
TESTING THE ENGEL'S LAW IN THE CONSUMPTION PATTERN OF ROMANIAN POPULATION

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(Received May 2017; Accepted August 2017)

Abstract: The aim of the paper is to test the valability of Engel's law in the Romanian consumption dynamics after 1990. We used NIS ad EUROSTAT data to interpret the dynamics of the households' income and consumption expenditures and its structure by destinations. We explored the relationship between consumption and income through the regression analysis and found that the Engel's law applies in the Romanian economy, since 1990 to 2016, with specific evolutions and influences.

Keywords: Engel's law, income, consumption, time-series model

JEL Classification: B12, B22, E 21, C01, C22

1. Introduction

At more than 150 years after the seminal paper of Engel "Die Productions und Consumptionsverhältnisse des Königreichs Sachsen", economists and policy makers have a tireless attention for its work, especially its applicability and relevance in different economic contexts.

According to Engel's law, there is a consumption hierarchy in the economy. The population with a low living standard will spend more money to cover their basic needs (food, clothing, housing, etc.). As the income increases, the spending is directed to purchase goods for their comfort (health, transport, recreation and culture, tourism). In the developed economies the transition to services consumption is faster. The share of food consumption evolves in an inverse relationship with income and the elasticity coefficient of this type of consumption is higher than 1, suggesting that at an increase of 1% of income, the increase of consumption will be lower than 1%. In the case of services consumption, the elasticity coefficient is higher than 1, meaning that an increase of 1% of income will lead to an increase higher than 1% in services consumption. The elasticity of non-food consumption is maintained around 1.

In our paper we use the different concepts of Engel's original statistical analysis (consumption, income, share of food, non-food and services consumption

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expenditures) to test the valability of his law in the Romanian economic context after 1990.

The paper is organised as follows: after the literature review, the data and methodology of the study is exposed, the fourth section describes the main findings and the last section is dedicated to conclusions.

2. Literature review

Engel was born in Eastern Germany in 1821. He studied in Germany, France and Belgium and founded the International Statistical Institute in 1885 (Chai and Moneta, 2010).

In his first article, "The Consumption-Production Relations on the Kingdom of Saxony", Engel introduced into discussion the theory of Malthus (1798) according to which the population growth expands faster than the means of production, conducting to a social catastrophe. Engel argued that it is possible to avoid such catastrophe when the economic production could balance the economic growing demand, through an adaptation of the goods and services provided to the evolving population demand. Therefore, Engel investigated how the pattern of demand changes as household income changes. He found that an increase in household income lead to a less than proportional increase in food household expenditures. This finding allayed the fear of Malthus that food demand grows at the same (geometrical) rate as the population. Due to the changes in the consumption structure (demand structure), when economy grows (per capita income grows) new resources can be directed to the production of non-food goods and services (Chai and Moneta, 2010).

There are several studies exploring, analysing and extending the Engel's work or constructed on its basis. The Engel's work was also faced with criticisms and highlights of its limitations.

For instance, the Engel's law was used to predict the consumption expenditures (Loeb, 1955), as an application of its work in the marketing science.

He was criticised for the assumption that the all households consume food only for nourishment by the marginalist economists such as: Gosen (1954), Menger (1871), Wieser (1889) and Marshall (1890) (Chai and Moneta, 2010).

Houthakker (1952, 1957) suggested that the variability of consumption patterns accross households cannot be explained by income and price alone. Other authors (i.e. Deaton and Muellbauer, 1980, p.323) suggest that other influences as the current prices and current total expenditures have to be included in the models explaining the income-consumption relationship.

In the twentieth century, many empirical studies were devoted to develop functional forms for Engel's curves. For example, Prais (1952) concluded that a

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semi-logarithmic form is more suitable to the necessities and double logarithmic form better suits to luxury goods. More complex forms are explored by Aitchison and Brown (1955) and non-parametric approach and regression functions were introduced (Deaton, 1986; Lewbel, 2008).

Engel focused on the consumer's wants, suggesting that a deeper understanding of the motivations driving consumption expenditures may provide a proper finding related to their relation with income. Various authors extended this vision by stating that goods and services related to particular wants have a distinctive income-expenditures pattern. As household income rises some motivations become more prominent against basic wants (i.e. Witt, 2001). Further studies were carried out to explore the link between Engel's law and hierarchy of needs (Chai and Moneta, 2012).

Building upon the Engel's legacy, Kaus (2013) applied a behavioral approach of structural changes in the consumption expenditures, by using non-parametric regression techniques and identified a number of empirical regularities in consumer expenditures patterns that go well beyond the Engel's law.

The Engel's law was tested in the European Eastern economies, by analysing the changes in the consumer standard of living, by economic and educational category of consumers (Hovorkova, 2015).

The Engel's law demonstrates its validity in the nowadays economies (i.e. Gibson, 2002; Teodoru, 2005, p.102; Anker, 2011). Tuttle and Kuhns (2016) found that in the American economy the share of income spent on food is more volatile for poorer households than for the higher income households. The share of income spent on food by the lowest income household dropped from 41.1% to 28.8% over the years 2001 to 2007 then rises to 35.5% in 2009 and in 2014 this share was 35.5%. Over the year 1990 to 2014 the fall of this consumption type was from 42.5% (in 1990) to 35.5% (in 2014).

3. Data and Methodology

The study uses two groups of data. One is extracted from NIS data base for a time span from 1997 to 2016, regarding the total average money monthly income of households and money consumption expenditures for food, non-food and services purposes and for 1990 to 2015 the share of each type of consumption expenditures in the total money consumption expenditures.

Generally, in statistical data base of NIS, the consumption expenditures are expressed in lei, in monthly or annual averages per household. As their dynamics follows the same path with income, the absolute values being not relevant, the significant data series are those referring to the structure of consumption expenditures. The NIS methodology makes the distinction between the money

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consumption expenditures and the total consumption expenditures, the last add to the first the value of the agricultural products from own resources (Teodoru, 2005, p.141).

The second group consists of data extracted from EUROSTAT data base from 1995 to 2015 regarding the final consumption expenditures by consumption purpose: food and non-alcoholic beverages; alcoholic beverages, tobacco and narcotics; clothing and footwear; housing, water, electricity, gas and other fuels; furnishings, household equipment and routine household maintenance; health; medical products, appliances and equipment; transport; communications; recreation and culture; education; restaurants and hotels; miscellaneous goods and services; personal care; and other services.

