Income elasticity of food expenditures of the average Czech household

Příjmová pružnost výdajů za potraviny u průměrné české domácnosti

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Abstract: The paper was focused on the quantitative research of the income elasticity in the field of the food expenditures within the consumer bundle of the average Czech household between 1995 and 2002. The quantitative analysis of the elasticity was based on the system of the nine one-equation regression models of the demands. Because of the time dimension of the used CZO databases, the partial equations of the demand system were developed in the explicit dynamic form. For the elimination of the price changes in the research of the income-elasticity, the real levels of the expenditures and the incomes were calculated. With respect to instant and easy interpretation of the results, the linear relationships between fixed base coefficients of percent growths of the household incomes and expenditures were used in the developed system of demand models. Thus, the income elasticity was determined by means of the value of *b* regression parameters. The achieved estimations of the studied income-expenditure elasticity were adjusted, so that Engel aggregation condition was kept. The paper contains the suggestion of the some methodological principles for the coefficient adjusting. The statistical diagnostics was involved in the quantitative part of the elasticity research. There was used the evaluation of determination coefficients, its *F*-tests, and *T*-tests of the relevant parameters (*b* regression parameters).

Key words: food expenditures, estimation of income elasticity of expenditures, Engel aggregation condition, adjusted coefficients of income elasticity

Abstrakt: Článek je zaměřen na kvantitativní analýzu v oblasti příjmové elasticity jednotlivých výdajových skupin v rámci potravinového spotřebního koše průměrné české domácnosti. Kvantitativní analýza pružnosti byla provedena na základě sestaveného souboru devíti jednorovnicových regresních modelů příjmové poptávky. S ohledem na časový faktor ve využívaných databázích ČSÚ (1995-2002) byla u vyvíjených modelů provedena přímá dynamizace. Vliv kolísaní cenových hladin byl při prováděné příjmově-poptávkové analýze ošetřen převodem získaných nominálních výdajů na jejich reálnou úroveň. Z důvodů jednoduché interpretace dosažených výsledků v rámci hodnocení příjmové pružnosti dané poptávky, byly jednotlivé modely definovány jako lineární vztahy mezi tempem relativního přírůstku reálných výdajů a tempem relativního přírůstku reálné úrovně příjmu. Vytvořené modely byly před vlastní aplikací statisticky otestovány (R^2, *F*-test, *T*-test). Prostřednictvím regresního parametru u „příjmové“ proměnné byly pak stanoveny bodové odhady hodnot jednotlivých koeficientů příjmové pružnosti sledovaných výdajů. Takto získané odhady byly přezkoušeny z pohledu Engelovy agregační podmínky. V návaznosti na vypočtený rozdíl mezi zjištěnou a teoretickou hodnotou Engelovy agregační podmínky byla provedena u koeficientů číselná korekce. Rozpracování metodiky výpočtu těchto korekcí tvoří součást předloženého článku. Z pozice dosažených výsledků (hodnoty korigovaných koeficientů příjmové pružnosti) lze mezi sledovanými kategoriemi dohledat výdaje se slabou negativní příjmovou reakcí a výdaje se slabou pozitivní příjmovou reakcí. Do první jmenované skupiny patří výdaje za ryby a rybí výrobky, dále výdaje za tuky a oleje, a výdaje za ovoce a ovocné výrobky (–0,24 %). Do druhé skupiny lze pak začlenit výdaje za brambory a zeleninu (+0,16 %), respektive výdaje za vejce, mléko a sýry (+0,52 %). Mezi příjmově neelastické je možné rovněž zařadit výdaje za chleba, pečivo, výrobky z obilovin a rýže. Tyto výdaje vykazovaly téměř nulovou citlivost na příjmové změny (0,09 %). Na druhé straně se v rámci sledovaného potravinového spotřebního koše také objevily výdaje se silně elastickou příjmovou reakcí. Silně elasticky reagovaly na příjmové změny výdaje průměrné české domácnosti za nealkoholické nápoje a výdaje za maso a masné výrobky (více jak +2,10 %). Rovněž výdaje za cukr, cukrovinky, kakao, kávu, čaj a ostatní potraviny dosahovaly poměrně vysokého stupně příjmové elasticity (+1,50 %).

