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SCIENCE, TECHNOLOGY AND INNOVATION

FORECASTING BY ECONOMETRIC MODELS AS SUPPORT TO MANAGEMENT

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Key words: Forecasting, econometric models, management.

Abstract: In the contemporary environment characterized by the dynamic structure of factors and the unpredictability of the relations existing between them, the central problem is the selection of strategic goals. Forecasting is the necessary precursor to the planning process and includes research into the future course of events. Numerous methods and techniques of forecasting are used nowadays. Econometric models can be used successfully for predicting the future development of a phenomenon, and thereby facilitate the choice of strategic goals.

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Research results

This paper uses data published by the Republic Office of Statistics of Serbia, obtained through Household Consumption Surveys.

The Household Consumption Survey is one of the oldest surveys conducted by the Republic Office of Statistics. The methodology of this survey has been revised several times since 1954, in order to obtain as reliable results as possible.

Since 2003, this research has been conducted in accordance with international standards and recommendations of EUROSTAT, ILO and UN, thus providing international data comparability. The survey gathers data on income, expenditure and household consumption, i.e. data on the basic elements of individual consumption.

A survey unit is taken to be every single or multi-member household, selected according to the sampling plan. A household is defined as: (a) a community of persons, whose members live, eat and jointly spend the earned income; (b) a single person living, eating and spending the earned income on his/her own.

200 households are surveyed every 15 days, i.e. 1200 households quarterly.

The gathered data refer to total disposable income, expenditure on food and non-alcoholic beverages, and the share of this expenditure in quarterly total individual consumption as well, and constitute the monthly averages per household (expressed in RSD and percentages). The data for all households were recorded separately for Vojvodina and the Republic of Serbia, for all households (Table 1).

Viewing the trends in the values of disposable income and expenditure on food, as well as the share of expenditure on food in total individual consumption over time, one can follow the trends in the population's living standard.

One of the most suitable formats for representing data over time is a chain index series, which can be used for calculating the mean development rate, i.e. the mean growth rate of a phenomenon. The graphic representation of chain index trends is shown on the Figure 3 (Appendix).

Based on the above figures, we can notice that trends in disposable income and expenditure on food show a growing tendencyy over the observed period both in Vojvodina and the Republic of Serbia. Moreover, we can see that, in the structure of the households' individual consumption structure, the expenditure on food and non-alcoholic beverages account for a high share - 36.64% in Vojvodina and 39.47% in Serbia (on the average for the observed period), and in addition, show a slight growing trend, which is a characteristic of undeveloped countries.

In most EU countries, the highest share in the individual consumption structure is taken up by expenditures on dwelling, water, power, gas and other fuels and transport, while expenditure on food and non-alcoholic drinks takes up the third place.

According to the latest Communication of the Serbian Republic Office of Statistics, in the fourth quarter of 2009, an average household in Serbia has the disposable monthly income amounting to 47582 RSD. At the same time, the average household expenditure amounts to 44886 RSD, where expenditure on food and non-alcoholic beverages amounts to 18249 RSD, i.e. 40.7%, which points to a fall in the population's living standards.

The Figures 4 and 5 (Appendix) show the average overlapping variance between data for disposable income and expenditure on food, used in econometric research.

Based on the t-test, we can conclude that there is no statistically significant difference between the actual value of expenditure on food and the ones forecast by economic model for the 3rd quarter of 2009, which means that we can consider the model's forecasting ability to be satisfactory with the probability of 95%, both in case of Vojvodina and the case of the Republic of Serbia

Based on the F-test, we can also conclude with the probability of 95% that the structural parameters are stable, both in case of Vojvodina and the case of the Republic of Serbia, i.e. that there is no statistically significant difference between the sums of squared residuals for the shorter (18 observations) and longer sample (21 observations), which means that the model's forecasting ability is satisfactory.

By this we have proven that *parameterized econometric models are also suitable for forecasting*; the results are in accordance with forecast values based on the trend and the mean development rate (see Table 2)

This research indicates to the management that there is reason for concern, in view of the fall in the population's living standards, i.e. the growing trend in the share of expenditure on food in Total individual consumption.

Conclusion

The pace of change of events nowadays is too rapid for experience to be used as a guide for the future. New conditions are characterised by unpredictable and complex problems and possibilities as well as uncertain situations, so that planning and forecasting should secure better results in accomplishing an organisation's objectives.

