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Absolute value and diversity of household spending: analysis on International Comparison Program (ICP) 2011 data

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Abstract

Research background: This article investigates the connection between consumer's budget growth and diversification of household spending. The main question of research is "are there new drivers of modern processes of consumer spending's diversification, at a time when spending on food has reached the minimum share in the consumer budget."

Purpose of the article: The objective of the article is to clarify the hypothesis about the existence of a certain limit of income (and consumer spending) after which the growing of consumer's purchasing capacity loses power of influence on spending diversity.

Methods: Theil entropy index was used for measuring the diversity of household spending. This index was defined as a sum of within-group and between-group entropy, which allows for comparing the diversification of household spending in two aggregate groups of expenditure, which were formed by the authors. The Workings' equation was used for modeling the spending entropy's dependence on their absolute value. Two categories of household spending were regrouped (consolidated) by us through forming a group more related to the development of human economic potential (SMRHD) and less related to these processes (SLRHD). The research was done on the basis of ICP (2011) data, which covers 178 countries and refers to 2011 year — the latest available on the moment of the article was completed.

Findings & Value added: The results obtained in this research confirmed that there is a limit of household spending's size, beyond which further increasing of consumers' economic opportunities loses a significant impact on the diversity of consumption spending. However, the weakening

of the link between size of spending and its entropy reflects impact of two qualitative differenced factors. The first is relatively much more radical decrease of spending growth influence on within-group entropy for SLRHD. The second — is relatively much less significant decrease of entropy's sensitivity to spending growth for SMRHD. Such results reflect the increase in the importance of "non-functional demand components", which reduces the capacity of data on functional distribution of household expenditures to characterize the extent of their diversification.

Introduction

In recent literature, devoted to analysis and comparing of national consumption patterns, the income and relative price are considered to be the main factors of consumer's spending structure. Several trends are associated with increasing income (Engel's law in 'strong' and weak formulations, decline of own and cross price elasticity of demand on wide defined categories of goods etc.). Among these trends, there is the following: 'Households tend to diversify their spending across a wide range of goods and services as they become more affluent' (Chai *et al.*, 2014).

Such diversification is associated with extension of consumer's choice and enhancement of consumer's well-being. For example, in (Clements *et al.*, 2004) a proverb is quoted that "variety is the spice of life" and growth of consumer's spending diversity is considered to be a manifestation of economic opportunities extension in consumers behavior.

It is important that empirical background for considering the consumer spending diversification as a constant companion of income growth have been caused by long process of reducing the food spending share in the total consumer spending. However, a reduction of any spending component has a limit of positive impact on diversification. Such a limit is mathematically determined: when its share reached $1/n$ (where n is number of component) further decline wouldn't lead to diversification growth. Thus, a few questions appear. Will the social consequences of consumption diversification remain unchanged in countries where reduction of the food share has lost impact on equalization of consumer spending proportions? Are there new drivers of modern processes of consumer spending's diversification which require updating approaches to investigating the dependence of "revenue growth — changes on national consumption patterns"?

Will the diversification continue and where is the limit of this process? Will some commodity category (a couple of categories) will become a new center of spending concentration? And is the trend to weakening the connection between income and measure of spending diversity the same regarding all commodity groups?

The answers to all these questions exceeds the capabilities of this article, but we will try to deepen the understanding of processes which lie behind the recent changes in the structure of consumers spending, through clarification of approaches to investigating the functional link between increasing income and — consumer's spending diversity.

Our hypothesis can be formulated as follows. The increasing of income is accompanied by the reduction in that part of consumer spending which must be distributed in certain proportions to keep the economic potential and capacity for income generation. It leads to growing freedom in individual's expression in the area of consumer choice. Thus the factors of choice, connected with functional and objective side of human needs lose the importance, as well as the component of demand which was called "functional" by H. Leybenstein (1950).

We suggest that this hypothesis may be empirically tested with data concerning the functional distribution of household spending through comparing strength of expenditures diversification dependence on income growth, inherent to the distinguished groups of spending. Then we have separate group of commodities, which are more related to keeping and improving the human economic potential, and group — less related to these processes. For the first group, the importance of functional component of demand should be stronger than for second. Thus, if the connection between income growth and spending diversity within the first group of commodities is stronger than within the second group — then we obtain empirical confirmation of our hypothesis.

We can also formulate an inverse relationship: the more opportunities to observe the "income growth — spending diversification" dependence within the aggregate group of spending, the higher we found the significance of "functional" component of consumer choice and less — the significance of cultural and emotional its component.