We analysed the dynamic of consumption expenditures and income in Romania through fixe-based and chain-based indices (calculated in the Annex). The interpretation of this dynamic is presented in the following section.

For a deeper analysis of the consumption-income relationship, we intend to explore the relationship between consumption expenditures and income through a regression equation, as follows:

$$y = \alpha + \beta \cdot x + \varepsilon \quad (1)$$

where: y represents the consumption expenditures, x is the income and ε is the error.

We estimated the equation (1) and tests for stationarity of variables, heteroskedasticity and autocorrelation of errors have been run by using the Eviews 9.0 software.

4. Main findings

4.1. Dynamics of expenditures consumption and income based on absolute values and dynamic indices

The monthly income of households evolved in the last 20 years from 82.09 lei to 2753.3 lei that represents a growth of 33.32 times. The highest growth is registered in 2001, with 71.3% more than in the previous year, in 1998, with 55.4% and in 2004 with 38.1 more than in 2003. In 2010 and 2014, slow decreases are registered, that didn't exceed 1.5% (Figure 1a).

The money food consumption expenditures of the population grew up, from 29.03 per household in 1997 to 538.64 lei in 2016. This means an increase of 18.55 times in the last 20 years examined. The highest increases were registered in 2001 (67.7%), in 1998(45%) and in 2000 (39.4%)(Figures 1a), b), c)).

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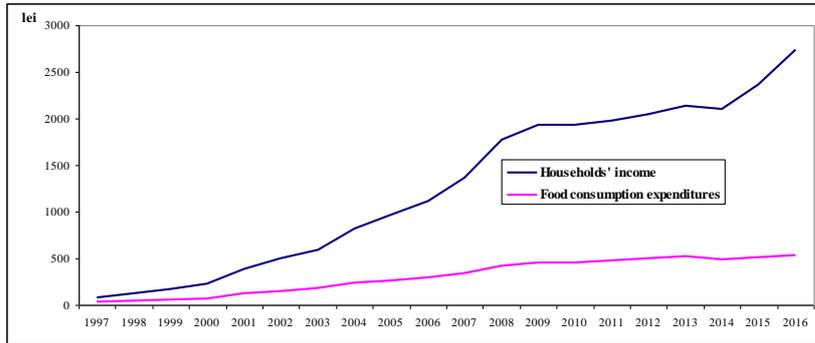


Figure 1a) Food consumption expenditures and households' income, 1997-2016 (absolute values)

Source: authors' own computation based on NIS data

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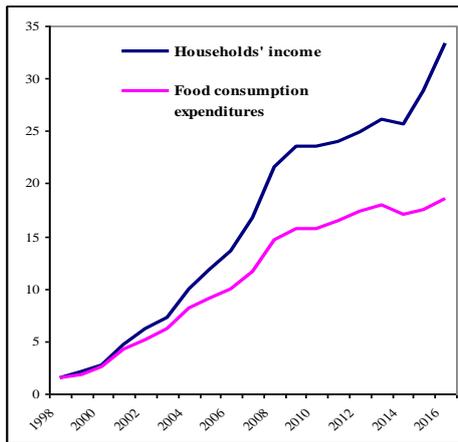


Figure 1b) Households' income and food consumption expenditures, 1998-2016 (fixe-based indices)

Source: authors' own computation based on NIS data

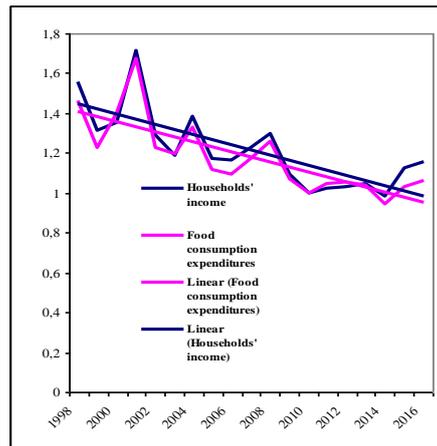


Figure 1c) Households' income and food consumption expenditures, 1998-2016 (chain-based indices)

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Only in 2014 a slight decrease of 5% is recorded. We notice an ascending trend, more pronounced for monthly household income as for food consumption expenditures, excepting 4 years: 2000 with a difference of 4 percentage points, in 2003, 2010 and 2012 the differences are very small and in the favour of food consumption expenditures (Figures 1a), b), c)).

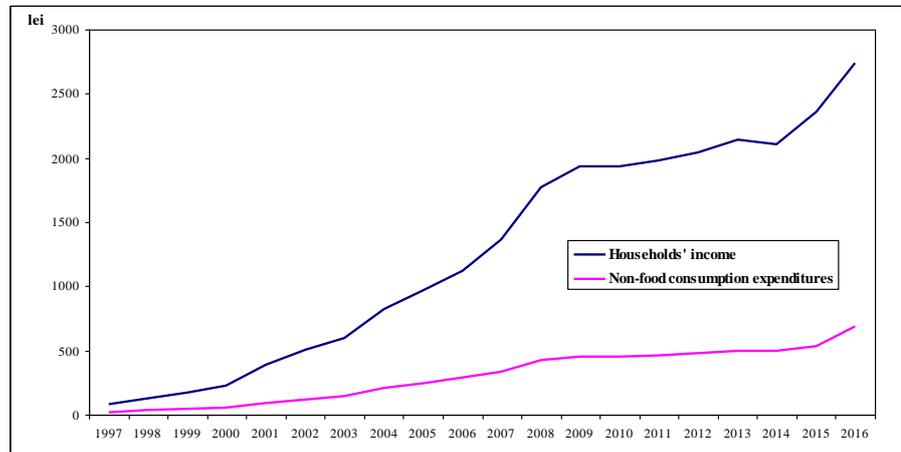


Figure 2a) Non-food consumption expenditures and households' income, 1997-2016 (absolute values)

Source: authors' own computation based on NIS data

The money consumption expenditures with non-food destination evolved from 21.73 lei in 1997 to 688.77 in 2016, which represents an increase of 31.70 times in 20 years. The highest growth is registered in 2001 (58.38%), in 1998 (51.2%) and in 2004(42.4%), as well as in the case of households' income. 2014 was the year when a decrease of 0.2% was registered. In the case of non-food consumption expenditures there are several cases in which the annual growth is higher than the income's growth. Thus, in 2002 the growth of food consumption exceeded the growth of income with 2-5%. The highest difference is registered in 2016, when the growth of non-food consumption expenditures was of 28.4% versus the income growth of 15.8% (Figure 2a), b), c).