Planning in modern conditions comes down to defining objectives and formulating strategies for achieving them. The management's main responsibility in the new conditions comes down to formulating and applying the strategy. Anticipating changes is not only a challenge but a prerequisite for the survival of an organisation in a dynamic setting. Forecasting by econometric models is an area that provides for planning and selection of strategic objectives. A large number of forecasting methods and techniques are used nowadays.

Ideal forecasting is achieved by combining two types of methods: the group of methods based on intuition and subjective assessment; and the group of methods relying on statistical and mathematical techniques, including econometric methods.

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APPENDIX

TABLE 1. DISPOSABLE INCOME AND EXPENDITURE PER HOUSEHOLD
in Vojvodina and the Republic of Serbia by quarters

VOJVODINA, SERBIA - all households (monthly average per household in RSD)											
		Vojvodina					Serbia				
Year	Quarter	Expenditure on food (Y)	Disposable income (X)	Chain indexes (Y)	Chain indexes (X)	Share (%)	Expenditure on food	Disposable income (X)	Chain indexes (Y)	Chain indexes (X)	Share (%)
2004	III	8195	26480			36.70	9452	23569			40.50
	IV	9937	24657	1.2126	0.9312	34.20	10578	22726	1.1191	0.9642	38.30
2005	I	9898	23839	0.9961	0.9668	37.70	10282	25057	0.9720	1.1026	38.10
	II	7462	23522	0.7539	0.9867	33.80	9488	23587	0.9228	0.9413	37.80
	III	8861	27567	1.1875	1.1720	33.30	10763	27816	1.1344	1.1793	37.10
	IV	10111	29588	1.1411	1.0733	36.90	11654	31160	1.0828	1.1202	37.10
2006	I	10806	32344	1.0687	1.0931	32.90	11644	32895	0.9991	1.0557	35.10
	II	10999	32641	1.0179	1.0092	35.30	12010	33027	1.0314	1.004	38.00
	III	11845	32129	1.0769	0.9843	38.40	13005	35337	1.0828	1.0699	39.90
	IV	12772	36422	1.0783	1.1336	36.30	14162	37358	1.0890	1.0572	39.50
2007	I	10690	32002	0.8370	0.8786	34.70	13310	36322	0.9398	0.9723	38.30
	II	11317	34501	1.0587	1.0781	36.50	12567	37396	0.9442	1.0296	39.30
	III	*11475*	*37276*	1.0140	1.0804	35.50	*13532*	40404	1.0768	1.0804	39.70
	IV	12433	35981	1.0835	0.9653	36.50	15083	40083	1.1146	0.9921	39.90
2008	I	13935	38209	1.1208	1.0619	37.90	15651	42672	1.0377	1.0646	39.90
	II	14462	38648	1.0378	1.0115	41.00	16365	41044	1.0456	0.9618	43.50
	III	15594	45642	1.0783	1.1810	37.30	16593	44835	1.0139	1.0924	41.40
	IV	18023	45361	1.1558	0.9938	39.60	17655	45637	1.0640	1.0179	40.90
2009	I	16531	47663	0.9172	1.0507	37.70	16929	45853	0.9589	1.0047	40.90
	II	16722	47434	1.0116	0.9952	39.10	16900	47068	0.9983	1.0265	41.90
	III	17200	49887	1.0286	1.0517	38.20	18177	50194	1.0756	1.0664	41.80
	IV	17194	45639	1.0000	0.9148	37.90	18249	47582	1.0040	0.9480	40.70

Source: www.stat.gov.rs (Communication LP-12 - Household Consumption Survey, 16 June 2010)

