Prediction of labour and personal costs development in the food industry branches in the Czech Republic up to 2013

Predikce vývoje pracovních sil a osobních nákladů potravinářských výrobních oborů v České republice do roku 2013

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Abstract: Production of food and beverages is one of the Czech traditional branches of processing industry. The article tries to describe the model prediction on the sector structure development oriented on labour and personal costs in food industry sector up to 2013 and it is based on the continuous monitoring of these indicators in the period 2000–2005. Except regress analysis of time orders, there was used the method of exponential smoothing. With regard to certain antagonistic tendencies, i.e. the lasting fall of the number of workers in the monitored period but at the same time the growth of personal costs, there were projected separate predictions of these indicators up to 2013, aimed namely at the set of companies with 20 and more employees. The prediction of the selected data up to the year 2013 is based on the running results of the Research Plan of the Research Institute of Agricultural Economics (VÚZE). The probable development of the number of workers and personal costs in the individual branches of food industry is characterised.

Key words: manufacture of food products and beverages, economic forecasting, labour forces, personal expenditures, wages

Abstrakt: potravinářský průmysl je jedním z tradičních sektorů českého zpracovatelského průmyslu. Článek popisuje modelovou predikci vývoje sektoru zaměřenou na pracovní síly a osobní náklady v potravinářském průmyslu do roku 2013. Predikce je založena na sledování vývoje těchto ukazatelů v období 2000–2005. Pro analýzu časových řad bylo využito kromě regresní analýzy též exponenciální vyrovnávání. Vzhledem k antagonistickým tendencím, tj. klesajícímu počtu zaměstnanců a současně rostoucím mzdovým nákladům byly zpracovány samostatné predikce těchto ukazatelů pro jednotlivé obory do roku 2013 zaměřené na skupinu podniků s 20 a více zaměstnanci. Predikce vybraných dat do roku 2013 je založena na průběžných výsledcích Výzkumného záměru, řešeného VÚZE. Je charakterizován pravděpodobný vývoj počtu pracovníků a osobních nákladů v jednotlivých oborech potravinářského průmyslu.

Klíčová slova: potravinářský průmysl, ekonomické prognózování, počet pracovníků, osobní náklady, mzdy

The prediction of the selected data up to the year 2013 is based on the running results of the Research Plan of the Research Institute of Agricultural Economics (VÚZE), which had been solved in the year 2005 and it also continued at the beginning of the year 2006 (Foltýn et al. 2006). This prediction includes model projection of the individual productions (NACE), resp. their aggregations in concord with the Classification of Economic Production Activities (NACE) and the entire branches. The function of two independent variables was used as the initial model for prediction of personal costs (Rastokin, Froněk 1973; Toutenburg 2003). As dependent variables, there were used working costs for the individual food productions and independent variables were the number of employees and the arithmetic mean of the number of workers and the natural

logarithms of time. The classic regression analysis linear in parameters was used, thereby there were gained mathematically statistical estimates of these parameters. These data were used as the basis for prediction by the calculations. There was used the process of the number of employees prediction by the method of exponential smoothing, which pertains to a wider class of self adaptive methods (Lewandowski 1974; Arlt 1999).

The possible development of the selected food industry branches up to 2013 from the competitiveness point of view was evaluated in Slovakia. The Policy Analysis Matrix (PAM) was used by Matošková (2002).

MATERIAL AND METHODS

As the initial model for the prediction of personal costs up till 2013 in the current prices, there was used the function of two independent variables, where the dependent variable were labour costs for the individual food productions and the independent variables were the number of employees and the natural logarithms of time (reduced about year 1900). The classic regression analysis linear in parameters was used, thereby there were gained mathematically statistical estimates of these parameters. These data were the basis for the predictions calculations.

It was necessary for predictions to have to our disposal also the predictions of the number of employees in all food productions they could be used in the above mentioned function as sizes of the independent variables, so that the result could be the prediction of dependent variables, i.e. sizes of the predicted personal costs. The use of simple trend analysis was not fully suitable for these purposes with regard to the fact that the function of two variables for personal costs would be reduced to one compound function of one time variable. Even if it was not taken into account, the influence of the possible stochastic noises in this consideration is as a matter of fact the basis of the matter. In addition, the simple trend analysis did not grant an objectively satisfactory record by using the method of linear regression in parameters for one independent variable (time resp. year).

Therefore, there was used the process of the number of employees prediction by the method of exponential smoothing, which pertains to a wider class of self- adaptive methods. The choice of parameters used for the individual food productions offered a wider field to the critical selection of the relatively extensive series modelling result's variants to be able to achieve co-ordination modelling results with the common matter – of -fact autonomous images about the next development of the predicted quantities. It was demonstrated that the common use of variables for all food productions is not possible, namely not only with reference to various sizes of modelling parameters, but also with reference to the specific model characters of the individual food productions.