The substitution effect generated by the effect evoked by Samuelson (1938) is reflected by the maintaining or even increasing the share of food consumption expenditures in the period of 1990-2002, to the detriment of non-food consumption, in spite of the fact that the decrease of purchasing power was due to the growth of food prices (Teodoru, 2005, p.162).

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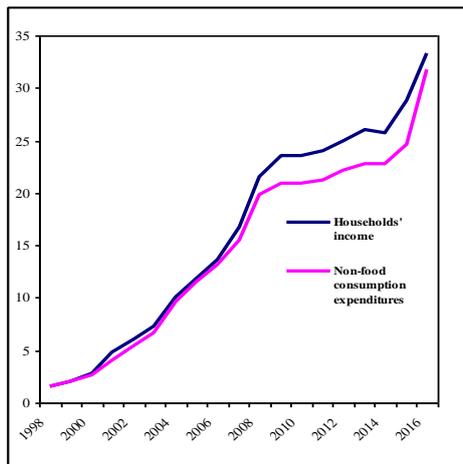


Figure 2b) Households' income and non-food consumption expenditures, 1998-2016 (fixe-based indices)

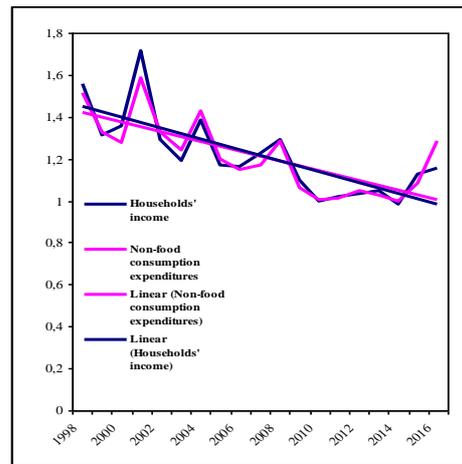
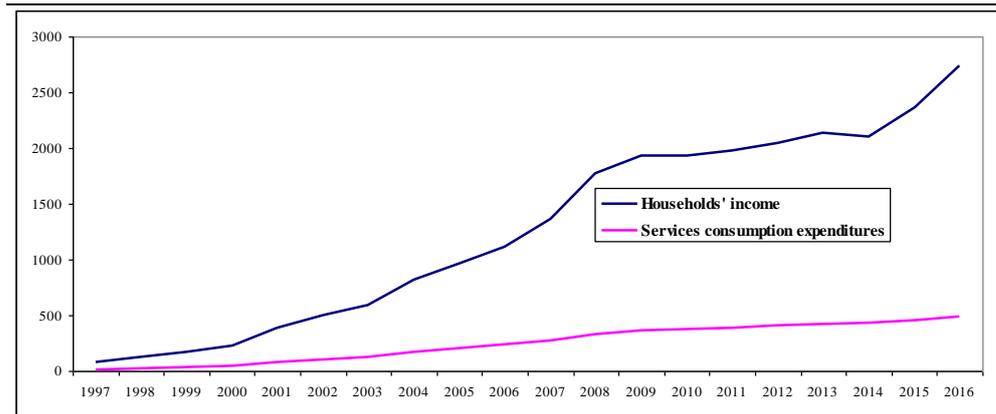


Figure 2c) Households' income and non-food consumption expenditures, 1998-2016 (chain-based indices)

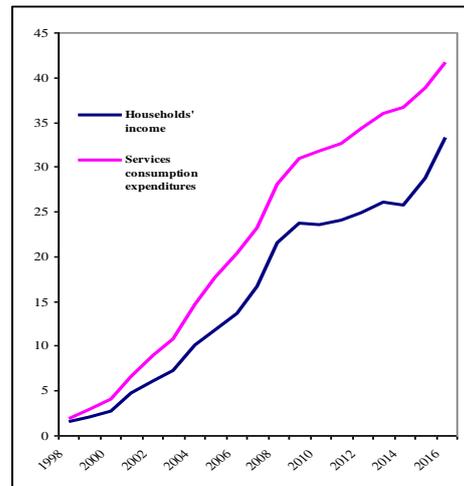
Source: authors' own computation based on NIS data

The services consumption expenditures had the most dynamic evolution, from 11.78 lei per household in 1997 to 491.09 in 2016, namely a multiplication of 41.67 times. The highest annual growth is registered at the beginning of the examined period of time: in 1998 (78.3%), in 1999 (55.65%). Decreases have been not recorded in any year, but since 2010 the annual growth are small (2-5%). Generally, the annual growth of services consumption expenditures exceeded the income's growth. There are, however, some years when the differences were net in the favour of one and other of these indicators. In 1998 and 1999, the growth of service consumption expenditures exceeded with 23-24 percentage points the income's growth. In 2001, 2007, 2008, 2015 and 2015 the income growth exceeded with 6-8 percentage points the growth of service consumption expenditures (Figure 3a), b),c)).

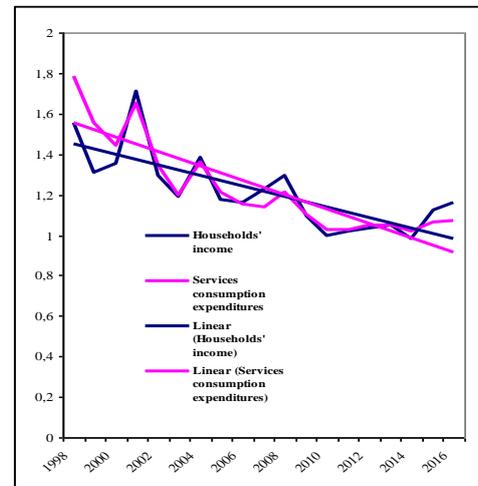
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Testing the Engel's law in the consumption pattern of Romanian population**Figure 3a) Services consumption expenditures and households' income, 1997-2016**

Source: authors' own computation based on NIS data

**Figure 3b) Households' income and services consumption expenditures, 1998-2016 (fixe-based indices)**

Source: authors' own computation based on NIS data

**Figure 2c) Households' income and services consumption expenditures, 1998-2016 (chain-based indices)**

The evolution of the structure of money consumption expenditures (per household) by consumption purpose is depicted in the Figure 4. We notice in this figure several stages in the consumption expenditures' evolution.