TABLE 2. COMPARATIVE OVERVIEW - RESEARCH RESULTS

No.	Model	Model equation for Vojvodina	FORECAST FOR VOJVODINA	Model equation for the Republic of Serbia	FORECAST FOR THE REPUBLIC OF SERBIA
1.	Linear trend for Y	Y_t=7276.35+460.89t (R^2=0.8644)	Y_{22}=17415.8374	Y_t=8584.752+438.62t (R^2=0.9457)	Y_{22}=18434.2952
2.	Linear trend for X	X_t=221350.18+1270.30t (R^2=0.9291)	X_{22}=4296.78	X_t=21696.74+1355.10t (R^2=9720)	X_{22}=51068.96
3.	Linear trend for Share	U_t=34.33+0.2t (R^2=0.3802)	U_{22}=38.96%	U_t=37.02+0.22t (R^2=4968)	U_{22}=41.92%
4.	Exponential trend for Y	Y_t=7949.78*1.038^t (R^2=0.8651)	Y_{22}=18077.96	Y_t=9299.88*1.033^t (R^2=9433)	Y_{22}=19113.02
5.	Exponential trend for X	X_t=23102.59*1.037^t (R^2=0.9316)	X_{22}=51304.92	Y_t=32153.47*1.039^t (R^2=9409)	X_{22}=54093.105
6.	Mean development rate for Y	1.0378	Y_{22}=17849.588	10332	Y_{22}=18781.1126
7.	Mean development rate for X	1.0322	X_{22}=51492.13	10385	X_{22}=52127.55
8.	Linear econometric model (for Y)	Y_t=504.7299+0.3644X_t (R^2=0.9001) (Adj. R^2=0.8945)	Y_{21}=17676.40 (mdr. X_{21}) Y_{22}=18193.14 (exp. trend X_{22})	Y_t=1390.192+0.3208X_t (R^2=0.9262) (Adj. R^2=0.9221)	Y_{21}=18033.65 (mdr. X_{21}) Y_{22}=18314.34 (lin. Trend X_{22})
9.	LOG-LOG model (for Y)	Y_t=0.2978*$X_t^{1.0151}$ (R^2=0.8793)	Y_{21}=17481.53	Y_t=2.7913*$X_t^{0.8087}$ (R^2=0.9198)	Y_{21}=1766.21
10.	Multiple model (+time)	Y_t=382.085+0.32X_t+58.68t (R^2=0.9012) (Adj. R^2=0.8896)	Y_{21}=17627.995	Y_t=6517.91+0.105X_t+296.08t (R^2=0.9404 (Adj. R^2=0.9334)	Y_{21}=18015.51

Source: Based on the author's own research

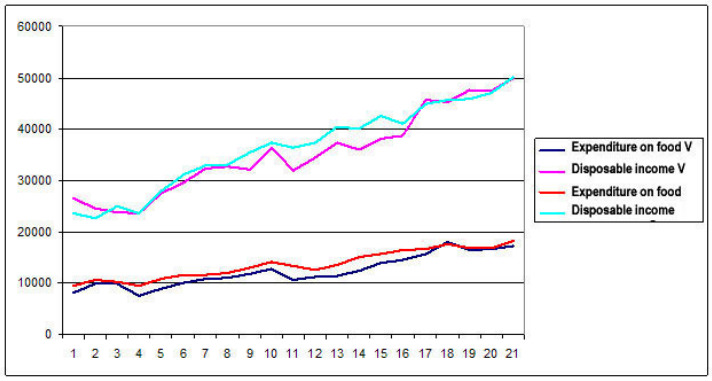
TABLE 3. TESTING THE MODEL'S FORECASTING ABILITY BY T-TEST

t-test	Actual value	Forecast value	Forecasting interval	t*	t-table (0.05;18)
Vojvodina	Y_{21}=17200	$Y_{21,p}$=17676.40	(15423.10; 19929.71)	0.4439	2.101
The Republic of Serbia	Y_{21}=18177	$Y_{21,p}$=18033.65	(16306.24; 19761.05)	0.1744	2.101

TABLE 4. TESTING THE MODEL'S FORECASTING ABILITY BY F-TEST

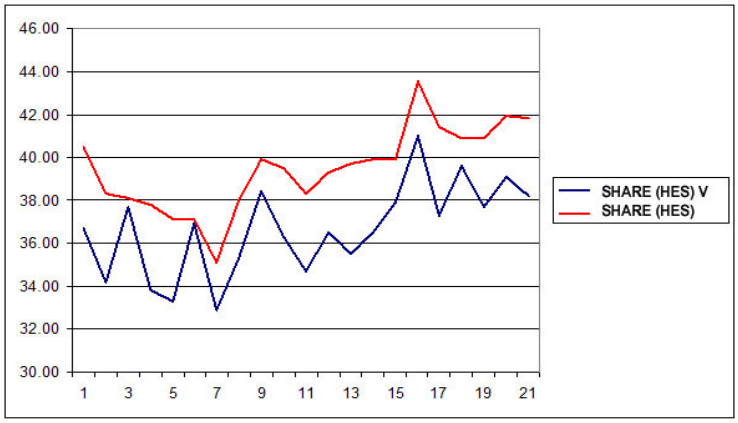
F-test	Model for t=1-18 (shorter sample)	Model for t=1-21 (longer sample)	F*	F-table (0.05;3;18
Vojvodina	Y_t=-738.50+0.37X_t	Y_t=-344.15+0.36X_t	0.1144	3.16
The Republic of Serbia	Y_t=1980.31+0.32X_t	Y_t=1886.03+032X_t	0.0655	3.16