The following prediction methods were used for the number of employees of the food production branches:

Winter's method with the additive periodic component (i.e. method with three components corresponding to base-line offset, trend and time – sharing component):

NACE 15.1 (Production, processing and preserving of meat and meat products), NACE 15.2 (Processing and preserving of fish and fish products) NACE 15.3 (Processing and preserving of fruit, vegetables and potatoes) and NACE 15.7 (Production of feeds). In spite of the fact that the constructional time series (past), on which the simulation was based. It is interesting, that even if the constructional time-series (past), on which the simulation was based, was relatively short, still the period of three years proved to be satisfactory and contributed to the precision of the construction and probably also prediction results, not with standing the fact that it can be even of constructional importance faced to the reality. Winter's method was used also for the number of employees prediction of the NACE 15.4 (Production of vegetable and animal's oils and fats). The optimal upper 55 % were used for the number of employees prediction.

Halt's method was used for the prediction of branches 15.5 (Processing of milk, production of dairy products and ice cream), NACE 15.6 (Production of grain, mill and starch products) NACE 15.8 (Production of others food products) and NACE 15.9 (Production of beverages). This method is based only on two components (base-line offset and trend).

The prediction of food industry sector as a whole was based on the sum of single food productions. The predicted personal costs based on use of Winter's method were confronted with the sum of single branches. The results differed only slightly.

It is necessary to remind that the prediction of the number of employees was at the single branches in exceptional cases also corrected in the years linked to reality to follow a certain continuity of the expected development.

RESULTS AND DISCUSSION

The manufacture of food products and beverages NACE 15 is an important product segment of the

processing industry. With a 10.2% share in receipts in current prices in 2005, the industry under review is one of four decisive processing branches. At the same time, the decisive shares in receipts in food and beverages production belong to four groups. It concerns manufacture of other food products, in which there dominates mainly the production of bakery and confectionary products (26.0%), production, processing and preserving of meat and meat products (22.0%), and then the production of beverages (22.0%), milk and dairy products and ice cream (16.0%).

The indicator number of employees in the monitored branch, which is still under reconstruction, is declining more quickly than the one within the entire processing industry. The share of the number employees of the food s and beverages production NACE 15 in the total processing industry was 9.7% in 2005.

The results are, with the reference to the monitored branch, relatively independent and include the following production branches:

15.1 – production, processing and preserving of meat and meat products,
15.2 – processing and preserving of fish and fish products,
15.3 – processing and preserving of fruit, vegetables and potatoes,
15.4 – production of vegetable and animal oils and fats,
15.5 – processing of milk, manufacture of dairy products and ice cream,
15.6 – production of grain mill and starch products,
15.7 – production of feeds,
15.8 – production of other food industry products,
15.9 – production of beverages.

Production, processing and preserving of meat and meat products (NACE 15.1)

As the second biggest production group measured by the number of employees and personal costs and also according to the prediction, the production of meat and meat products will therefore belong to the decisive food productions. The process of restructuring of food production and the restricted capacity range of production base parallel depend on the growth of the efficient use of technology. It can be supposed according to projected calculation that the number of employees would be reduced by 16.9% in the period 2005–2013.

Processing and preserving of fish and fish products (NACE 15.2)

Processing and preserving of fish and fish products belongs to the smallest productions inside the monitored industry (0.6%). The development of the number of employees would be according to the elaborated prediction for the monitored period 2005–2013 approximately on the same level (index 2013: 100.1). The main role plays the seasonal character of domestic production and import of fish products.

Table 1. Number of employees NACE 15

Year	NACE 15.1	NACE 15.2	NACE 15.3	NACE 15.4	NACE 15.5	NACE 15.6	NACE 15.7	NACE 15.8	NACE 15.9	NACE 15 total
2000	29 510	1 164	5 385	3 243	14 121	4 425	8 003	57 755	20 744	144 350
2001	29 484	972	4 285	3 357	13 427	3 968	7 809	59 158	20 682	143 142
2002	30 573	819	4 512	3 313	13 506	3 781	7 764	57 354	19 577	141 199
2003	29 217	1 066	4 095	3 112	12 797	4 285	7 581	57 942	18 621	138 716
2004	27 897	956	3 842	2 866	12 324	4 229	6 840	57 840	18 444	135 238
2005	26 165	743	3 958	2 393	11 946	3 998	6 588	58 873	16 693	131 357
2006	26 066	1 019	3 849	2 334	11 780	3 923	6 592	57 874	16 665	130 102
2007	25 967	869	3 280	2 274	11 432	3 897	6 139	57 846	16 008	127 713
2008	25 640	686	3 562	2 215	11 083	3 871	6 007	57 819	15 351	126 234
2009	24 540	957	3 420	2 061	10 735	3 845	5 794	57 792	14 694	123 837
2010	23 860	806	2 850	2 033	10 386	3 819	5 342	57 764	14 037	120 898
2011	23 533	624	3 132	1 812	10 038	3 793	5 210	57 737	13 380	119 258
2012	22 432	895	2 990	1 661	9 689	3 767	4 997	57 710	12 723	116 864
2013	21 753	744	2 421	1 634	9 341	3 741	4 545	57 682	12 066	113 926