In the period of 1990-1994 the food consumption expenditures represents almost a half of the total, its share having an increasing trend, of 40.4% to 47.1%. If in 1990

and 1991, the share of non-food consumption expenditures exceeds that of food consumption, since 1992 the situation has changed net in favour of food by almost 7%. Service consumption expenditures dropped from 15.8% to 12.5%. This development is explained by the fact that during this period the biggest inflationary shocks were registered, the prices increasing of 70 times between 1990 and 1994, and the highest increase being in food products, of almost 80 times. Under these conditions, the purchasing power expressed in the real earning index fell to 59.4%. Thus, against the backdrop of the relative and absolute decrease of the population's incomes, most of the money expenditures were directed towards the purchase of daily consumption goods for daily living needs.

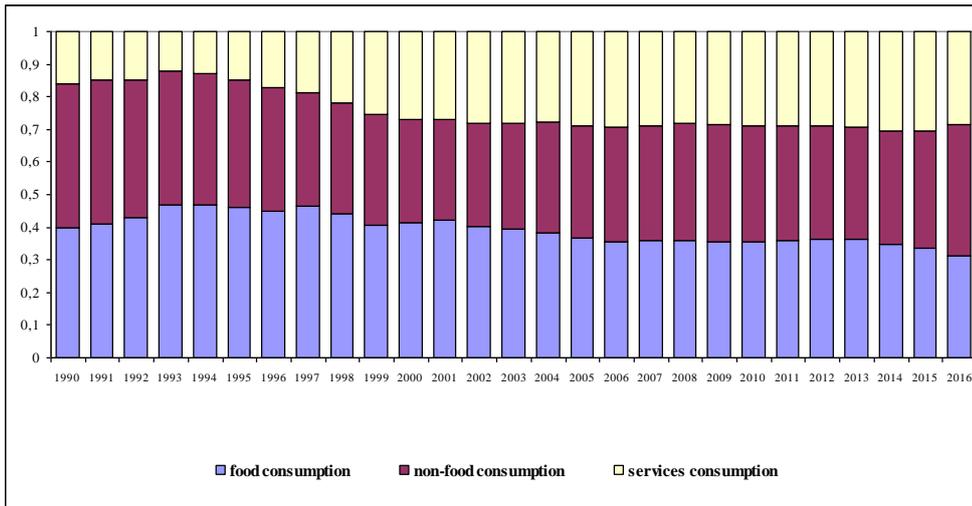


Figure 4 Evolution of consumption structure in Romania, 1990-2016

Source: authors' own computation based on NIS data

Between 1995 and 1998 some stabilization of the structure of the money consumption expenditures took place. The share of food declines slightly, maintaining around of 45%, non-food expenditure continues to fall to 34%, while those with services increase significantly to 21.8%. During this time, the inflationary phenomenon was kept under control, with monthly average rates of between 2% and 4%, except for 1997, when the average monthly rate was 8%, especially on services. Purchasing power increased especially in 1995 and 1996, less in 1998 and declined in 1997. However, from this period, the impact of the incomes growth and purchasing power began to be felt by lowering the share of food expenditure and increasing the service expenditures.

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The findings related to the dynamics of household consumption expenditures by consumption purpose in relation with the household income's growth come to confirm the findings regarding the evolution of the consumption expenditures structure (food, non-food and services).

In the period of 1999-2005 a downward trend of food consumption to 36.7% is shown and a decreasing non-food consumption until 2001, to 30.7% (the lowest level of the whole examined period) and a revival to 34.5% in 2005. The most visible evolution belongs to share of service consumption, which almost doubles in ten years, from 15.5% in 1995 to 28.8% in 2005. These developments take place in the context of a gradual decrease of inflation rate, which decreases less than 1% in 2004. We notice also, a continuous yearly growth of purchasing power. The remarkable presence of service consumption reflects their diversification and penetration in all daily spheres.

Between 2006 and 2014 the ratio between the shares of the three main consumption purposes of money consumption expenditures is stabilised. The food and non-food consumption shares achieve similar positions, each having 35-35% of the total expenditures, with small variations of the "force ratio". The services share is maintained to 28-29%, with a maximum of 30.4% in 2014. It is a period of time when inflation reached some negative values and the households' monthly income grows steadily.

Comparing the dynamics of monthly households' income with the dynamics of each component of money consumption expenditures the following conclusions can be drawn regarding the period of 1997-2016 in Romania:

- the growth of food consumption expenditures represents 55.67% of the income's growth, its share declining from 46% to 31.3%;
- the growth of non-food consumption expenditures is very close to that of income, representing 95.14 of the last, its share being at 34-36%, with a slight increase in 2016;
- the growth of services consumption expenditures exceeds the income's growth with 25%, its share increasing to 18.9% to 30.5%.

Figure 5 depicts the image of Romanian consumption pattern during 1995-2015, showing that the food and non-alcoholic beverages, housing and transport are the best valued expenditures categories. Their shares in the total consumption expenditures range from 45.8% to 27% for food, from 25.1% to 19.2% for housing and from 18% to 10.1% when the households' income is increasing in the whole examined period.

In the first 2 years, the share of food and alcoholic and tobacco expenditures is almost a half of the total consumption expenditures in context of a purchasing power being below that of 1990. The non-food consumption expenditures

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(clothing, footwear, housing, household equipment, health, transport) represent approximately a third part of the total expenditures. Within this component of consumption expenditures, the highest share belongs to housing, water, electricity and other fuels (12-13%) and a reduced share for clothing (3.6-3.7%). The services expenditures are not exceeding a quarter of expenditures and the transport expenditures are 10%, followed by tourism services, with 5.4-6%, and recreation and culture with 5.1-5.3% (Figure 5).