Klíčová slova: výdaje za potraviny, odhady příjmové pružnosti výdajů, Engelova agregační podmínka, nastavené koeficienty příjmové elasticity

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INTRODUCTION

The research of the income impacts on the expenditure levels forms the essential element of the Marshall analysis of consumer behaviour (Nicholson 1992). In order to get a measure of how demand for goods reacts to the income changes, one could study the slope of the demand curve. In the economic terminology, this marginal characteristic of demand functions is termed marginal propensity to consume, respectively for the expenditure form of demand, it is marginal propensity to buy. However, this method might cause problems because it depends on the units in which the goods are measured. In order to avoid the unit problems, the concept of elasticity has been developed. Here the percentage change in demand as a result of a percentage change in incomes is measured. In this way, we get a concept independent of the units. The numerical value of the income elasticity is measured by means of the elasticity coefficients (Browning E.K., Browning J.M. 1992). The coefficient of the income elasticity (η_i^*) shows the percentage change in the level of the consumer expenditures for the given goods (e_i) as the result of the income (M) increase by 1%. Formalized, the income-elasticity coefficient is given as:

$$\eta_i^* = \frac{\frac{\partial e_i}{e_i}}{\frac{\partial M}{M}} = \frac{\partial e_i}{\partial M} \times \frac{M}{e_i} \tag{1}$$

Beside the formula (1), the income elasticity is alternatively measured (Tiffin A., Tiffin R. 1999) by formula (2):

$$\eta_i = \frac{\frac{\partial e_i}{e_i}}{\frac{\partial m}{m}} = \frac{\partial e_i}{\partial m} \times \frac{m}{e_i} \tag{2}$$

In the formula (2), the value of elasticity coefficient reflects the percentage change in the level of the consumer expenditures for the i^{th} goods (e_i) as the result of the 1% growth of the part incomes set aside for relevant consumptions (m). The patterns in form (2) are primarily used for the complete income-elasticity analysis of closed component of the consumer basket:

$$e_1 + e_2 + ... + e_i + ... + e_n = \sum_{i=1}^{n} e_i = m \tag{3}$$

For the achieved coefficients of the income elasticity, Engel aggregation condition (4) is kept (Denzau 1992).. Thus, the average value of the income elasticity within closely defined group expenditures is one:

$$w_1 \times \eta_1 + w_2 \times \eta_2 + ... + w_i \times \eta_i + ... + w_n \div \eta_n = \sum_{i=1}^{n} w_i \times \eta_i = 1, \tag{4}$$

In the aggregation condition (4), w_i represents the i^{th} budget share in the consumer bundle. The budget shares (w_i) are defined by the following formula:

$$w_i = \frac{e_i}{\sum_{i=1}^{n} e_i} = \frac{e_i}{m}; (t = 1, 2, \ldots, n) \tag{5}$$

In any case of the income-elasticity analysis, it is necessary to consider the multifactor base of demand functions (Koutsoyiannis 1979).

The aim of the paper is primarily accomplish the quantitative analysis in the field of income elasticity of expenditures within the food consumer basket of the average Czech household. At the quantitative level, the estimations of the income-elasticity coefficients are based on the system of relative independent models. The achieved values of the coefficients are adjusted by Engel aggregation condition in the second part of this contribution. For the adjusting coefficients, the simple method is developed in the paper. The developed method could use for adjusting the complete set of obtained coefficients together or for adjusting its subset.

