Multifactor Econometric Modeling of Strategic Food Industry Management

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Annotation

Multifactor econometric models have been developed to increase the efficiency of business development in the food industry, production volume, household consumption costs and consumption levels. Therefore, using these econometric models, the effective (elasticity) coefficients of the factors were determined, their reliability levels were compared, and the significance level of the factor was determined.

Keywords: efficiency, production volume, consumption rate, sensitivity of factors, elasticity, reliability, tightness, econometric forecasting, determination coefficient.

Introduction

The importance of entrepreneurship in the food industry is growing due to the growing share of the private sector in the economy of Uzbekistan. But in today's pandemic environment, small food businesses and micro-firms are completely private. Our country has become self-sufficient in basic foodstuffs. However, some types of products that are not produced in the country are imported. Consequently, it is impossible to ensure the full economic development of any country without involving it in world economic relations, no matter how its economy is developed.

The possible negative consequences of the pandemic process of the economy will inevitably affect the economic development of any country. As the President of the Republic of Uzbekistan Sh.M.Mirziyoev noted, "...it is necessary to ensure the balance and stability of the national economy and increasing its share in industry, services, small business and private entrepreneurship, deep restructuring of high-tech industries and local raw materials, to produce high value-added finished products, further strengthen the country's food security and increase the export potential of agricultural products" [1].

The degree which the problem has been studied. Scientific researchs of a number of foreign scientists have been devoted to analysisof the multifactor econometric models of business development in the food industry: S. Djankov, M. Desai, R. Dennis, T. Ovaska, J. Robinson, R. Capone, S. Negi, B. Lovder [2 , 3,4,5,6,7,8,9]. It was extensively described in the researchs among the CIS scientists O. Gogb, G. Zinchuk, M. Kisel, G. Seyalova, D. Khodos, N.E. Pavlenko [10,11,12,13,14,15]. From local Uzbek scientists B.Berkinov, I.Boboev, O.Ismailov, K.Muftaydinov, U.Gafurov, N.Sotvoldiev [16,17,18,19,20,21] and others studied this theme .

Although the above-mentioned scientific research reflects a systemic approach to the problem under study, it shows that today the articles on improving the analysis of multifactor econometric models of entrepreneurship development in the food industry of the country have not been

sufficiently studied. This determines the choice of the research topic, its purpose and specific tasks

Research methods. The methods of scientific abstraction, comparative comparison, data grouping, economic-mathematical modeling, correlation and regression analysis were used in the research process.

Analysis and results. Therefore, we have chosen the regression equation for the linear function. This is because the range of determination coefficients is [0; 1], indicating the degree of linear dependence of the values of t_i and y_i. Correlation and regression coefficients and coefficients of R^2-determination were found in the econometric forecasting of consumption of certain types of food products by business entities in the country. Depending on the

coefficient of determination in the model, it is possible to check whether the indicators in the model are interrelated. Therefore, the linear function obtained by the prediction can be trusted and usedsince the determination coefficients of a particular type of food are close to the coefficient{1}. In particular, the most favorable function for the prognosis is the consumption of meat and meat products ($R^2 = 0,76$), for bread and bakery products ($R^2 = 0,63$). A multifactor econometric model was developed to determine the number of business entities in order to increase the efficiency of entrepreneurship in the country. The effect of factors on this model is determined by the coefficients of its sensitivity through the following table ("see Table 2").

Table 2

The results of the econometric model of factors affecting the number of business entities in the country [23]

Method: The least squares method
Selection periods: 2003 2022
Number of observations received: 20

Variables	Coefficient	Standard error	t-statistics	Probability
Number of business registration processes (LN_PROCED_)	0.144604	0.197495	0.732191	0.4827
The average time that takes to register - a day (LN_DAY)	-0.084383	0.087237	-0.967285	0.3587
Official registration costs (LN_COST)	-0.048429	0.066894	-0.723977	0.4875
Number of procedures regulating judicial activity (LN_EPROCED)	-0.318591	0.114337	-2.786424	0.0212
Formal costs of fulfilling the terms of the contract (LN_ECOST)	0.189020	0.091006	2.077013	0.0676
Food production capacity (LN_Q)	-0.176905	0.443211	-0.399143	0.6991
Constanta(C)	6.243916	0.334152	18.68588	0.0000

R^2	0.716283F-statistics 3.786961
Probability value	0.036489Darbin-Watson sta. 3.083