Accordingly, the general goal of the authors is to contribute to the development of scientific instruments, suitable for investigation of consumer demand on the new level of its freedom from functional subordination and in conditions of new power of influence the cultural and emotional factors. This article, as the first stage of such research, is devoted only to examining the trends of consumer spending diversification in dependence on income growth, which are observed in most developed and other groups of countries. This causes three main tasks of this article.

First, we try to verify the hypothesis, proposed by Chai and Moneta that at a certain level of income the "saturation of needs to diversify expenditures" occurs and alignment of budget distribution between the broadly aggregated groups of goods has stopped.

Second, we try to test a new grouping of consumer spending in research of link "growth of income — diversification of household spending" that may be helpful to explaining the differences observed in the characteristics of this connection in the different countries. As the base of grouping we are going to use the level of significance of the particular spending category for keeping person's economical potential, its possibility to generate the revenue.

Third, we are going to pre-test the hypothesis about differences of connection between income growth and diversification of consumer spending, inherent to diverse consolidated groups of goods.

Our sample covers 178 countries included to a panel data and the ICP data referring to the 2011 year was initial resource of information about the size and structure of consumer spending. This research was conducted in 2016.

The next part contains analyses of literature devoted to explaining the differences in the structure of consumer spending between countries. The third part is devoted to choice and development of the analytical tools of research. The fourth part represents the results and discussion, and the last part is conclusion.

Literature review

A vast majority of current research in consumer spending of households has considered them as a dependent parameter, reflecting the impact of factors, among which there are almost always two mandatory ones: income (sometimes — the total expenditure) of households and relative prices by commodity groups. Specificities of the individual studies are largely linked to choice of additional factors, included in the model and structure of mathematical tools, used for the simulation. The similar generalization is conducted in the Chai *et al.* (2014, p. 3): "The predominant method used in applied studies of demand has been the demand systems approach, in which a system of equations is used and the dependent variable is household spending on a particular good (usually expressed as a budget share), while the independence variables are the relative prices of other goods, household income (discussed below) and the household's demographic characteristics. The core theory underpinning this approach is based on the view that these expenditures are an outcome of a single, representative household that maximizes its utility in each period by spending on the observed categories according to a linear budget constraint".

Such works are based mainly on the works of Theil, Slutsky, Working, Hicks, which have been transformed into such prevalent tools as multistage budgeting, model Florida-Preference Independence (PI) and Florida-Slutsky model. Illustrative examples of such tools' application for the study of national consumption patterns and their comparative analysis are given by works Seale and Regmi (2006); Muhammad *et al.* (2011); Clements and Qiang (2003).

The similar methodic principles are applied for investigation of the consumer spending diversification, which accompanies growth of income and for estimating the heterogeneity of consumers spending patterns.

Numerous studies have found empirical evidence for positive consumer spending diversification dependence on income growth (Theil & Finke, 1983; Clements & Chen, 1996), or clarified the nature of this link, like Chai and Moneta (2012), who confirm the presence of certain income limit, after which growth stops affecting on spending diversification — there is a phenomenon of "saturation of desire diversity".

In our opinion, the mentioned bodies of research in many cases use the same term "diversification" for designation of qualitatively different processes. For example, already mentioned work Chai and Moneta (2012), estimated the extent of consumer spending diversification by data on widely aggregated commodity groups. While in Falkinger and Zweimüller (1996), such diversification was investigated by the number of particular goods consumed by households in countries with different income level. We believe that diversification of consumer spending and a variety of consumption which are studied in two referred sources have a fundamentally different nature. It's important not only for applying the principle of Preference independence (PI) to analyze consumption patterns: "The assumption of preference independence should be viewed as a convenient simplification when broad groups of goods are considered. Allowing such goods to be specific substitutes or complements will in many cases yield estimates that are even less precise." (Theil, 1987, p. 148).

On the one hand, the models which examine the structure of consumer spending by the widely aggregated commodity groups show high explanatory power with incorporation of such basic factors as the size of income and relative prices as in Klements and Qiang (2003) and Seale and Regmi, (2006). On the other hand, the complex of established patterns of demand still cannot explain most of the changes observed in the behavior of households: "Yet the grave reality is that current state-of-the-art models of household demand still fail to explain most of the observed variation in household consumption behavior." (Chai *et al.*, 2014, p. 2).