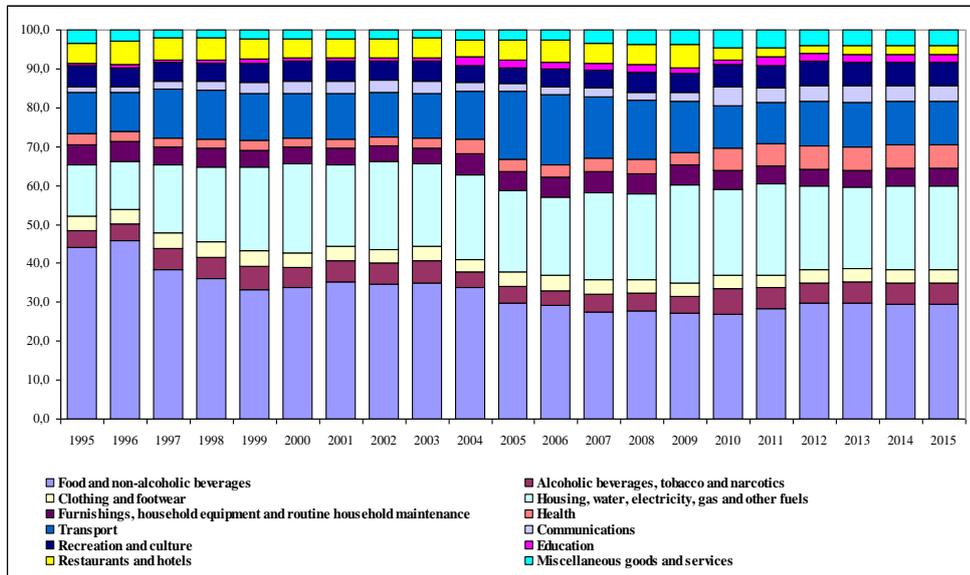


Figure 5. The distribution of consumption expenditures by consumption purposes in Romania, 1995-2015

Source: authors' computation based on EUROSTAT data

Between 1997 and 2004, the share of food consumption is slightly decreasing and stabilizes around the value of 38-41%. The share of non-food consumption grows sensibly to 35-36%, especially due to the growth of housing, furnishing and equipment (the fourth and fifth positions) which held 25% of the total. This development is explained by the growth of the population purchasing power (explained at its turn by the growth of nominal income and the sustainable decrease of inflation rate) which allowed a larger part of income to be directed to "domestic investments" in the detriment of strict necessity goods. The share of services consumption grows to 30%, the transport services are dominant, with 11.5-12.5%. The recreation and culture, restaurants and hotels expenditures are maintained to 10-11% (Figure 5).

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In the period of 2005-2015, the share of food consumption is kept almost constant (33-35%), mentioning that the alcohol beverages and tobacco are in a slight increase in the detriment of food and non-alcoholic beverages. The non-food consumption expenditures are balancing around the value of 40%. The clothing and footwear expenditures are constant around 3.5% and housing at 26-27%, with a maximum of 30.3% in 2009, when they are almost equal to the share of food consumption expenditures. The health consumption expenditures have a share of 4.1% in the last three years, more than double compared to the beginning of the period. The services expenditures reached a maximum share of 34% in 2006, especially due to the transport expenditures which register the highest level of 18%. Then, as the share of transport consumption decreases vertiginously to a minimum of 10.7% in 2011, the share of services consumption decreases as well to the level of 24% in the same year. Starting with 2010, when the share of transport consumption expenditures is stabilized at 11.3%, the share of services consumption expenditures is stabilised as well, around the value of 27%. A significant growth is registering the communication services, which reached the level of 4.1-4.5% of the total, with the generalization of mobile phone services and internet services. The recreation consumption expenditures, in a slight decrease, due to the reduction of restaurants and hotel consumption, are maintained to around of 8%. The education services consumption had a share of 2% (Figure 5).

4.2. Estimation of regression equation (1)

We check the stationarity of variables CONSUMPTION and INCOME, by running the ADF test of unit root (Table 1).

Table 1 - ADF stationarity test (first level)

Null Hypothesis: CONSUMPTION has a unit root			Null Hypothesis: INCOME has a unit root		
Exogenous: Constant			Exogenous: Constant		
Lag Length: 0 (Automatic - based on SIC, maxlag=4)			Lag Length: 0 (Automatic - based on SIC, maxlag=4)		
	t-Statistic	Prob.*		t-Statistic	Prob.*
Augmented Dickey-Fuller test			Augmented Dickey-Fuller		
statistic	0.087626	0.9558	test statistic	0.636757	0.9868
Test	1% level	-3.831511	Test	1% level	-3.831511
critical	5% level	-3.029970	critical	5% level	-3.029970
values:	10% level	-2.655194	values:	10% level	-2.655194

*MacKinnon (1996) one-sided p-values.

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Source: authors' computation by using EViews 9.0 software

Due to the fact that the value of Prob for both variables is higher than 0.05, we accept the null hypothesis of the unit root existence and non-stationarity of dataseries (first levels) (Table x). Therefore, we check the stationarity of first and

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second difference series and we found that the second difference series are stationary (Table 2):

Table 2 - ADF test of stationarity (second difference)

Null Hypothesis: D(CONSUMPTION,2) has a unit root		Null Hypothesis: D(INCOME,2) has a unit root	
Exogenous: Constant		Exogenous: Constant	
Lag Length: 1 (Automatic - based on SIC, maxlag=4)		Lag Length: 0 (Automatic - based on SIC, maxlag=4)	
	t-Statistic	Prob.*	
Augmented Dickey-Fuller test			
statistic	-4.226421	0.0056	
Test	1% level	-3.920350	
critical	5% level	-3.065585	
values:	10% level	-2.673459	
Augmented Dickey-Fuller test			
statistic	-4.035938	0.0074	
Test	1% level	-3.886751	
critical	5% level	-3.052169	
values:	10% level	-2.666593	

*MacKinnon (1996) one-sided p-values.

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Source: authors' computation by using EViews 9.0 software

The values of Prob for both series are lower than 0.05, reflecting the stationarity of second difference series (Table 2).

We construct the new series of D2CONSUMPTION and D2INCOME in order to estimate the regression model.