MATERIAL

The income elasticity of consumer expenditures for the foodstuffs was investigated on the base of the average Czech household data. There was used the database of the Czech Statistical Office (CSO) from 1995 to 2002. This database provided the quarterly levels of the food expenditures of the average Czech household (e_i) for:

1. meat and meat products (e_1)
2. fish and fish products (e_2)
3. fats and oils (e_3)
4. eggs, milk and cheese (e_4)
5. bread and bakers' products (e_5)
6. potatoes and vegetables (e_6)
7. fruit and fruit products (e_7)
8. sugar, sweet, cocoa, coffee, tea and other foods (e_8)
9. beverages (e_9)

The nominal values of studied expenditures (e_1), (e_2), … , (e_9), are available in the CSO publication – Labour, Social Statistics: line 30 – Living Costs. For the elimination of the prices impacts on the analysed income dependences within the food component of consumer basket (Maurice, Phillips 1992), the original nominal data ware transformed on their real levels (re_1), (re_2), … , (re_9). The real levels of the food expenditures were calculated by the following formula:

$$re_i = \frac{e_i}{CPI_i}; (i = 1, 2, 3, \ldots, 9) \tag{6}$$

For the calculation of the real level of food expenditures in the studied years, the denominator of the fraction (6) was determined by the geometric mean of the fixed base indexes of the month consumer prices of the observed nine food categories (CPI_i). The fixed base CPI_i (January 1995 = 100%) were calculated by their chain form, which

Table 1. Yearly real expenditures household for foods and yearly real amounts of the average Czech for foods (CZK)

Year	yre_1	yre_2	yre_3	yre_4	yre_5	yre_6	yre_7	yre_8	yre_9	yrm
1995	3 529	340	762	2 181	1 808	1 563	899	1 906	752	13 741
1996	3 822	346	769	2 241	1 840	1 647	921	2 065	882	14 534
1997	3 980	344	749	2 341	1 821	1 631	872	2 132	952	14 823
1998	4 103	306	732	2 412	1 748	1 627	859	2 092	1 035	14 915
1999	4 214	295	741	2 475	1 678	1 644	901	2 195	1 025	15 168
2000	4 047	306	746	2 486	1 716	1 605	903	2 147	1 065	15 021
2001	3 980	308	736	2 509	1 696	1 711	868	2 180	1 116	15 104
2002	4 190	288	725	2 517	1 676	1 767	898	2 156	1 194	15 411

is registered in the CSO publication: Prices, line 71 – Consumer Prices.

The studied set of the food expenditures constituted complete component of consumer basket of Czech household (food component of consumer bundle), therefore income elasticity was evaluated by concept (2). From the point of view, it was necessary to determine the real amount of the incomes set aside for purchases of foodstuffs (rm). The sum of money (rm) was calculated with respect to formula (3) and the real levels of partial food expenditures (re_i):

$$rm = \sum_{i=1}^{n} re_i = re_1 + re_2 + ... + re_i + ... + re_n \qquad (7)$$

Before the research of income elasticity of the food expenditures, the time dimension of the used database was primarily analysed. No respect of the trends or/and the periodical oscillations in the used CZO database would give the deformed values of the estimated coefficients of the income elasticity, the problem of factitious regression (Hušek 1932). A set of methods and strategies is defined for the elimination of the factitious regression (Seger, Hindls, Hronová 1998). Within the demand analysis, the seasonality was eliminated by the year aggregation of original quarterly data (yre_1), (yre_2), … , (yre_9), (yrm). The trend components were built in the equation body of the developed demand model – the explicit dynamisation of the models in the form (9). The acquired year real levels of the food expenditures (yre_1), (yre_2), … , (yre_9) and the year real amount of money set aside for the food purchases (yrm) are displayed in Table 1.