The existence of "heterogeneity of consumption" phenomenon can be considered as a sign of presence of such two types of consumption diversity. Mentioned phenomenon is traditionally illustrated by example from Lewbel (2005), or Chai *et al.* (2014, p. 4): "suppose we have a dependent variable Y such as household purchases of a particular good and a vector of covariates X, such as the prices of substitutes, the income of households and their demographic characteristics. Heterogeneity is defined as the variation in Y that is not explained by X".

The fact which also has great significance is that various factors of consumer choice (the study of which requires different tools) have not equal weight to determine the proportion of distribution of consumer spending between broad categories of goods and between particular goods. The proportions of budget distribution between widely defined categories of goods are much more functionally determined and can be better explained using the patterns of choice, described in orthodox theory of consumer behavior (maximizing behavior, constancy of preferences, rationality and consumers' tastes regardless from country of residence, or social status of the household).

At the same time, proportions of budget distribution between specific goods, brands, or products of different "quality classes" are more difficult to explain within orthodox models of consumption. Real drivers of consumption behavior do not fit in an appropriate way to the concept of maximizing behavior, which is still indifferent to the socio-cultural environment of human interactions when the choice between specific products and services is studied.

And moreover, even refer to widely aggregated commodity groups, size of income and relative prices cannot explain all variation of spending structure. And we suggest that diversification of consumption spending occurs in a different way concerning various commodity groups and the importance of certain commodity for reproduction and improvement the human economic potential has significant impact on the specificity of such diversification.

Thus, the clarifying of features, inherent to the diversity of consumption spending on groups of commodities, which have different importance for improvement of human economical potential, forms a "gap" in the body of research on consumption spending structure and defines the motivation of research.

Methodology

The work Chai *et al.* (2014) through example of the long-term trend of the households' consumption expenditure distribution shows that three groups of indices most commonly used to characterize the distribution diversification (index Gini, Gini-Simpson index, Theil index) give similar results of assessing the extent of consumer spending diversification.

All three indexes are built on the same assumption that the maximum equity of distribution (maximum diversification of expenditure) is achieved in a situation where each part of the whole is $1/n$, where n is number of shares. Accordingly, by comparing actual proportion of distribution with "a priori set as most diversified" we can get the desired assessment.

The works by Chai *et al.* (2014), and Clements *et al.* (2004) contain similar expressions to assess the extent of diversification of consumer spending. In particular, Chai *et al.* (2014, p. 10) used the Theil index to assess inequality of total expenditure distribution between different categories of products:

$$D_{Theil} = - \sum_{k=1}^K S_k \times \text{Log}(S_k), \quad (1)$$

where:

S_k – the share of total expenditures allocated to expenditure category k ;

K – total number of goods, included to consumption bundle;

In Clements *et al.* (2004, p. 10) similar algorithm is provided (after the argument of the logarithm submission in degrees (-1) negative sign disappears) to assess the extent of the entropy of consumer budget distribution:

$$H = \sum_1^n w_i \times \log\left(\frac{1}{w_i}\right), \quad (2)$$

where:

w_i – share of commodity group "i" in total consumer budget;

n – number of commodity groups, which share consumer budget.

More complex algorithms are used in cases where research tasks require to depart from the provisions of maximizing diversification in case of actual distribution proportions equality to $1/n$. In particular methods "Dissimilarity based on the Euclidean distance", "Dissimilarity based on the absolute value function", "Dissimilarity derived from the concept of entropy".

However, at this stage of our research we can assume the thesis of maximizing diversification in case of equality of all shares quite acceptable. Accordingly, as the basic method for assessing diversification of households' consumer spending we will use Theil index (measure of entropy).

We also consider that the opportunity to develop the algorithm (2) to highlight the impact of between-group and within-group entropy, very significantly. Appropriate procedures are proposed by Clements *et al.* (2004, p. 12):

$$H = \sum_{g=1}^G Wg \times \text{Log} \left(\frac{1}{Wg} \right) + \sum_{g=1}^G Wg Hg, \quad (3)$$

where:

G – number of commodity groups, created from n goods ($G < n$);

Wg – specific weight of group “ g ” in total consumer budget, which equal $\sum_{i \in G} w_i$;

$$Hg = \sum_{i \in G} \frac{w_i}{Wg} \times \text{Log} \frac{1}{w_i/Wg} \quad (4)$$

Then, equation (4) shows the within-group entropy (which due to the distribution of expenditures among the goods included in the composition of a group): “Accordingly, equation (3) states that the entropy of the entire basket can be decomposed into the sum of the between-group entropy and a weighted average of the G within-group entropies, the weights being the relevant group budget shares.” (Clements *et al.*, 2004, p. 12).