This leads to the appearance of the following model, i.e. the state after setting the regression coefficients:

$$LN(ENTERP)_{i,t} = 6,24 + 0,14 * LN(PROCED)_{it} - 0,084 * LN(DAY)_{it} - 0,048 * LN(COST)_{it} - \quad (1)$$
$$0,31 * LN(EPROCED)_{it} + 0,19 * LN(ECOST)_{it} - 0,18 * LN(Q)_{it}$$

The following conclusions and opinions can be made about the factors influencing the increase in the number of business entities in the future as a result of changes in the values of indicators. **First,** 2 out of 8 indicators in the model, ie the minimum capital issued on the level of sensitivity since 2014, the time and date required to resolve disputes in the courts were not accounted for by the State Statistics Committee of the Republic of Uzbekistan. Only two - the number of business registration processes, as well as the official costs of fulfilling the terms of the contract (as a percentage of the amount of debt) have the strongest impact on business activity.A 1-day decrease in the number of business registration processes will increase the number of business entities by 0,14 points, and a 1% decrease in the official costs of fulfilling the terms of the contract will increase the number of business entities by 0.19 points. **Second,** due to the reduction of the registration day (DAY) from 4 to 2 days, the number of procedures regulating judicial activity (EPROCED) from 18 to 15 days, the reduction of DAY from 2 days to 0.084 points, the reduction of EPROCED from 3 days to 0.31 points. affects the increase in the number.

In the scientific work, a linear model is proposed to analyze the state of food production in the context of sustainable economic development. The results of the calculations performed on this model are as follows ("see Table 3").

3-Table

The results of the econometric model of factorsaffecting the volume of production of meat products [23]

Method: The least squares method
Selectionperiods: 1999 2022
Numberofobservationsreceived: 24

Variables	Coefficient	Standard error	t-statistics	Probability
Number of consumers (LN_POP_)	3.871227	0.575961	6.721333	0.0000
Per capita income (LN_GDP_POP_)	-0.038052	0.034587	-1.100177	0.2912
The number of people employed in the food industry (LN_EPL_)	-0.072451	0.069922	-1.036178	0.3190
Prices of finished products in the food industry (LN_P_)	-0.032889	0.043595	-0.754425	0.4640
Tax rate set for the food industry (LN_TAX_)	-0.140631	0.094631	-1.486100	0.1611
Price index of products in the food industry (LN_п__)	-0.001893	0.010543	-0.179581	0.8603
C	-38.74758	5.335640	-7.262031	0.0000

R^2 (R-squared)	0.996238	Meandependentvar	0.494750
Adjusted R-squared	0.994501	S.D. dependentvar	0.361608
		Akaikeinfocriterio	
S.E. ofregression	0.026815n		-4.130521
Sumsquaredresid	0.009347	Schwarzcriterion	-3.782014
		Hannan-	
Loglikelihood	48.30521	Quinncriter.	-4.062489
		Darbin-Watson	
F-statistics (F-statistic)	573.7166	stat.	1.789114
Probability value	0.000000		

The scientific work proposed a natural logarithmic linear model that determines the volume of production of 4 types of food products in the future. Coefficients of susceptibility of factors to the volume of

$$LN(Q) = -38,79 + 3,87 * LN(POP) - 0,039 * LN(GDP/POP) - 0,072 * LN(Epl) - 0,033 * LN(P) - 0,14 * LN(TAX) - 0,002 * LN(\pi) \quad (2)$$

According to the results of the econometric analysis obtained on the multiplicative function of meat production, the multidimensional determination coefficient (R^2) was 0.996, indicating that the value calculated by Fisher's F-criterion ($F_{account} = 573.7 > F_{table}$) was greater than its table value. However, the regression equation was obtained by comparing the number of free degrees and the value of alpha 0.05 with the Student's value in the table (the t-criterion is 2.0860). Also, all influencing factors t-Student criteria

food production by types of meat, milk, bread and melons and vegetables were developed. We also obtained the following multifactor regression model based on the results of the calculations of the first meat production volume given in table 3:

$_{POP1}$=6,69>tx$_{жад}$=2,0860>t$_{TAX5}$=|-1,47|>t$_{GDP/POP2}$=|-1,14|>t$_{Epl3}$=|-1,027|>t$_{P4}$=|-0,71|>t$_{п6}$=|-0,233|. Darbin-Watson statistics d_L and d_U, the significance level was calculated at a = 0.05 d_{wl} = 0.60 <**d_w= 1.79>d_{wu}** = 1.74. In this model, when we check the reliability of the main influencing factors, the price index of meat product for meat production **$t_{п6}$ = | -0,233** | and the cost of the finished product in the meat industry **t_{P4} = | -0,71** | (see "Table 4").