METHODS OF RESEARCH

The estimations of the income elasticity of the studied food expenditures were based on the system of the nine independent linear-models with the explicit time variable (8). In this system of one-equation models, the income-expenditure relations were defined by means of the fixed base coefficients of percent growths of the household incomes (Krm_t) and the expenditures (Kre_{it}):

$$Kre_{it} = a_i + b_i \times Krm_t + c_i \times t \; ; \; (i = 1, 2, …, 9) \qquad (8)$$

The time variable (t) in the equation system (8) simulated the trend development of the used coefficients of growth. For the realised research, the time variable was declared consequently:

$t = 1$	1995
$t = 2$	1996
………………………………	
$t = 8$	2002 (9)

The next independent variable (Krm_t) in the designed system of the demand equations (8) represented the fixed-base coefficient of the percentage changes in the real year level of spent amount for foods within the total income of the average Czech household. The first year of this time-series (1995) was chosen as the fixed base of the growth coefficients. Thus the growth coefficients were defined as following percentage shares:

$$Krm_t = \frac{rm_t - rm_1}{rm_1} \times 100 = \left(\frac{rm_t}{rm_1} - 1 \right) \times 100 \; ; \; (t = 1, 2, …, 8) \qquad (10)$$

The endogenous variable (Kre_{it}) of the designed model system (8) reflects percentage changes in the real year expenditures of the average Czech household for the food group i. These percentage changes in the studied consumer expenditures were also defined like the fixed-base coefficients with the identical fixed base term:

$$Kre_{it} = \frac{re_{it} - re_1}{re_1} \times 100 = \left(\frac{re_{it}}{re_1} - 1 \right) \times 100 \; ; \; (i = 1, 2, …, 9) \text{ and } (t = 1, 2, …, 8) \qquad (11)$$

The regression parameters (a_i), (b_i), (c_i) in the designed dynamical system of the demand linear-models were determined on the base of the ordinary least-squares method. The basic statistical verification of the developed demand models (8) was led through the obtained coefficients of determination (R_i^2) and F-tests of its statistical significance ($F[R_i^2]$). With respect to the aim of the article, T-test of b_i regression parameter ($T|b_i|$) was included too. The details about the used procedures

of the statistical verification are available in Basic Econometrics by Gujarati (1988) e.g.

After the parameters quantification of dynamical demand system (8) and its statistical verification, the income elasticity of the studied groups of food expenditures was evaluated. For the evaluation of the investigated elasticity of expenditures of the average Czech household for the i^{th} food groups, the achieved value of the b_i regression parameter (coefficient) was used:

$$\eta_i = b_i \; ; (i = 1, 2, 3, \ldots, 9) \tag{12}$$

If obtained values of income-expenditure elasticities (12) are supplemented with the significant levels of relevant T-tests of b_i regression parameter, then we receive the probability (P) of these point estimations:

$$P[\eta_i = b_i] = (1 - \alpha) \; ; (i = 1, 2, 3, \ldots, 9) \tag{13}$$

With respect to the consequent adjustments of the income-elasticity coefficients (12) to Engel aggregation condition (4), it is useful to determine limits of the estimation. For the maximal extent of the coefficient adjusting, it is possible to use 95% confidence intervals of the relevant regression parameters (b_i)

$$P[b_i - T_{(0,05)/2} \times s(b_i) \le \eta_i \le b_i + T_{(0,05)/2} \times s(b_i)] = 1 - 0.05$$

$$(i = 1, 2, 3, \ldots, 9) \tag{14}$$

Thus, the adjusted values of the elasticity coefficient have to lie on the probability level of 95% between the lower $(h_i)_L$ and the higher $(h_i)_H$ limit of the defined confidence intervals (Gujarati 1988):

$$P[(\eta_i)_L \le \eta_i \le (\eta_i)_H] = 0.95 \; ; (i = 1, 2, 3, \ldots, 9) \tag{15}$$

After the outlines of basic statistical aspects of the point estimations of studied elasticity, the obtained values of the income-elasticity coefficients were tested by Engel aggregation condition (4). For the realisation of the aggregation test (4), the relevant weights (w_i) were firstly determined by principle (5). The designed system of demand model (8) provides the constant values of income-expenditure elasticities from 1995 to 2002, so the quantifications of the partial weights were based on its average level within the studied period of eight years (w_i):

$$\overline{w}_i = \frac{\sum_{t=1}^{8} yre_{it}}{\sum_{t=1}^{8} yrm_t} \; ; (i = 1, 2, 3, \ldots, 9) \tag{16}$$

The received weights for the investigated food groups are depicted in Table 2.