In the mentioned research, measure of consumer spending's diversity was defined as the size of entropy between food and non-food groups of goods and entropy within the group of non-food products which has been weighted by proportion of corresponding spending's group in budget.

We consider it is important that the mentioned above approach (split into two groups: food and non-food expenditures), leads to that the level of total entropy is obtained as a result of two components, with the opposite orientation of reaction to revenue growth. Between-group entropy reduces due to reduction of the share of food (respectively, increasing dominance of spending on non-food products). Within-group entropy (represented in these studies by only group of non-food products as food — are considered like a single good, consequently, the entropy within this group is zero) increases, reflecting dominant trend of changes in the structure of consumer spending. But qualitatively, the process of reducing the share of expenditure on food has the same economic sense as the processes of diversification within group of non-foods commodities. But mentioned approach to assess entropy defines that the first process causes the decrease of the en-

tropy level, while the second one — its increase. Accordingly, it is difficult to interpret the phenomenon of reducing between-group entropy in case of increasing household incomes. But this phenomenon is caused by choice of way to grouping consumer spending.

We propose grouping in which the dependence the entropy (both within-group, and between-group) on the revenue growth is suitable for treatment in the context of initial theoretical frames of our research.

To assess the diversification of consumer spending, we used the method of assessing the total entropy as the sum of within-group and between-group entropy with formula (3).

The paper Clements *et al.* (2004, p. 12) have proposed the algorithm of estimates for the case of two groups, one of which is considered as a single monolithic product (the first commodity group – food and nonalcoholic beverages), corresponding, its within-group entropy is zero:

$$H = w_1 \times \log \frac{1}{w_1} + (1 - w_1) \times \log \frac{1}{1-w_1} + (1 - w_1) \times \sum_{i=2}^8 \frac{w_i}{1-w_1} \log \frac{1}{w_i/1-w_1}, \quad (5)$$

But the formula (5) can be easily transformed into estimation algorithm with two groups, both of which are seen as heterogeneous. Correspondingly, the total entropy will consist of three components (the entropy between two aggregate groups formed, the within-group entropy of the first group and the within-group entropy of second group):

$$H_t = w_d \times \log \frac{1}{w_d} + (1 - w_d) \times \log \frac{1}{1-w_d} + (1 - w_d) \times \sum_{i=1}^D \frac{w_i}{1-w_d} \log \frac{1}{w_i/1-w_d} + W_d \times \sum_{d+1}^{12} \frac{w_i}{w_d} \times \log \frac{1}{w_i/W_d}, \quad (6)$$

Grouping of consumer spending was made on the basis of more / less power of influence on the processes of human economic potential formation. We to some extent arbitrarily, according to the tradition, spread in the literature on human capital, have proposed that some groups of consumer spending (such as Health, Transport, Communication; Recreation and Culture; Education) are more connected with the preservation and development of human capacity to generate revenues than other groups of expenditures. The latter are Food and nonalcoholic beverages; Alcoholic beverages, tobacco, and narcotics; Clothing and footwear; Housing, water, electricity, gas and other fuels; Furnishings, household equipment and maintenance; Restaurants and hotels; Miscellaneous goods and services.

The thesis about relatively strongest connection between human capital stock and spending on education and health is grounded by a rich body of literature, considering public and private spending on education (Acemoglu & Pischke, 1999; Feldmann, 2017) and health (Chang & Yung-Hsiang, 2006; Bleakley, 2010; Bloom & Canning, 2003) as a significant part of investment in human capital.

Expenditure on transport and communication, leading to development of national infrastructure, is also considered as a factor of labor productivity (one of prominent indicator on macroeconomic level (Boopen, 2006)). However, most of the bodies of research are devoted to public expenditures on transport and communication, which are driven by politic mechanisms and effect on human capital stock on macroeconomic level as for example Randolph *et al.* (1996).

However, household expenditures on such commodity are also considered as elements of human capital investments:

“Resident’s human capital investments: Human capital investment in health is measured by the “healthcare and medical services” of household consumption expenditures; education investment is measured by “education, culture and recreation supplies and services” of household consumption expenditures; and migration investment is measured by the “transport and communications” of household consumption expenditures. The overall human capital investment is measured by the sum of these three investments.” (Yang & Huang, 2017).