Table 4
The results of the econometric model of the most reliable of the factorsaffecting the volume of production of meat products[23]

Method: The least squares method
Selection periods: 1999 2022
Number of observations received: 24

Variables	Coefficient	Standarderror	t-statistics	Probability
Number of consumers (LN_POP_)	3.080056	0.260127	11.84059	0.0000
Tax rate set for the food	-0.089084	0.040187	-2.216731	0.0406

industry(LN_TAX_)

C	-31.25664	2.579425	-12.11768	0.0000

R^2 (R-squared)	0.994997	Meandependentvar	0.4947
S.E. ofregression	0.027040	Akaikeinfocriterion	-4.2455
Sumsquaredresid	0.012430	Schwarzcriterion	-4.0961
Loglikelihood	45.45535	Hannan-Quinncriter.	-4.2163
F-statistics	1690.500	Darbin-Watson stat.	1.0143
Probability value	0.000000		

4 coefficients were found to be statistically insignificant and the values of 2 influencing factors were found to be significant. As a result, based on the results of the calculations of meat production in Table 4, we have the following multifactor regression model:

$$\mathbf{LN(Q)} = -\mathbf{31,26} + \mathbf{3,08} * \mathbf{LN(POP)} - \mathbf{0,089} * \mathbf{LN(TAX)} \qquad (4)$$

In this model, the number of consumers was found to be directly proportional and the change in tax rates to be inversely proportional. The Fisher criterion (F = 1690.5; R^2 = 0.995) was determined for this last regression model. The values of the t-student criterion by the coefficients of sensitivity (elasticity) of the factors were determined by the factors t_{POP1}=11,84>t_{TAX5}=|-2,22|>tx_{tab}=2,0860, ie MAPE-13.85, TIC-0.02. As a result, the Darbin-Watson statistic dL and dU, the significance level a = 0.05 dwl = 0.60 <dw = 1.014 <dwu = 1.74.

The effect of the number of consumers and tax rates on the model for dairy production has been identified. For the production of bakery products, it was found that the result of the latest model will be affected by changes in per capita income and tax rates at the expense of the correct relationship.

The final model for melons and vegetables shows that the influencing factors are directly proportional to the number of consumers and per capita income, and the price of the finished product is inversely proportional (see Table 5)

Table 5

A linear model that determines the volume of food production in the coming period[1]