Table 2. Personal expenditures (c.p.) NACE 15

Year	Year–1990	LN (year–1900)	NACE 15.1	NACE 15.2	NACE 15.3	NACE 15.4	NACE 15.5
2000	100	4.605170186	4 773.9	223.2	854.2	923.8	2 677.7
2001	101	4.615120517	5 023.1	195.9	786.4	1 009.1	2 784.5
2002	102	4.624972813	5 848.6	170.9	901.3	1 069.4	3 001.8
2003	103	4.634728988	5 770.6	210.0	844.9	1 000.7	2 958.8
2004	104	4.644390899	5 874.6	335.0	960.8	1 000.7	2 871.0
2005	105	4.65396035	5 881.7	180.7	928.5	1 033.8	3 210.5
2006	106	4.663439094	6 199.5	321.8	994.9	1 034.2	3 276.7
2007	107	4.672828834	6 550.5	298.2	990.0	1 060.5	3 375.8
2008	108	4.682131227	6 841.6	264.5	1 057.9	1 086.4	3 472.9
2009	109	4.691347882	6 938.3	370.6	1 088.9	1 099.5	3 568.0
2010	110	4.700480366	7 135.6	346.4	1 082.8	1 128.9	3 661.3
2011	111	4.709530201	7 416.5	312.1	1 149.5	1 132.6	3 752.6
2012	112	4.718498871	7 503.3	417.6	1 179.4	1 145.2	3 842.2
2013	113	4.727387819	7 690.8	392.7	1 172.2	1 173.9	3 929.9
		abs. number	−186 728.4698	−11 356.5398	−21 221.4715	−16 207.8587	−106 234.6620
		coeff. ln (year–1900)	39 989.0458	2 436.8011	4 692.9870	3 631.0666	22 658.7897
		coeff. number of workers	0.2471	0.3085	0.0860	0.1323	0.3263
			14 919.8	729.6	2 328.9	2 277.7	7 594.8

Year	Year 1990	LN (year–1900)	NACE 15.6	NACE 15.7	NACE 15.8	NACE 15.9	NACE 15 Total
2000	100	4.605170186	846.7	1 819.3	9 620.3	5 303.6	27 042.7
2001	101	4.615120517	822.9	1 960.1	10 288.3	5 682	28 552.3
2002	102	4.624972813	860.1	2 096.7	10 946.5	5 792.8	30 688.1
2003	103	4.634728988	960.9	2 099.7	11 291.3	5 992.1	31 129.0
2004	104	4.644390899	1 056.6	2 344.6	11 336	6 484.9	32 264.2
2005	105	4.65396035	985.7	1 872.6	13 071.4	6 428.6	33 593.6
2006	106	4.663439094	1 052.5	2 208.9	13 024.0	6 835.8	34 943.8
2007	107	4.672828834	1 093.3	2 211.6	13 573.6	7 090.6	36 188.6
2008	108	4.682131227	1 133.6	2 281.5	14 118.1	7 341.5	37 618.2
2009	109	4.691347882	1 173.5	2 333.3	14 657.5	7 588.5	38 828.6
2010	110	4.700480366	1 213.0	2 333.3	15 191.9	7 831.7	39 903.1
2011	111	4.709530201	1 252.2	2 400.6	15 721.4	8 071.2	41 249.5
2012	112	4.718498871	1 290.9	2 449.7	16 246.1	8 306.9	42 413.6
2013	113	4.727387819	1 329.3	2 447.1	16 766.0	8 539.1	43 442.5
		abs. number	−21 940.7485	−48 386.0220	−276 390.3422	−208 243.7691	−874 468.2982
		coeff. ln (year–1900)	4 793.2374	10 547.9819	59 204.8780	45 198.0350	188 839.1594
		coeff. number of workers	0.1632	0.2132	0.2301	0.2581	0.2212
			2 543.1	4 850.3	31 967.4	16 378.1	

Processing and preserving of fruit, vegetables and potatoes (NACE 15.3)

The number of employees represented 3.0% in the monitored year 2005 in the frame of food industry. The production has a seasonal character. This food sector is less competitive due to the level of technological equipment. There are used obsolete and power- inefficient technologies. It is the reason for the necessary further investments to the sector technologies mainly with regard to domestic market. The foreign trade will also play a big role in the future. Due to these factors, there is supposed in period 2005–2013 the decline of number of employees about 38.8%.

