, “Subsidy rationalisation for general purpose flour: Market and economics implications,” *The Journal of Asian Finance, Economics and Business*, vol. 4, no. 2, pp. 25–36, May 2017, doi: 10.13106/jafeb.2017.vol4.no2.25.
- [10] I. F. Balaniuk, D. I. Shelenko, M. V. Biloshkurskiy, I. M. Povorozniuk, and L. A. Slatvinska, “An integrated approach to the enterprises’ business efficiency assessment,” *Management Theory and Studies for Rural*

- Business and Infrastructure Development*, vol. 42, no. 4, pp. 486–495, Dec. 2020, doi: 10.15544/mts.2020.50.
- [11] B. Brümmer, S. Cramon-Taubadel, and S. Zorya, “The impact of market and policy instability on price transmission between wheat and flour in Ukraine,” *European Review of Agricultural Economics*, vol. 36, no. 2, pp. 203–230, June 2009, doi: 10.1093/erae/jbp021.
- [12] T.-C. Ma, “Testing oligopolistic behaviors: Conduct and cost in Taiwan’s flour market,” *Agribusiness*, vol. 28, no. 1, pp. 1–14, Jan. 2012, doi: 10.1002/agr.20284.
- [13] G. Valera, K. Taniguchi, “Asymmetric price transmission in Indonesia’s wheat flour market,” Asian Development Bank, Mandaluyong, Philippines, Economics Working Paper Series, no. 394, Aug. 2014, doi: 10.2139/ssrn.2479704.
- [14] N. Hassanzoy, S. Ito, H. Isoda, and Y. Amekawa, “Cointegration and spatial price transmission among wheat and wheat-flour markets in Afghanistan”, *Applied Economics*, vol. 49, no. 30, pp. 2939–2955, 2017, doi: 10.1080/00036846.2016.1251563.
- [15] V. V. Martynenko, “Macroeconomic factors of market pricing under perfect competition,” (in Ukrainian), *Scientific bulletin of Polissia*, vol. 2, part. 1, pp. 105–112, June 2017, doi: 10.25140/2410-9576-2017-1-2(10)-105-112.
- [16] L. Xue, F. WenGe, “Asymmetric transmission between wheat and flour price in China: Under the background involving the minimum purchasing price policy,” *Acta Agriculturae Shanghai*, vol. 34, no. 1, pp. 111–117, 2018.
- [17] S. S. Deora, M. Kaur, “Predicting selling price of first time product for online seller using big data analytics,” *International Journal of Computer Science and Network Security*, vol. 21, no. 2, pp. 193–197, Feb. 2021, doi: 10.22937/IJCSNS.2021.21.2.22.
- [18] N. V. Biloshkurska, “Adaptive behavior models and their role in formation of enterprise economic security,” (in Ukrainian), *Actual Problems of Economics*, vol. 114, pp. 101–105, 2010.
- [19] N. V. Biloshkurska, “Marketing research of pricing factors in a competitive market,” (in Ukrainian), *Marketing and Management of Innovations*, vol. 1, pp. 24–31, Mar. 2015.
- [20] N. V. Biloshkurska, M. V. Biloshkurskyi, and L. A. Chvertko, “Influence of the security market condition on the collective investment development,” *Scientific bulletin of Polissia*, vol. 3, part. 2, pp. 138–142, Sept. 2017, doi: 10.25140/2410-9576-2017-2-3(11)-138-142.
- [21] O. Dragan, A. Berher, and J. Pustovit, “Estimation of marketing price policy efficiency of the enterprise of meat-processing industry,” *Management Theory and Studies for Rural Business and Infrastructure Development*, vol. 40, no. 2, pp. 175–186, July 2018, doi: 10.15544/mts.2018.17.
- [22] M. Iorgachova, O. Kovalova, and I. Plets, “Financial engineering as a tool for the development of corporate bond market in eastern europe on the example of Ukraine,” *Baltic Journal of Economic Studies*, vol. 4, no. 4, 2018, pp. 120–125, 2018, doi: 10.30525/2256-0742/2018-4-4-120-125.
- [23] O. V. Prokopenko, N. V. Biloshkurska, M. V. Biloshkurskyi, and V. A. Omelyanenko, “The role of banks in national innovation system: General strategical analytics,” *Financial and Credit Activity – Problems of Theory and Practice*, vol. 3, no. 30, pp. 26–35, Sep. 2019, doi: 10.18371/fcaptp.v3i30.179455.
- [24] United States Department of Justice. (2021). *Herfindahl-Hirschman Index* [Online]. Available: <https://www.justice.gov/atr/herfindahl-hirschman-index>.
- [25] S. Sakirkin. “Ukrainian flour market – results for 11 months of 2019/20 MY.” apk-inform.com. <https://www.apk-inform.com/en/exclusive/topic/1512259> (accessed Jul. 11, 2020).
- [26] O. V. Bokii, “Flour market in Ukraine,” (in Ukrainian), *Visnyk ONU imeni I. I. Mechnikova*, vol. 18, no. 4/1, pp. 37–41, 2013.
- [27] Cabinet of Ministers of Ukraine. (1996, December 15). *Resolution No. 1548, About establishment of powers of executive bodies and executive bodies of city councils concerning regulation of the prices (tariffs)* (in Ukrainian). [Online]. Available: zakon5.rada.gov.ua/laws/show/1548-96-п.
- [28] O. V. Braslavska, O. H. Penkova, I. I. Plets, T. Y. Sus, N. V. Biloshkurska, and M. V. Biloshkurskyi, “Management of the higher education institutions innovative potential: Formalization and evaluation,” *Revista Inclusiones*, vol. 7, no. 4, pp. 624–645, July 2020. [Online]. Available: <http://www.archivosrevistainclusiones.com/gallery/42%20VOL%207%20NUM%20OCTUBREDICIEMBRE2020%20REVISTAINCLUS.pdf>.