Table 3 - Estimation of equation 1

Dependent Variable: D2CONSUMPTION		Sample (adjusted): 1999 2016		
Method: Least Squares		Included observations: 18 after adjustments		
Date: 08/10/17	Time: 10:22			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.240126	6.654477	0.036085	0.9717
D2INCOME	0.549493	0.053877	10.19905	0.0000
R-squared	0.866689	Mean dependent var		10.24688
Adjusted R-squared	0.858358	S.D. dependent var		74.19606
S.E. of regression	27.92399	Akaike info criterion		9.601289
Sum squared resid	12475.99	Schwarz criterion		9.700219
Log likelihood	-84.41160	Hannan-Quinn criter.		9.614930
F-statistic	104.0205	Durbin-Watson stat		2.434242
Prob(F-statistic)	0.000000			

Source: authors' computation by using EViews 9.0 software

The model can be validated due to the value of Prob (F-statistic) (lower than 0.05) and the value of F-statistic ($F\text{-statistic}=105.0205 > F_{0.05;1;18}=4.414$). The value of R-squared (determination coefficient) is 0.866689, meaning that 86.66% of the variation of consumption can be explained by the variation of income. The value of Prob for C is higher than 0.05 meaning that the constant C is not statistically

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significant. The value of Prob for INCOME is 0.000(<0.05) reflecting its statistical significance.

The estimated equation is:

$$D2CONSUMPTION = 0.240126 + 0.549493 \cdot D2INCOME \quad (2)$$

(6.65447)
(0.0053877)
(0.9717)
(0.0000)

We test the errors autocorrelation using the Breusch-Godfrey Serial Correlation LM Test:

Table 4- Errors autocorrelation test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	8.505862	Prob. F(1,15)	0.0106
Obs*R-squared	6.513504	Prob. Chi-Square(1)	0.0107

Note: for lag=1

Source: authors' computation by using EViews 9.0 software

The values of Prob.F and Prob.Chi-Square are lower than 0.05 indicating an errors' autocorrelation of first order.

We intend to correct the autocorrelation of errors using the Cochrane Orcutt procedure by generating the equation $D2CONSUMPTION = C + D2INCOME + ar(1)$:

Table 5- Adjusted equation 2

Dependent Variable: D2CONSUMPTION

Method: Least Squares

Date: 08/10/17 Time: 11:27

Sample (adjusted): 2000 2016

Included observations: 17 after adjustments

Convergence achieved after 12 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.017213	3.275546	-0.615840	0.5479
D2INCOME	0.567215	0.039506	14.35788	0.0000
AR(1)	-0.802758	0.300386	-2.672419	0.0182
R-squared	0.914523	Mean dependent var		10.95171
Adjusted R-squared	0.902312	S.D. dependent var		76.41741
S.E. of regression	23.88428	Akaike info criterion		9.343104
Sum squared resid	7986.426	Schwarz criterion		9.490141
Log likelihood	-76.41638	Hannan-Quinn criter.		9.357719
F-statistic	74.89364	Durbin-Watson stat		1.586212
Prob(F-statistic)	0.000000			
Inverted AR Roots	-.80			

Source: authors' computation by using EViews 9.0 software

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This new model is statistically validated due to the fact that Prob(F-statistic) is 0.000(<0.05) and the value of F-statistic (74.89364) is $> F_{0.05;1;18}(4.414)$. As well as in the initial model the Prob of the constant C is higher than 0.05 and the coefficient of D2INCOME is significant for the 0.05 level.

The new regression equation is the following:

$$D2CONSUMPTION = -2.017213 + 0.567215 \cdot D2INCOME \quad (3)$$

(3.275546)
(0.003506)
(0.5479)
(0.0000)

Comparing with the initial estimated equation, we notice that the constant C became negative, the coefficient of D2INCOME is $0.567215 > 0.549493$, the errors for C and independent variable are smaller.

In this adjusted model, when D2INCOME has an increase of one unit, the increase of D2CONSUMPTION will be of 0.567215 units.

We test the correlation of errors of the adjusted model:

Table 6- Errors autocorrelation test for the adjusted model

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.307355	Prob. F(1,13)	0.1527
Obs*R-squared	2.562496	Prob. Chi-Square(1)	0.1094

Note: lag=1

Source: authors' computation by using EViews 9.0 software

In the Table 6 the value of Prob.F and Prob.Chi-Square are higher than 0.05 indicating the independence of errors by accepting the null hypothesis of no correlation.

We check the heteroskedasticity of errors using the ARCH test from Eviews:

Table 7-Heteroskedasticity test

Heteroskedasticity Test: ARCH

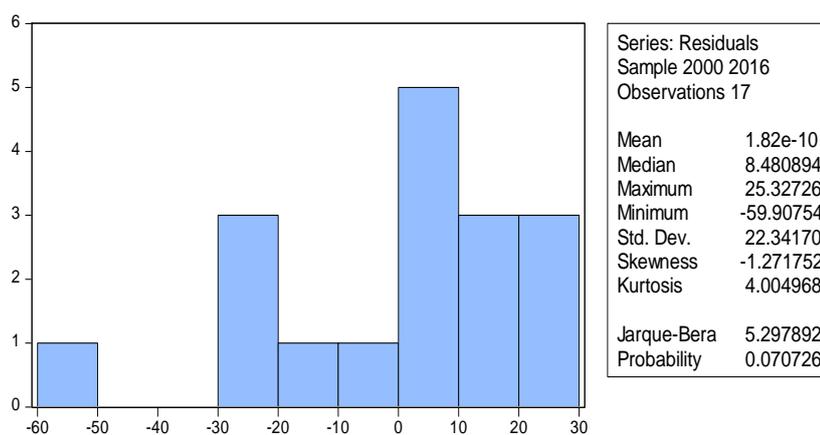
F-statistic	0.224751	Prob. F(1,14)	0.6428
Obs*R-squared	0.252800	Prob. Chi-Square(1)	0.6151

Source: authors' computation by using EViews 9.0 software

We notice in the Table 7 that the values of Prob. are higher than 0.05 that means we can accept the null hypothesis of homoscedasticity of errors. This indicates that the variation of dependent variable (D2CONSUMPTION) remain the same for any level of variation of independent variable (D2INCOME).

We test further the normality of errors' distribution with Jarque-Bera test:

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Source: authors' computation by using EViews 9.0 software

The probability is $0.070726 < 0.05$ indicating that we accept the null hypothesis of a normal distribution of errors (Table 8).

At the end of the regression analysis, we can conclude that:

- the initial estimated model of income-consumption relationship is validated for a significance threshold of 0.05, but the autocorrelation of errors imposed to adjust it;
- the new model is statistically validated as well for the 0.05 significance level and has homoscedastic, independent and normal distributed errors;
- the model reflects a positive influence of income growth in the consumption growth, suggesting that the households' income is stimulating the consumption growth in the Romanian economy, after 1990.