Accordingly, the first list of spending is called in our study as aggregate group "Spending on goods, more related to development of human economic potential" (SMRHP), and the second — "Spending on goods, less related to development of human economic potential" (SLRHP).

We expect that empirical confirmation of our hypothesis would be expressed through the following feature of functional relationship between income growth and diversification of consumer spending. For a SMRHD group, this relationship should be persisted even at income level which leads to disappearance of this dependence for SLRHD.

To model the dependence of household spending diversity (expressed by Theil index of entropy) on the income (we use absolute value of household’s spending as indicator of income) we take the equation:

$$H = a + \beta \times \log(CSH) + \varepsilon \quad (7)$$

where:

H – dependent variable, indicator of household spending entropy;

CSH – explanatory variable, indicator of household spending absolute value;

a – estimated coefficient, reflecting autonomous (independent from scale of spending) level of household expenditures entropy;

β – estimated coefficient, reflecting sensitiveness of household expenditures entropy from scale of spending (marginal growth of entropy in dependence on spending's change);

e – the error term.

This model is similar to widely used model of demand which was proposed in the paper by Working (1943). The dependent variables in our model and the Working model are similar, though both express universal, integral result of interaction of consumer preferences with budget constraints on all commodity groups. Thus the specific weight of certain commodity in total consumer spending (the dependent variable in the Working model), and the degree of consumer spending diversification (dependent variable in our model) are considered as being under influence of all spending groups. Then, the degree of consumer spending diversification is integrated results of consumer choice that mediate the relation to all goods, included in the consumer basket (for which MU/P is greater than marginal utility of income).

Using the logarithmic form of factor variable makes this mathematic tool applicable for both hypotheses: about linear and nonlinear form of spending entropy dependence on size of spending.

Our research was conducted in 2016 on a sample covering 178 countries included to a panel data which is referred to 2011 and formed on ICP (2011) indicators. The size of our sample is determined by data availability only. Using data covering countries with widely different level of income and consumption spending (factor variable in our model) conduces to most general results.

The data about the structure of households' expenditures and consumptions is applicable for international comparison through using the price, measured in US \$ by purchasing power parities. This allows us also to estimate the amount of consumption for each commodity group after elimination of price variation impact: "ICP comparisons of price and real expenditure levels of GDP are based on the expenditure aggregates of the national accounts using spatial price deflators or purchasing power parities (PPPs) as the measure of the price component. In these cases, the prices of commodities constituting final demand are collected and compared across

economies to produce the price relatives, PPPs, with which the GDPs and component expenditures being compared are deflated to obtain the real expenditure relatives. In other words, the price measures are derived directly, and the real expenditure measures indirectly. This is called the price approach” (World Bank. 2015, p. 175).

The total amount of expenditure in our sample is estimated by considering both individual and collective consumption. That makes the structure of consumption dependent not only on individual choice, but on mechanisms of collective and even political choices. But only such approach provides available data about the whole amount of goods consumed by households.

Using household consumption expenditure's absolute value instead of a more widespread indicator of national income per capita, or GDP per capita is caused by the desire to reflect exactly the impact of economic empowerment for consumption. This means that we eliminate differences, caused by the national propensity to save, amortization policy, used in country and other specifics, inherited to particular countries in case of using GDP or GNI per capita.

Entropy index of consumer spending was calculated by formulas (4) and (6) according to data of International Comparisons Program (ICP 2011). Absolute value of consumer expenditure is calculated in US dollars PPP (at current prices of 2011 year) based on the same data source.

Results

In the first stage, indexes of household spending diversification for 178 countries and for average shares of all countries were calculated. This allowed us to gain database appropriating for modeling entropy indexes dependence on income (consumer spending) level. This database includes follows components. First — the size of individual consumption expenditure of households per capita measured in US dollars at purchasing power parity (PPP). Second — the share of spending attributed to the group SMRHD, as a percentage of the total consumer budget. Third — the entropy index for the total consumer spending (absolute estimate and the same indicator, expressed in % of the mathematically determined possible maximum, that in our case is $\log(12) = 1.079$). Forth — the data on between group entropy (mathematically determined maximum = $\log(2) = 0.301$). Fifth — the entropy within-group for SLRHD (mathematically determined maximum = $\log(7) = 0.845$), and Sixth — the within-group entropy for SMRD (mathematically determined maximum = $\log(5) = 0.699$).

The full database table was not included in article not to burden it with too large annexes, but may be provided by request if required.