The achieved average levels of weights (Table 2.) together with the estimations of income-elasticity coefficients (12) were inserted to the Engel aggregation condition (4), so the theoretical error of estimations (ψ) can be defined:

$$\psi = 1 - \sum_{i=1}^{9} \overline{w}_i \times \eta_i \tag{17}$$

The issue of the ψ elimination in the estimated values of income-elasticity coefficients (12) stays the strategy for the separation of adjusted individual coefficients from non-adjusted individual coefficients. In this view, the y distribution among the complete set of the estimated coefficients of income elasticity is mathematically easier cause. The distribution theoretical error of estimation (ψ) can be based on the defined system of the weights (16), thus:

$$\psi = \psi \times \sum_{i=1}^{9} \overline{w}_i = \overline{w}_1 \times \psi + \overline{w}_2 \times \psi + \ldots + \overline{w}_9 \times \psi \tag{18}$$

The use of the weight system of Engel aggregation condition (16) for the ψ distribution resulted in the simple patterns for coefficient adjusting:

$$(\eta_i)_C = \eta_i + \psi \; ; (i = 1, 2, 3, \ldots, 9) \tag{19}$$

But the realisation of y distribution process (19) is affected the one practical disadvantage, that the correct values of the income elasticities are also changed together with the incorrect estimations of the given coefficients. Because, the value adjusting within a selected subset of obtained coefficients of income elasticity is more suitable for the real analysis of the income-demand elasticity. The subset of the adjusted coefficients can be determined in association with achieved significant level of T-test. The limit value for the definition of studied subset is possible to take the 95% level of T-test significance. Thus, the

Table 2. Average budget shares of yearly real expenditures for foods in order to the total sum of money set aside for total food purchases of average Czech household.

Meat and and meat products	Fish and fish products	Fats and oils	Eggs, milk and cheese	Bread and bakers' products	Potatoes and vegetables	Fruit and fruit products other foods	Sugar, sweet, cocoa, coffee, tea and	Beverages
0.2684	0.0213	0.0502	0.1614	0.1178	0.1112	0.0600	0.1421	0.0676

value adjusting will be done only for income-elasticity coefficients with the significant level of *T*-test lesser than 95%.

With respect to the definition criterion, the complete set including 9 coefficients of income-elasticity was divided into two parts. The first part of the set contained *r* of income-elasticity coefficients, which will be adjusted. The extent of this coefficient subset was (1, … , *r*). The second part of the set included (9 – *r*) non-adjusted coefficients of investigated income elasticity, thus extent of the subset was (*r* + 1, … , 9). The total theoretical error of the elasticity estimations (ψ) was naturally distributed only within the first subset of coefficient set. The subset-bounded process of *y* distribution was based on the modified system of weights (20):

$$\psi = \psi \times \sum_{i=1}^{r} \frac{\overline{w}_i}{\sum_{i=1}^{r} \overline{w}_i} = \frac{\overline{w}_1}{\sum_{i=1}^{r} \overline{w}_i} \times \psi + \frac{\overline{w}_2}{\sum_{i=1}^{r} \overline{w}_i} \times \psi + ... + \frac{\overline{w}_r}{\sum_{i=1}^{r} \overline{w}_i} \times \psi \; ;$$

$$(r < n) \qquad (20)$$

Within the given subset, the adjusted values of the income-elasticity coefficients were determined by the formula (21):

$$(\eta_i)_C = \eta_i + \frac{\psi}{\sum_{i=1}^{r} \overline{w}_i} \; ; \; (i = 1, 2, ..., r); \; (r < n) \qquad (21)$$

RESULTS AND DISCUSSION

According to the above-described methodology, the income-elasticity research of the food expenditures within the average consumer basket of Czech household began by the construction of the demand system of nine independent linear-models with the explicit time variable (8). The individual parameters and the statistical diagnostics of the developed models are listed in Table 3.