Dairy products	Bakery products	Melons and vegetables
$LN(Q)=-35,19+3,43*LN(POP)-0,071*LN(GDP/POP)+0,039*LN(Epl)+0,022*LN(P)-0,15*LN(TAX)-0,016*LN(\pi)$; F=367,2; R^2=0,994; α=0,05; t_{POP1}=2,73> $tx_{жад}$= 2,0860> $t_{GDP/POP2}$=|-1,68|> t_{TAX5}=|-1,43|>$t_{п6}$=|-0,75|> t_{Epl3}=0,414> t_{P4}=0,236; d_{wl}=0,60<d_w=1,54<d_{wu}=1,74	$LN(Q)=4,785-0,691*LN(POP)+0,543*LN(GDP/POP)+0,352*LN(Epl)-0,211*LN(P)+0,273*LN(TAX)+0,016*LN(\pi)$; F=41,7; R^2=0,95; α=0,05; $t_{GDP/POP2}$=3,07> $tx_{жад}$=2,0860> t_{TAX5}=0,82> t_{P4}=|-0,73|> t_{Epl3}= 0,702> t_{POP1}=|-0,53|> $t_{п6}$=0,35; d_{wl}=0,60<d_w=1,64<d_{wu}=1,74	$LN(Q)=-39,12+4,16*LN(POP)+0,241*LN(GDP/POP)-0,45*LN(Epl)-0,453*LN(P)-0,242*LN(TAX)-0,058*LN(\pi)$; F=310,9; R^2=0,993; α=0,05; t_{POP1}=6,37> $tx_{жад}$= 2,0860> t_{P4}=|-2,038|> $t_{GDP/POP2}$=2,017> t_{Epl3}=|-1,63| > $t_{п6}$=|-1,598| >t_{TAX5}=|-1,593|; d_{wl}=0,60<d_w=1,95>d_{wu}=1,74
$\mu=(LN(Q)i-LN(Q)хис)^2=0$		
$LN(POP)=10,07+0,017*T$		
$LN(GDP/POP)=0,2695+0,2152*T$		
$LN(Epl)=6,72+0,088*T$	$LN(Epl)=7,24+0,0196*T$	$LN(Epl)=7,482+0,0042*T$
$LN(P)=-0,104+0,156*T$	$LN(P)=0,097+0,162*T$	$LN(P)=0,161+0,144*T$
$LN(TAX)=-1,0767-0,1067*T$		
$LN(\pi)=-2,384+0,064*T$	$LN(\pi)=-1,548+0,024*T$	$LN(\pi)=-1,640+0,025*T$
We examine the reliability of the influencing factors in these models		
t_{P4}=0,236the condition in which the factors were excluded from the model $LN(Q)=-37,65+3,69*LN(POP)-0,067*LN(GDP/POP)-0,021*LN(Epl)-0,146*LN(TAX)-0,009*LN(\pi)$; F=464,3; R^2=0,994; α=0,05; t_{POP1}=4,63> $tx_{жад}$= 2,0860 > $t_{GDP/POP2}$=|-1,61| >t_{TAX5}=|-1,42|> $t_{п6}$=|-0,62|> t_{Epl3}=0,27; d_{wl}=0,60<d_w=1,57<d_{wu}=1,74	**tx_6=0,35** the condition in which the factors were excluded from the model $LN(Q)=5,45-0,79*LN(POP)+0,53*LN(GDP/POP)+0,39*LN(Epl)-0,2*LN(P)+0,25*LN(TAX)$; F=53,3; R^2=0,95; α=0,05; $t_{GDP/POP2}$=3,15> $tx_{жад}$=2,0860 > t_{Epl3}=0,83> t_{TAX5}=0,79> t_{P4}=|-0,72|> t_{POP1}=|-0,64|; d_{wl}=0,60<d_w=1,57<d_{wu}=1,74	**t_{TAX5}=|-1,593|; $t_{п6}$=|-1,598|**the condition in which the factors were excluded from the model $LN(Q)=-41,1+4,49*LN(POP)+0,39*LN(GDP/POP)-0,58*LN(Epl)-0,55*LN(P)$; F=336,9; R^2=0,989; α=0,05; t_{POP1}=6,16; $t_{GDP/POP2}$=4,26 >t_{P4}=|-3,94|> $tx_{жад}$= 2,0860 > t_{Epl3}=|-1,806|; d_{wl}=0,60<d_w=1,44<d_{wu}=1,74
t_{Epl3}=0,the condition in which the factors were	**t_{POP1}=|-0,64|; t_{P4}=|-0,72|**the condition in which the	**t_{Epl3}=|-1,806|** the condition in which the factors

excluded from the model $LN(Q)=-39,32+3,87*LN(POP)-0,064* LN (GDP/POP)-0,13*LN (TAX)-0,008* LN(\pi)$; $F=618,7$; $R^2=0,994$; $t_{POP1}=9,7> tx_{жад}= 2,0860> t_{TAX5}=|-1,72| > t_{GDP/POP2}=|-1,65| >t_{п6}=|-0,59|$; $dwl=0,60<dw=1,59<dwu=1,74$	factors were excluded from the model $LN(Q)=-1,087+0,414*LN(GDP/ POP)+0,22*LN(Epl)+0,406*LN(TAX)$; $F=96,5$; $R^2=0,948$; $\alpha=0,05$; $t_{GDP/POP2}=4,52> tx_{жад}= 2,0860 >t_{TAX5}=1,79> t_{Epl3}=0,57$; $dwl=0,60<dw=1,49<dwu=1,74$	were excluded from the model $LN(Q)=-38,85+3,83*LN(POP)+ 0,401* LN(GDP/POP)-0,50* LN(P)$; $F=392,7$; $R^2=0,986$; $\alpha=0,05$;$t_{POP1}=5,67>t_{GDP/POP2}=4,06 >t_{P4}=|-3,43|> tx_{жад}= 2,0860$; $d_{wl}=0,60<dw=1,47<d_{wu}=1,74$
$t_{GDP/POP2}=|-1,65|$; $t_{п6}=|-0,59|$the condition in which the factors were excluded from the model $LN(Q)=-35,74+3,53*LN(POP)-0,034* LN(TAX)$; $F=1183,6$; $R^2=0,993$; $\alpha=0,05$; $t_{POP1}=11,04> tx_{жад}= 2,0860 >t_{TAX5}=|-0,7|$; $d_{wl}=0,60<d_w=1,09<d_{wu}=1,74$	$t_{Epl3}=0,57$ the condition in which the factors were excluded from the model $LN(Q)=0,45+0,405*LN(GDP/POP)+0,346* LN(TAX)$; $F=150,6$; $R^2=0,946$; $\alpha=0,05$; $t_{GDP/POP2}=4,59> tx_{жад}= 2,0860< t_{TAX5}=1,76$; $d_{wl}=0,60<d_w=1,37<d_{wu}=1,74$	