5. Conclusions

The paper intended to test the consumption laws, as they were expressed by Engel, by exploring the Romanian consumption pattern after 1990.

We found that, during 1997-2016 the growth of food consumption expenses is faster than the growth of household's income, the growth of non-food consumption expenditures has the same dynamics, and the growth of services consumption expenditures exceeds the income's growth. This suggests a propensity of population to extend their consumption to services expenditures as the income grows. Thus, we can conclude that the Engel's law, fundamental for explaining the population consumption pattern is keeping its valability in our country in the period

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of transition to the market economy, accession and integration in the European Union.

The findings of the regression analysis suggest that there is a high correlation between households' income and consumption, confirming the general economic perception that the income is a strong stimulating factor of consumption.

We have to mention the limits of our study consisting in the reduced time to the 20 years of observations, the results could be more relevant if the times series would be longer. As further studies, it could be very interesting and useful, as well as relevant for economic policy makers, to investigate the relationship between the structure of consumption expenditures (the expression of population demand) and the price index (CPI) dynamics.

References

1. Aitchison, J. and James A. C. Brown, J.A.C. (1955). A Synthesis of Engel Curve Theory. *The Review of Economic Studies*, Vol.22, Issue 1, pp. 35–46.
2. Anker, R. (2011), Engel's Law Around the World 150 Years Later. *Working Papers Series 247*, Political Economy Research Institute.
3. Chai, A., Moneta, A. (2010). Retrospectives-Engel curves. *Journal of Economic Perspectives*, Vol.24. No.1, pp.225-240.
4. Chai, A., Moneta, A. (2012). Back to Engel? Some evidence for the hierarchy of needs. *Journal of Evolutionary Economics*, Vol.22, pp. 649–676.
5. Deaton, A., and John Muellbauer, J. (1980). *Economics and Consumer Behavior*. Cambridge: Cambridge University Press.
6. Deaton, A. (1986). Demand Analysis. In: *Handbook of Econometrics*, vol. 3, ed. Zvi Griliches and Michael D. Intriligator, North-Holland, pp. 1767–1839.
7. Engel, E. (1857). Die Productions- und Consumtionsverhältnisse des Königreichs Sachsen. *Zeitschrift des Statistischen Bureaus des Königlich-Sächsischen, Ministerium des Innern*, No. 8 u. 9, pp. 1–54. It was reprinted as an appendix to "Die Lebenskosten Belgischer Arbeiter Familien früher und jetzt", *Bulletin de l'institut international de statistique*, tome IX, premiere livraison, Rome 1895.
8. Gibson, J. (2002). Why Does Engel Method Work? Food Demand, Economies of Size and Household Survey Methods. *Oxford Bulletin of Economics and Statistics*, Vol.64, Issue 4, pp.341-359.
9. Houthakker, H.S. (1952). The Econometrics of Family Budgets. *Journal of Statistical Society, Series A*. Vol.115, Issue 1, pp.1-28.
10. Houthakker, H.S. (1957). An international Comparison of Household Expenditure Patterns, Commemorating the Century of Engel's Law. *Econometrica*, Vol.25 Issue 4, pp.532-551.
11. Hovorkova, J. (2015). Evaluation of consumer standard of living in the Czech Republic in the period 2010-2013: Application of revealed preference theory in discussion with Engel's law. *Acta Oeconomica Pragensia*, Vol.23, No.6, pp.21-46.

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Testing the Engel's law in the consumption pattern of Romanian population

12. Lewbel, A. (2008). *Engel Curve*. *The New Palgrave Dictionary of Economics*, 2nd edition, edited by Steven N. Durlauf and Lawrence E. Blume. Palgrave Macmillan.
13. Loeb, B.S. (1955). The use of Engel's law as basis for predicting consumer expenditures. *Journal of Marketing*, Vol.20, Issue 1, pp.20-27.
14. Kaus, W. (2013). Beyond the Engel's law. A cross-country analysis. *The Journal of Socio-Economics*, Vol.47, pp.118-134.
15. Malthus, Th. (1798). *An Essay on the Principle of Population*. London: J. Johnson.
16. Prais, Sig J. (1952). Non-Linear Estimates of the Engel Curves. *The Review of Economic Studies*, Vol.20 Issue 2, pp. 87–104.
17. Samuelson, P.A. (1938). A note on the Pure Theory of Consumer's Behaviour. *Economica*, New Series, Issue 17, pp.61-71.
18. Teodoru, M.C. (2005). *Mecanismul de formare a prețurilor produselor alimentare și comportamentul consumatorului*. Cluj Napoca: Editura Risoprint.
19. Tuttle, C. and Kuhns, A. (2016). Percent of Income spend in Food Falls as Income Rises. *Food Price Outlook*, USDA Economic Research Services. Available at: <https://www.ers.usda.gov/data-products/food-price-outlook/.aspx> Accessed 15.07. 2017.
20. Witt, U. (2001). Learning to Consume - A Theory of Wants and the Growth of Demand. *Journal of Evolutionary Economics*, Vol.11 Issue 1, pp. 23–36.
21. <http://statistici.insse.ro/shop/index.jsp?page=tempo2&lang=ro&context=20> Accessed 5 July 2017
22. http://ec.europa.eu/eurostat/web/products-datasets/-/nama_10_co3_p3 Accessed 7 July 2017

Annex

Table 1a - Households' income and food consumption expenditures, 1997-2016 (absolute values-lei)

Year	Households' income	Food consumption expenditures
1997	82,0879	29,0345
1998	127,6021	42,3938
1999	167,3697	51,8867
2000	226,7706	72,4589
2001	388,43	121,5531
2002	501,852	148,8056
2003	595,7448	178,1046
2004	822,9919	236,9223
2005	964,93	264,47
2006	1118,75	289,92
2007	1368,75	338,72
2008	1770,97	425,09
2009	1937,45	455,62
2010	1932,84	456,31

Table 1b- Households' income and food consumption expenditures, 1998-2016 (fixe-based indices)

Year	Households' income	Food consumption expenditures
1998	1,5544569	1,4601181
1999	2,0389083	1,7870706
2000	2,7625338	2,4956138
2001	4,7318789	4,1865057
2002	6,1135929	5,1251304
2003	7,2574009	6,1342403
2004	10,025739	8,1600269
2005	11,754838	9,1088188
2006	13,628683	9,9853622
2007	16,674199	11,666121
2008	21,574069	14,640858
2009	23,602139	15,692366
2010	23,545979	15,716131
2011	24,054824	16,41461