Even a cursory review of tabulated data shows that in contrast to the grouping into two groups "food / non-food goods" obtained results demonstrate the identical nature of the consumption spending entropy dependence on the absolute size of household expenditure for three entropy assessments (total, between-group and within the group SMRHD) and much lower increasing of the entropy amidst growing consumer spending in the group SLRHD.

In particular, there is a fairly expressed positive correlation between income growth and the total assessment of consumer spending entropy (correlation coefficient between the size of consumer expenditure and entropy equal to 0.605 — between vectors of values of 0.724 — between rank vectors). There are similar indexes of correlation between consumer spending and between-group entropy (0.575 — between vectors of values and 0.724 — between rank vectors). Therefore, in contrast to grouping on base of "food / non-food" between-group entropy for groups SMRHD and SLRHD demonstrates the same type of dependence on revenue growth with the total entropy.

The share of expenditure on group SMRHD increases with income, but even in most developed countries, this increasing has not provided a proportion of these spending close to 50%, which should lead to reduction of the value of between-group entropy in case of a further increase in the specify weight of this group. It means that the proposed grouping can be used to display dependence shifts in consumption patterns, which are associated with increase of social welfare on the income growth.

It is also important that the correlation between the scale of spending and indexes of entropy in the group SMRHD is higher than similar correlation for the group SLRHD, and the correlation between spending and indexes of total (within-group and between-group) entropy. The correlation coefficient for SMRHD group is 0.621 — for vectors of values and 0.740 — for vectors of ranks, but for the group SLRHD such correlation is almost absent (0.019 and 0.066 for ranks). This fact confirms the meaningfulness of conducted grouping and truth of our initial hypothesis (connection between increasing of expenditures and diversity of consumption patterns stronger in group of SMRHD than in SLRHD).

Also we must take into account that among 21 countries which have a higher than the world's average level of the total entropy of consumer spending, 18 also have the amount of consumer spending per person which is higher than the average worldwide. Among 34 countries with between-group entropy of consumer spending higher than the average in the world,

32 — also have the amount of consumer spending more than the average in the world. Finally, among 33 countries having SMRHD within-group entropy higher than the average in the world, 30 also belong to the group of countries with above-average consumer spending.

However, only 37 of the 78 countries having a higher than the world average indicator of SLRHD within-group entropy are also characterized by above-average amount of consumer expenditure. It is also empirical evidence that, firstly, the increase in consumer spending is positively connected with the increase in the total entropy of consumer spending. Second, that this connection is stronger regarding between-group entropy and within-group entropy for the group SMRHD, but much less in respect of SLRHD.

The parameters of functions, reflecting spending entropy dependence on the size of household consumer spending were evaluated on the second phase of our research.

The models with specifications represented in table 1 were used for estimating.

Evaluation results are summarized in Table 2, and graphical illustrations are shown in Figures 1–4.

The simulation results in generally confirmed positive rather pronounced total entropy dependence on the size of spending. This trend is also seen concerning to between-group entropy dependence on the size of consumer expenditure (Figure 2). Less clearly this dependence may be seen concerning within-group entropy for SLRHD (Figure 4). The most pronounced this dependence is in relation to within-group entropy for SMRHD (Figure 3).

So, coefficient β is 0.1013 for within-group SMRHD entropy dependence on size of consumer expenditure, but the similar coefficient for the group SLRHD — only 0.066. We interpret this as a sign, that functional component of demand has more pronounced influence on structure of consumer expenditure concerning to goods referred to SMRHD, comparing to the goods, distributed to SLRHD.

Concerning the general and between-group, and within-group entropy index dependence on scale of spending the number of observations that lie above and below the trend line has peculiarity of distribution. If the interval of consumer spending's near logarithm of 4 (the level of expenditure at around 10051 USD PPP) number of observations, lying above and below the trend is about the same, then the interval between 4.02 and 4.21 is characterized by obviously prevails observations that are above trend, and after the limit of 4.21 — on the contrary, is clearly greater number of observations that lying below trend.

Thus, among the 37 countries with annual consumption expenditure of household above 16000 dollars per person, 27 have total entropy of consumer spending that is below the trend line. And for the spending scale from 10,051 per year to 16,000 we can see that only 6 of 25 countries have the value of entropy less than expected on trend.

Only 3 countries have the actual value of between-group entropy lies below the trend line among 37 with the highest levels of consumer spending. Only 8 countries have the value of between-group entropy less than the calculated by trend among countries belonging to the group from 38th to the 63-th rank by consumer expenditure (25 countries).