Appendix

Average monthly dynamics of pricing determinants in the wheat flour market of Ukraine in 2017–2020

Period of time		Chain indices:					
		Prices of 1 kg of wheat flour, %	Consumer prices, %	Producer prices of industrial products, %	Sales prices of crop products, %	Energy prices, %	Average monthly salary of one employee, %
2017	January	1	1	1	1	1	1
	February	1.018	1.010	1.031	1.033	0.890	1,034
	March	1.030	1.018	1.035	1.031	0.967	1,087
	April	1.016	1.009	1.016	1.026	1.006	0,986
	May	1.008	1.013	0.987	0.975	0.985	1,027
	June	1.001	1.016	0.994	0.983	0.988	1,076
	July	1.001	1.002	1.018	0.986	1.057	0,997
	August	0.995	0.999	1.004	0.951	1.018	0,969
	September	1.008	1.020	1.016	0.972	1.007	1,033
	October	1.002	1.012	1.023	1.047	1.006	1,004
	November	1.012	1.009	1.018	1.017	1.014	1,014
	December	1.013	1.010	1.017	1.032	1.040	1,174
2018	January	1.012	1.015	1.044	1.037	1.102	0,879
	February	1.010	1.009	1.012	1.021	1.104	1,015
	March	1.009	1.011	1.003	1.036	1.138	1,071
	April	1.005	1.008	1.000	1.052	1.132	1,012
	May	1.009	1.000	1.008	0.987	1.167	1,029
	June	1.011	1.000	1.011	0.957	1.216	1,048
	July	1.005	0.993	1.016	0.989	1.287	1,003
	August	1.019	1.000	1.013	0.978	1.303	0,979
	September	1.050	1.019	1.012	0.996	1.295	1,007
	October	1.034	1.017	1.003	0.986	1.258	1,019
	November	1.013	1.014	1.017	1.017	1.310	0,994
	December	1.009	1.008	0.996	1.003	1.298	1,154
2019	January	1.002	1.010	1.010	1.044	1.055	0,872
	February	1.012	1.005	1.010	1.012	1.100	1,022
	March	1.012	1.009	0.990	0.976	1.043	1,086
	April	1.006	1.010	0.985	1.012	0.983	1,003
	May	1.009	1.007	1.021	0.972	1.037	0,997
	June	1.001	0.995	0.973	0.979	0.945	1,053
	July	1.001	0.994	1.036	0.992	1.100	1,017
	August	0.992	0.997	0.993	0.928	1.090	0,960
	September	0.992	1.007	0.985	0.906	1.091	1,014
	October	0.985	1.007	0.988	1.010	1.119	1,004
	November	0.983	1.001	0.970	1.019	1.040	0,996
	December	0.995	0.998	0.964	1.028	0.944	1,148
2020	January	0.989	1.002	1.025	1.041	1.081	0,875
	February	1.007	0.997	1.001	1.071	1.058	1,011
	March	1.014	1.008	1.018	1.024	1.120	1,055
	April	1.023	1.008	1.001	1.147	1.120	0,911
	May	1.013	1.003	0.994	0.952	1.147	1,011
	June	1.003	1.002	0.980	1.016	1.067	1,098
	July	0.990	0.994	1.004	0.974	1.050	1,020
	August	0.991	0.998	1.023	0.977	1.046	0,970
	September	0.988	1.005	1.017	1.076	1.012	1,048
	October	1.016	1.010	1.038	1.070	1.026	1,015
	November	1.060	1.013	1.020	1.098	1.033	0,985
	December	1.032	1.009	1.018	1.054	1.039	1,183
Average per month		1.008	1.006	1.007	1.009	1.078	1.018

Source: Formed and performed calculations according to the data given in [4].



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