The results of the significant levels of performed *F*-tests (in Table 3) clearly demonstrate, that the developed demand system of dynamic linear models (8) is statically significant. Thus, the demand system (9) can be completely used for the quantitative analysis of income elasticity in the field of food expenditures of the average Czech household. Maybe only, the individual demand model for fruit and fruit products was not acceptable from that point of statistical diagnostics. The model did not get even the 10% significant level of *F*-test.

The income elasticity of the expenditure groups within consume basket of the average Czech household was investigated by means of the point estimations of the relevant regression parameters (b_i), formula (12). The achieved values of the coefficients together with upper and lower bounds of these estimations are displayed in Table 4.

But the estimated coefficients of income elasticity in Table 4 do not keep the Engel aggregation condition, formula (4):

$$\sum_{i=1}^{n} \overline{w}_i \times \eta_i = 0.2684 \times (+2.1291) + 0.0213 \times (-0.1282) + 0.0502 \times (-0.1302) + 0.1614 \times (+0.6280) + 0.1178 \times (+1.1221) + 0.1112 \times (+0.2698) + 0.0600 \times (-0.1293) + 0.1421 \times (+ 1.4766) + 0.0676 \times (+2.2044) = 1.0590 > 1 \qquad (22)$$

For that reason (22), the following research of income elasticity of studied expenditures was focused on adjusting of the obtained values of elasticity coefficients (12). In order to adjust the relevant values of elasticity coefficients, the total theoretical error of estimation (*y*) was firstly determined by the formula (17):

$$\psi = 1 - \sum_{i=1}^{9} \overline{w}_i \times \eta_i = 1 - 1.0590 = -0.0590 \qquad (24)$$

For the distribution of ψ value (24), both described approaches were used. Within the first adjustment method, the distribution process of *y* was based on the weight system (16). Thus, the distribution of the total theoretical error of estimations ran numerically by formula (18) for the complete set of income-elasticity coefficients. The adjusted values of all income-elasticity coefficients were determined in accordance with the formula (19). Within the second adjustment method, the distribution process of ψ was based on the modified weight system (20) and was purely applied to the subset of studied elasticity coefficients with significant level lower than 95%. Within the given subset, the adjusted values of the income-elasticity coefficients were calculated by the formula (21). In the investigated group of food expenditures, the coefficient of the income elasticity of the expenditures for fish and fish products, for fat and oils, for eggs, milk and cheeses, for bread and bakers' products, for potatoes and vegetables, for fruits and fruit products was adjusted. Thus, the value of 6 of 9 elasticity coefficients was adjusted. On the other hand, 3 coefficients of studied elasticity remained aloof the value adjusting. Both levels of results in the field of the coefficient adjusting (19), (21) are depicted in Table 5. In economical interpretations of achieved results, the primary emphasis will lay on the adjusted values of coefficients by the formula (21).

According to the displayed results in Table 5, it is possible to define within the studied component of the consumer basket of the Czech average household the normal (the positive values of income-elasticity coefficients) and the inferior (the negative values of income-elasticity coefficients) groups of foodstuffs. But, this classification of the food groups in the investigated consumer basket has to be taken very reasonably, because the negative values of the income-elasticity coefficients were found very near to the zero level (less than 0.25%). In the observed period (1995–2002), very weak negative responses to the income changes were especially found in the field of expenditures of the average Czech household for fish and fish products, for fats and oils, and for fruit and fruit products. Within those enumerated groups of the foodstuffs, the rise of

the real yearly incomes by 1% caused the decrease in the real year level of the food expenditures by approximately 0.24%. In the observed period, other studied groups of food expenditures of the average Czech household achieved entirely positive reaction to the income changes. The positive income responses manifested the most intensively in the field of expenditures for beverages and in the field of expenditures for meat and meat products. In both expenditures groups, the income elasticities of the yearly real expenditures were bigger than 2%. By 0.5% lower, the income-expenditure reactions were detected in the field of expenditures of the average Czech household for sugar, sweet, cocoa, coffee, tea and other foods. In association with the 1% rise of real yearly income, the year real volume of these expenditures increased by 1.5%. On the contrary, inelastic income reactions were identified in the field of real expenditures of the average Czech household for eggs,