Actual within-group SMRHD entropy for 37 countries with the highest consumer spending is below than calculated by the trend in 19 cases. And only 9 countries among group with 27-th — 52-th rank by consumer spending, have actual value of within-group entropy below than calculated by trend.

So distribution of the total number of observations between zones "above" and "below" of the trend we consider as a mark of important feature of all countries general trend. This trend has averaged three types of entropy dependence on absolute size of consumer spending. The first type of dependence is typical for the countries with the highest consumer spending. It is a gradual decrease of entropy along the increasing of the spending size. The second type of dependence (for the countries with an average size of consumer expenditure) provides that the spending entropy dependence on expenditure size has no pronounced orientation. Finally, the third type (for the countries with the smallest size of household consumer expenditure) provides a fairly pronounced positive correlation between the size of consumer expenditure and consumption expenditure entropy.

Accordingly, we have identified two groups of countries which, in our opinion, are characterized by qualitatively different dependence of consumption basket diversity on the size of consumer spending.

We have formed a group of countries with the first and second types of entropy's dependence on the size of spending consisting 63 countries with highest income (based on income sizes which indicate a border between the types of distribution total number of observation among "above" and "below" line of the trend). Accordingly, we have built functions similar to calculated by the database on all 178 countries but only for the data of 63 countries with highest spending (Figure 5–8, Tables 3 and 4). We expected to reveal, at least — the weakening of empirical evidence, of the positive relationship between increasing income and entropy of consumption spending. As a maximum, we expected the appearance of signs of an inverse

relation between the size of consumer spending and consumption spending entropy.

The sufficient weakening of connection strength between spending size and entropy is the important result for us. Such weakening wouldn't be explained only by reduction number of observation (data of 63 countries were used for modeling instead 178).

Such results were confirmed by all calculated estimation of models parameters: they point to the loss of connection strength between size of spending and entropy of consumption patterns. In other words, the consideration of enough variable vector of spending sizes is required to provide manifestation of such connection, but it was not observed regarding the variety of consumption spending in the richest countries (countries with the highest size of consumption spending).

However, the results obtained in this work have also clarified the following hypothesis: a more blurred connection concerning goods whose consumption plays a relatively smaller role in the formation of human economic potential and less blurred — referring to the goods whose consumption plays a larger role for formation of such potential. Indeed, the explanatory power of models decreased more than expected based on the reduction of the observations number, but a model built on within-group entropy in SLRHD is differ by largest decreasing of connection strength among all models build.

We tend to interpret the empirical data as a sign of qualitative changes occurring in the consumption concerning the increase in the weight of non-functional demand's component as a factor which determines the structure of consumer spending. We believe that the growth of household consumption diversity does not stop after reaching a certain level of income and consumer expenditure, but changes shape.

The spending diversification between categories of goods with different functionality is replaced by diversification between the spending for goods, with different nonfunctional features (affiliation to the brands, direction of fashion, channels and methods of distribution, etc.). Accordingly, instead of functional factors of consumer choice, nonfunctional component of demand (culturally, emotionally, socially determined) has taken effect. Thus, the transformation of functional diversification of household spending into non-functional diversification is occurring and this transformation is accompanied by further increasing of transaction costs and the information burden on consumers.

Accordingly, we tend to hypothesize that the diversification of consumption patterns with rising incomes and consumer spending has continued, keeping the full range of social consequences, although statistics about

the structure of consumer spending by functional classification are not able to show the degree of consumption diversification.

Actually, the clarification of these social consequences and approaches to statistical evaluation of household spending diversity will be subject to more detailed research in our future work.

The simulation results for the second group of countries (115 countries from 64th on 178-th position by size of consumer expenditure) displayed in Figures 9–12 and Tables 5–6. Generally, they confirm the basic thesis about increasing of household expenditures diversification with increasing the size of spending and our clarification about the differences of this trend strength, which inherent to goods from group SMRHD and SLRHD.

For the second group of countries, the results of modeling may be interpreted as a sign that the vast majority of countries from second group have not yet reached a limit of spending size, after which a growth of income (and consumer spending) ceases to be accompanied by an increase in entropy of consumption patterns. For three kinds of entropy indicators, we have observed much better explanatory capacity of models and entropy higher sensitivity to growth in consumer spending than for the first group of countries (countries with highest consumption spending). But the within-group entropy for SLRHD dependence on size of spending is quite different from a similar dependence for within-group entropy SMRHD, total entropy and between group entropy. The near extinction of connection between within-group entropy for SLRHD and size of consumption spending is observed.