Manufacture of vegetable and animal oils and fats (NACE 15.4)

The production of vegetable and animal oils and fats in 2005 presented 1.8% of the total number of employees in food industry and the employment continued to decrease. Czech oils and fats industry is relatively highly concentrated and the technological equipment of the sector is on a good level. There could be supposed future technological improvement. There is presumed the fall by about 31.7% in the category of the number of employees in the period 2005–2013.

Processing of milk, manufacture of dairy products and ice cream (NACE 15.5)

Concentration of production capacities leading to the savings is significant for this sector. According to the sufficient market supply with milk products, including a relatively considerable import, it could be supposed, that in the monitored period there would be reduced the number of employees by 21.8%.

Manufacture of grain mill and starch products (NACE 15.6)

Technological facilities of this aggregation have been on the average level. A reasonable decrease of the number of employees could be presumed in consequence with introducing more progressive technologies. There is presumed the fall by about 6.4% in category of number of employees in the period 2005–2013.

Production of feeds (NACE 15.7)

Production of feeds represented in 2005, measured by the number of employees, 5.0% of the total food industry. The level of technological facilities is on a good standard but there always exist differences in comparison with the EU states. Future modernisation of technologies is supposed. The development of the employees number will be rather connected to the needs of the industry and will represent a step- by- step decrease. The fall of the number of employees in 2013 in comparison with 2005 is supposed by about 31.0%.

Manufacture of other food industry products (NACE 15.8)

The increase of the share in the total number of employees is expected and this aggregation with the share of 44.8% is still a leading production branch in food industry. Production of NACE 15.81 – Production of bakery and confectionary products presents the main share of NACE 15.8 (36.0%) measured by the monitored indicator. It could be supposed that in this very diverse branch, there will continue a mild fall of the number of employees in connection with the introduction of new technologies. Good perspectives appear for the confectioner's production which represents a wide range of products.

Manufacture of beverages (NACE 15.9)

The aggregation represented 12.7% of food and beverages industry in the year 2005 measured by the number of employees. The main position inside this aggregation fills NACE 15.96 – Production of beer with the share of 50.6% in the total value of the monitored indicator. It could be expected that the strong competition in the production of beverages will influence the slow decline (27.6%) of the employees number in the period to 2013. One of the reasons could be the decreasing demand for spirits.

It is obvious that from the production performance point of view, the following four groups, resp. aggregations, are the decisive ones, namely (ranked according to the volume of receipts by descending line): NACE 15.8 – Production of other food products (44.8%), 15.1 – Production, processing and preserving of meat and meat products (19.9%), 15.9 – Production of beverages (12.7%) and 15.5 – Processing of milk, dairy products and ice cream (9.1%).

CONCLUSIONS

Development prediction of the number of employees and personal costs in the CR production of food and beverages up to the year 2013 is presented in Table

1 and 2. Antagonistic tendencies of both monitored indicators i.e. the lasting fall of the number of employees in the monitored period but at the same time the growth of personal costs will continue till the year 2013. The total number of employees of organisations with 20 workers and more could achieve the level of 113 926 persons in the year 2013. It presents a decrease by about 17 thousands persons (13.3%) in comparison with the year 2005. The biggest share of employees in 2013 will be concentrated (as in the year 2005) in the production of other food industry products (50.6%). In all food production branches, there will continue the decrease of the number of employees. A more rapid decrease of the number of employees in the period 2005–2013 can be expected, according to the prediction, in the following production branches: Processing and preserving of fruit, vegetables and potatoes (38.8%) and at Manufacture of vegetable and animal oils and fats (31.7%).

There is predicted the increase of personal costs up to the year 2013 in all production branches of the food industry. The value of this indicator would be in 43 442.5 CZK. There is supposed the increase by about 29.3% in comparison with the year 2005. The biggest growth of personal costs is expected in the production of grain, mill and starch products (34.9%), the production of beverages (32.9% and in the production of feeds (30.7%).

The research of the development of the individual links of food chain efficiency belongs to the priorities of economic research in this area. It is especially necessary to pay attention to the future development of the individual branches. Model prediction with a high measure of probability aimed at the production of food and beverages sector, like coherent systems on agriculture and the pivotal line manufacturing industry, will estimate the future rise of efficiency, i.e. whether in the years to come it will be among the sectors with a high potential of future development.

In the next research period, it would be necessary to continue in precising of this prediction and to develop programs for modelling predictions which could be applicable on the changing economic conditions of the food and beverages production.

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