Table 3. Parameters and statistical diagnostics of the developed demand model

Food groups (i)	Demand model (6):		b_i value
	$Kre_{it} = a_i + b_i \times Krm_t + c_i \times t$		
	Determination index	Value of F-test; Significant level of F-test	Value of T-test of b_i; Significant level of T-test
Meat and meat products (i = 1)	$Kre_{1t} = -0.07620 + 2.1291 \times Krm_t - 0.9090 \times t$		$b_1 = +2.1291$
	$R_1^2 = 0.9374$	$F[R_1^2] = 37.4195$; $\alpha[F_1] = 0.0010$	$T\|b_1\| = 5.4719$
			$\alpha[T\|b_1\|] = 0.0028$
Fish and fish products (i =2)	$Kre_{2t} = +4.0898 - 0.1282 \times Krm_t - 2.1945 \times t$		$b_2 = -0.1282$
	$R_2^2 = 0.7273$	$F[R_2^2] = 6.6673$; $\alpha[F_2] = 0.0388$	$T\|b_2\| = 0.1464$
			$\alpha[T\|b_2\|] = 0.8893$
Fats and oils (i =3)	$Kre_{4t} = +1.0039 - 0.1302 \times Krm_t - 0.4954 \times t$		$b_4 = +0.1302$
	$R_3^2 = 0.7196$	$F[R_3^2] = 6.4154$; $\alpha[F_3] = 0.0413$	$T\|b_3\| = 0.5107$
			$\alpha[T\|b_3\|] = 0.6313$
Eggs, milk and cheese (i = 4)	$Kre_{4t} = -1.7133 - 0.6280 \times Krm_t + 1.4493 \times t$		$b_4 = +0.6280$
	$R_4^2 = 0.9437$	$F[R_4^2] = 41.9352$; $\alpha[F_4] = 0.0008$	$T\|b_4\| = 1.8244$
			$\alpha[T\|b_4\|] = 0.1277$
Bread and bakers' products (i = 5)	$Kre_{5t} = +2.4428 + 0.1221 \times Krm_t - 1.5000 \times t$		$b_5 = +0.1221$
	$R_5^2 = 0.7907$	$F[R_5^2] = 9.4471$; $\alpha[F_5] = 0.0200$	$T\|b_5\| = 0.2930$
			$\alpha[T\|b_5\|] = 0.7813$
Potatoes and vegetables (i = 6)	$Kre_{6t} = -0.7911 + 0.2698 \times Krm_t + 0.9235 \times t$		$b_6 = +0.2698$
	$R_6^2 = 0.6208$	$F[R_6^2] = 4.0933$; $\alpha[F_6] = 0.0885$	$T\|b_6\| = 0.4400$
			$\alpha[T\|b_6\|] = 0.6783$
Fruit and fruit products (i = 7)	$Kre_{7t} = +0.1378 - 0.1293 \times Krm_t - 0.0068 \times t$		$b_7 = -0.1293$
	$R_7^2 = 0.0443$	$F[R_7^2] = 0.1160$; $\alpha[F_7] = 0.8928$	$T\|b_7\| = 0.2269$
			$\alpha[T\|b_7\|] = 0.8296$
Sugar, sweet, cocoa, coffee, tea and other foods (i = 8)	$Kre_{8t} = +0.7540 + 1.4766 \times Krm_t - 0.4249 \times t$		$b_8 = +1.4766$
	$R_8^2 = 0.9112$	$F[R_8^2] = 25.6399$; $\alpha[F_8] = 0.0024$	$T\|b_8\| = 4.1375$
			$\alpha[T\|b_8\|] = 0.0090$
Beverages (i = 9)	$Kre_{9t} = -3.8424 + 2.2044 \times Krm_t + 4.3272 \times t$		$b_9 = +2.2044$
	$R_9^2 = 0.9788$	$F[R_9^2] = 115.5539$; $\alpha[F_9] = 0.0001$	$T\|b_9\| = 3.3307$
			$\alpha[T\|b_9\|] = 0.0208$