FIGURE 1. TRENDS IN ORIGINAL DATA OVER TIME
(disposable income and expenditure on food, monthly average per household in RSD Vojvodina and the Republic of Serbia)



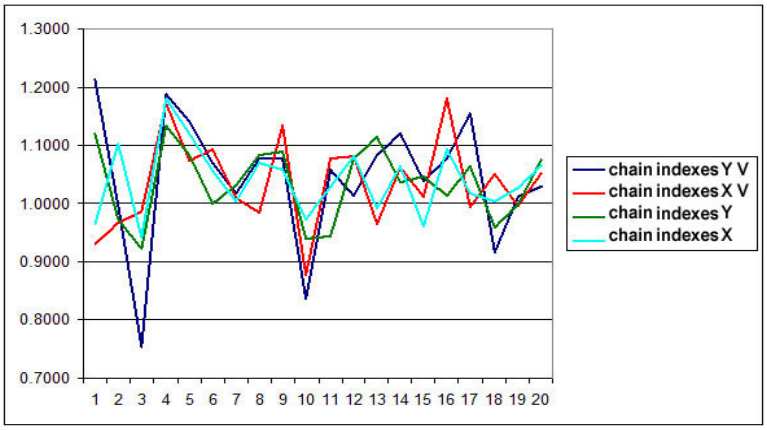
Source: Based on Table 1.

FIGURE 2. TRENDS IN THE SHARE OF EXPENDITURE ON FOOD AND NON-ALCOHOLIC BEVERAGES IN TOTAL INDIVIDUAL CONSUMPTION (%)



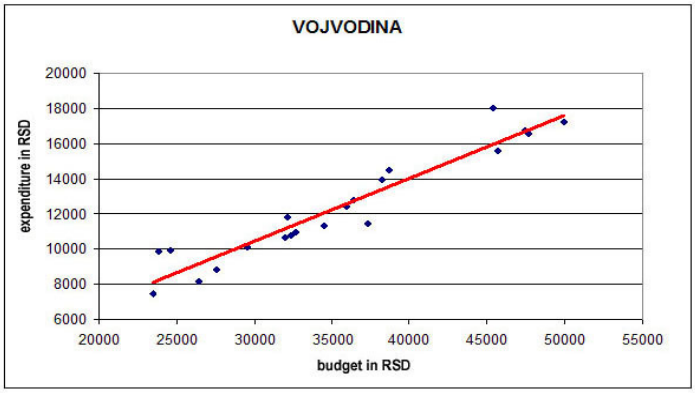
Source: Based on Table 1.

FIGURE 3. TRENDS IN CHAIN INDEXES
(Vojvodina and the Republic of Serbia)



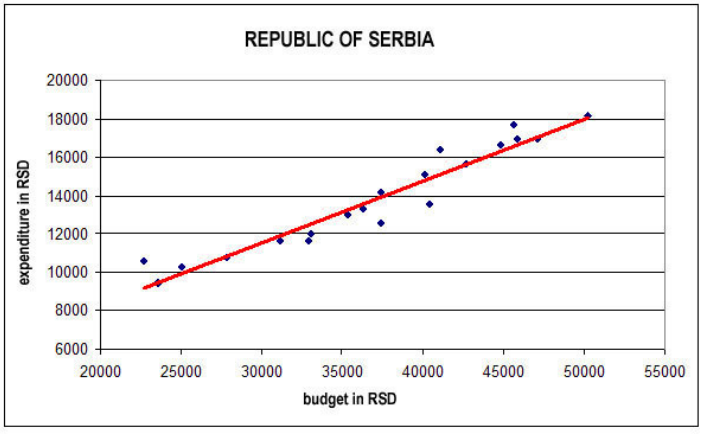
Source: Based on Table 1.

FIGURE 4. SCATTER DIAGRAM AND REGRESSION LINE FOR VOJVODINA



Source: Based on Table 1.

FIGURE 5. SCATTER DIAGRAM AND REGRESSION LINE FOR THE REPUBLIC OF SERBIA



Source: Based on Table 1.