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2011	1974,61	476,59
2012	2040,57	502,39
2013	2137,45	522,12
2014	2104,31	492,81
2015	2361,99	506,01
2016	2735,3	538,64

Source: NIS data

2012	24,858353	17,303208
2013	26,038551	17,982745
2014	25,634838	16,973256
2015	28,773912	17,427888
2016	33,321598	18,551723

Source: authors' own computation based on NIS data

Table 1c- Households' income and food consumption expenditures, 1998-2016 (chain-based indices)

Year	Households' income	Food consumption expenditures
1998	1,5544569	1,4601181
1999	1,3116532	1,2239219
2000	1,3549083	1,3964831
2001	1,7128764	1,6775455
2002	1,2920011	1,2242024
2003	1,1870926	1,1968945
2004	1,3814504	1,3302425
2005	1,172466	1,1162731
2006	1,1594105	1,0962302
2007	1,2234637	1,1683223
2008	1,2938594	1,2549894
2009	1,094005	1,0718201
2010	0,9976206	1,0015144
2011	1,0216107	1,0444435
2012	1,0334041	1,0541346
2013	1,0474769	1,0392723
2014	0,9844955	0,9438635
2015	1,1224534	1,0267852
2016	1,1580489	1,0644849

Source: authors' own computation based on NIS data

Table 2a - Households' income and non-food consumption expenditures, 1997-2016 (absolute values-lei)

Year	Households' income	Non-food consumption expenditures
1997	82,0879	21,7254
1998	127,6021	32,8499
1999	167,3697	43,6608
2000	226,7706	55,8722
2001	388,43	88,4879
2002	501,852	117,304
2003	595,7448	145,4857
2004	822,9919	207,2413
2005	964,93	248,21
2006	1118,75	285,57
2007	1368,75	334,82
2008	1770,97	429,14
2009	1937,45	454,46
2010	1932,84	455,75
2011	1974,61	460,33
2012	2040,57	481,69
2013	2137,45	495,58
2014	2104,31	494,54
2015	2361,99	536,39
2016	2735,3	688,77

Source: NIS data

Table 2b- Households' income and non-food consumption expenditures, 1998-2016 (fixe-based indices)

Year	Households' income	Non-food consumption expenditures
1998	1,5544569	1,5120504
1999	2,0389083	2,0096661
2000	2,7625338	2,5717455
2001	4,7318789	4,0730159

Table 2c- Households' income and non-food consumption expenditures, 1998-2016 (chain-based indices)

Year	Households' income	Non-food consumption expenditures
1998	1,5544569	1,5120504
1999	1,3116532	1,3290999
2000	1,3549083	1,279688
2001	1,7128764	1,5837554

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2002	6,1135929	5,3993943
2003	7,2574009	6,6965718
2004	10,025739	9,5391247
2005	11,754838	11,424876
2006	13,628683	13,144522
2007	16,674199	15,411454
2008	21,574069	19,752916
2009	23,602139	20,918372
2010	23,545979	20,97775
2011	24,054824	21,188563
2012	24,858353	22,171744
2013	26,038551	22,811087
2014	25,634838	22,763217
2015	28,773912	24,689534
2016	33,321598	31,703444

Source: authors' own computation based on NIS data

2002	1,2920011	1,3256502
2003	1,1870926	1,240245
2004	1,3814504	1,4244788
2005	1,172466	1,197686
2006	1,1594105	1,1505177
2007	1,2234637	1,1724621
2008	1,2938594	1,2817036
2009	1,094005	1,0590017
2010	0,9976206	1,0028385
2011	1,0216107	1,0100494
2012	1,0334041	1,0464015
2013	1,0474769	1,028836
2014	0,9844955	0,9979014
2015	1,1224534	1,0846241
2016	1,1580489	1,2840843

Source: authors' own computation based on NIS data

Table 3a- Households' income and services consumption expenditures, 1997-2016 (absolute values-lei)

Year	Households' income	Services consumption expenditures
1997	82,0879	11,7841
1998	127,6021	21,0165
1999	167,3697	32,6936
2000	226,7706	47,1567
2001	388,43	77,8553
2002	501,852	104,8778
2003	595,7448	125,8258
2004	822,9919	171,6407
2005	964,93	207,59
2006	1118,75	239,97
2007	1368,75	272,46
2008	1770,97	331,1
2009	1937,45	364,95
2010	1932,84	374,23
2011	1974,61	383,91
2012	2040,57	403,82
2013	2137,45	423,62
2014	2104,31	432,2
2015	2361,99	457,95
2016	2735,3	491,09

Source: NIS data

Table 3b- Households' income and services consumption expenditures, 1998-2016 (fixe-based indices)

Year	Households' income	Services consumption expenditures
1998	1,5544569	1,7834625
1999	2,0389083	2,7743824
2000	2,7625338	4,0017227
2001	4,7318789	6,6068092
2002	6,1135929	8,8999414
2003	7,2574009	10,677591
2004	10,025739	14,565448
2005	11,754838	17,61611
2006	13,628683	20,36388
2007	16,674199	23,120985
2008	21,574069	28,097182
2009	23,602139	30,969696
2010	23,545979	31,757198
2011	24,054824	32,578644
2012	24,858353	34,268209
2013	26,038551	35,948439
2014	25,634838	36,676539
2015	28,773912	38,861687
2016	33,321598	41,67395

Source: authors' own computation based on NIS data

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Table 3c- Households' income and services consumption expenditures, 1998-2016
(chain-based indices)

Year	Households' income	Services consumption expenditures
1998	1,5544569	1,7834625
1999	1,3116532	1,5556158
2000	1,3549083	1,4423832
2001	1,7128764	1,6509913
2002	1,2920011	1,3470862
2003	1,1870926	1,1997372
2004	1,3814504	1,3641137
2005	1,172466	1,2094451
2006	1,1594105	1,1559805
2007	1,2234637	1,1353919
2008	1,2938594	1,2152243
2009	1,094005	1,102235
2010	0,9976206	1,0254281
2011	1,0216107	1,0258664
2012	1,0334041	1,0518611
2013	1,0474769	1,0490317
2014	0,9844955	1,020254
2015	1,1224534	1,0595789
2016	1,1580489	1,072366

Source: authors' own computation based on NIS data