Table 4. The estimations of the income elasticity of food expenditures of the average Czech upper and lower bounds of these estimations

Category of foods	Meat and and meat products	Fish and fish products	Fats and oils	Eggs, milk and cheese	Bread and bakers' products	Potatoes and vegetables	Fruit and fruit products	Sugar, sweet, cocoa, coffee, tea and other foods	Beverages
η_i	+2.1291	–0.1282	–0.1302	+0.6280	+0.1221	+0.2698	–0.1293	+1.4766	+2.2044
$(\eta_i)_L$	+1.1289	–2.3797	–0.7856	–0.2569	–0.9488	–1.3066	–1.5945	+0.5592	+0.5031
$(\eta_i)_H$	+3.1293	+2.1233	+0.5251	+1.5129	+1.1929	+1.8462	+1.3359	+2.3941	+3.9058

Table 5. The adjusted estimations of the income elasticity of food expenditures of the average Czech

Category of foods	Meat and and meat products	Fish and fish products	Fats and oils	Eggs, milk and cheese	Bread and bakers' products	Potatoes and vegetables	Fruit and fruit products	Sugar, sweet, cocoa, coffee, tea and other foods	Beverages
$(\eta_i)_c$ (19)	+2.0701	–0.1872	–0.1892	+0.5690	+0.0631	+0.2108	–0.1883	+1.4176	+2.1454
$(\eta_i)_c$ (21)	+2.1291	–0.2413	–0.2433	+0.5150	+0.0090	+0.1568	–0.2424	+1.4766	+2.2044

milk and cheeses. In that case, the increase of yearly real level of incomes induced the rise in the given expenditures by 0.52%. More and more inelastic normal income-expenditure reactions were determined for potatoes and vegetables, where the rise of the year real income by 1% brought only 0.16% increase in the given expenditure field. And finally, the expenditures of the average Czech household for bread and bakers' products were found almost without income reactions. The coefficient of income elasticity converged to zero level.

CONCLUSION

The realised research was focused on the quantitative analysis of the income elasticity in the field of the food expenditures of the average Czech household between 1995 and 2002. In addition to the quantification of the income elasticity of the analysed expenditures, the article contains the suggestion of the methodological principles for the adjustment of income-elasticity coefficients so that Engel aggregation condition was kept. The method of value adjusting can be used for complete set of estimated coefficients of income elasticity or only for their selected subset. According to the adjusted values of the year income-elasticity coefficients, the studied food expenditures included the category of the inferior goods and the normal goods. In the group of the inferiors, there were the expenditures for fish and fish products, for fats and oils, and for fruit and fruit products. In the group of the normal food goods, there were bread and bakers' products; potatoes and vegetables; eggs, milk and cheese; sugar, sweet, cocoa, coffee, tea and other foods; meat and meat products; and beverages. However, the demonstrated food classification in the investigated consumer basket has to be taken very reasonably, because the negative values of the income-elasticity coefficients were found very near to the zero level (less than 0.25%). Around zero level (0.009%), the positive income elasticity of expenditures for bread and bakers' products was founded too. The inelastic income reaction was also identified in the field of expenditures for eggs, milk and cheese (0.52%). On the other hand, the strong elastic reactions to the income changes were found for the food groups: sugar, sweet, cocoa, coffee, tea and other foods (1.48%); meat and meat products (2.13%); and beverages (2.20%).

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