POP-number of consumers; **GDP/POP**-per capita income; **Epl**-Number of people employed in the apple food industry; **P-**is the price of the finished product in the food industry; **TAX-**the established tax rate in the food industry; **п**- is the price index of the product in the food industry.[1] Calculations based on the author's development.

Sensitivity coefficients of factors influencing household consumption expenditures have been developed (see "Table 6").

We also obtained the following multi-factor regression model based on the calculation results of Table 6 of household consumption expenditures:

LN(IX)=2,83+1,87*LN(IO)+0,28*LN(OIS)+0,156*LN(FS)-
0,287*LN(1+INI)+0,86*LN(1+IHD)+1,27*LN(1+TD)+0,65*LN(1+ITD)-2,459*LN(AS)   (5)

Table 6
The results of the econometric model of factors affecting household consumption expenditures
[23]

Method: The least squares method
Selectionperiods: 2003 2018
Number of observations received: 16

Variables	Coefficient	Standarder ror	t-statistics	Probability
GDP growth rate(LN_IO_)	1.874571	1.467510	1.277382	0.2422
The growth rate of food production (LN_OIS_)	0.279053	0.255948	1.090272	0.3117
Average annual interest rate on short-term loans (LN_FS_)	0.155860	0.095686	1.628868	0.1474
Consumer goods price index (LN_1_INI_)	-0.287532	0.237113	-1.212637	0.2646
Household income in the form of wages (LN_1_IHD_)	0.861140	0.542438	1.587535	0.1564
Уй хўжаликларининг тадбиркорлик ва бошқа шаклдаги даромадлариHousehold and other forms of household income (LN_1_TD_)	1.278093	0.904752	1.412645	0.2006
Household income in the form of social payments (LN_1_ITD_)	0.652819	0.427550	1.526884	0.1706
Permanent population growth rate (LN_AS_)	-2.458669	1.916615	-1.282818	0.2404
C	2.833058	1.968216	1.439404	0.1932

R^2	0.699362	Meandependentvar		-0.346477
Adjusted R-squared	0.355776	S.D. dependentvar		0.043859
Regressionstand. error	0.035203	Akaikecriterion		-3.557041
Involuntarychange. arithmeticmean	0.008675	SchwartzBaescriterion		-3.122459
Proximitytologarithmicreality	37.45632	Xanan-Quinncriterion		-3.534786
F-statistics	2.035477	Darbin-Watsonsta.		0.919860
Probability value	0.182333			

It is suggested that the increase in household consumption expenditures is mainly influenced

by the constant population growth rate and the consumer goods price index. As a result, an increase in the consumer price index by 1% will lead to an increase in household consumption expenditures by 0.29%, and an increase in the rate of permanent population growth by 1%, leading to an increase in household consumption expenditures by 2.46%. The remaining indicators significantly affect household consumption expenditures.

These indicators include the growth rate of food production (OIS), household income in the form of wages (IHD), household income in business and other forms (TD), and household income in the form of social payments (ITD) 1 % increase, reducing household consumption expenditures by 0.28%, 0.86%, 1.27%, and 0.65%, respectively.

Conclusion.

In 2018, the minimum per capita budget for food consumption will increase by 2.6 times for dairy products, 15.2% for fruits and berries, 1.3 times for potatoes, or 13 times for meat according to rational medical standards. , 3 percent, melons 41.9 percent, fruits and berries 11.1 percent, eggs 27.4 percent less. This is due to a certain decrease in the income of the population and an artificially rapid increase in prices.

In assessing the development of production in the food industry and the competitiveness of their activists: the share of key sectors of the economy in production; participation in ensuring the functioning of food and food markets in the country; credit ratio of food industry enterprises; it is expedient to use indicators to determine the level of their fixed assets and their participation in export processes.

Establishment of a stable raw material base on farms specializing in the cultivation of meat, dairy, melons and vegetables and other products in the quantities required for processing and production of high quality food products and specialized enterprises exporting a significant amount of food products, in foreign markets a targeted approach is needed to modernize them by introducing new modern foreign equipment and technologies that are in constant demand.

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