Discussion

We have received empirical evidence which is coincident with "three stylized facts about the diversification of demand and their theoretical implications" in the work Chai *et al.* (2014, p. 6). In particular, our result confirmed the third important fact, which is given in Chai *et al.* (2014): The structure of household consumer spending becomes more diversified with the growth of their income.

The sufficient weakening of connection strength between the spending size and the entropy of consumer expenditure was observed. Such weakening, in our opinion, means that the hypothesis of Chai and Moneta (2012) has empirical confirmation: the "saturation of diversity desire" takes place after reaching a certain size of income and connection between spending increasing and diversity growth becomes weaker and even disappears.

However, we have also clarified the hypothesis proposed by Chai and Moneta about erosion of the link between the growth of income (in our study — household spending) and diversity of consumption patterns. The categories of household spending were regrouped (consolidated) by us through forming a group, more related to the development of human economic potential (SMRHD) and less related to this processes (SLRHD). The results obtained in this research confirmed that there is a limit of household spending's size, beyond which further increasing of consumers' economic opportunities at least loses a significant impact on the diversity of consumption patterns. However, the observed phenomenon of weakness of the link between the spending size and its entropy reflects much more radical decreases of influence spending growth on within-group entropy for SLRHD and much less significant decrease of entropy's sensitivity from change in spending size for SMRHD.

Such a phenomenon can be considered as a modern form of continuing the trend known as “second basic fact” about consumer spending patterns (Chai *et al.*, 2014): income growth is accompanied by increasing diversification of consumer spending, and the leading role in this process is played by reducing the share of expenditure on food. The most radical expression of this thesis was the "strong" wording of Engel's Law, "doubling the income of a typical (representative) household is accompanied by a decline in the share of household expenditure on food by 10 percentage points” (Theil *et al.*, 1989).

We tend to consider the obtained empirical evidence as a sign of whether to continue the study of social consequences, caused by empowerment of consumers' purchasing capacity and the extent of using the economic potential, which current level of households spending gives to improve social welfare. In particular, in the context of our hypothesis that growth diversity of household spending does not stop after reaching, a certain level of income and size of expenditure, but changes its shape: Instead of spending diversification between categories of goods with different functionality, diversification between the spending for goods can be observed, with different nonfunctional features (affiliation to the brands, direction of fashion, channels and methods of distribution, etc.). Accordingly, instead of functional factors of consumer choice, nonfunctional component of demand (culturally, emotionally, socially determined) has taken effect.

Accordingly, we tend to hypothesize that the diversification of consumption patterns with rising incomes and consumer spending has continued, keeping the full range of social consequences, although statistics about the structure of consumer spending by functional classification are not able to show the degree of consumption diversification.

Conclusions

The results of our research has confirmed that diversification of consumption patterns with rising incomes and consumer spending has continued even in countries with the highest incomes, keeping the full range of social consequences, although the statistics about the structure of consumer spending by functional classification, are not able to show the degree of consumption diversification.

Upon reaching a certain level of income, the nature of consumer spending diversification has undergone a change. Before achieving this level of income, diversification of consumer spending was primarily functional, and was reflected by fluctuations of shares of different commodity groups, selected on the basis of functional purpose (food and nonalcoholic beverages, clothing and footwear, health, transport, communication, etc.).

After reaching the mentioned limit of income, diversification of consumer spending becomes of "emotional and cultural" nature and can be expressed in proportions of spending distribution between brands, products from different market segments, different technologies, which are used to meet personal needs.

Accordingly, the empirical database of applying research should be adapted for investigation of this kind of consumer spending distribution. Such an adaptation requires information about expenditures distribution not between groups, used in traditional international statistics data, but between different brands, goods belonging to different market segments, products associated with a different ways of life. Such information will reflect the impact of cultural and emotional factors of choice, which replace (at a certain level of income) the factors associated with the need to preserve the ability to generate revenue.

The research has some limitations. The database of this research was formed on indicators reflecting functional distribution of consumer spending's and the mathematical tools, which were used, are quite simple. This didn't allow us to estimate the weakening of impact power for some and strengthening for other factors of consumer's choice in process of replacing the factors, associated with the need to preserve the ability to generate revenue.

The clarification of complex set of social consequences, due to the rising of freedom in individual's expression in the area of consumer choice, and approaches to statistical evaluation of household spending diversify which will be adequate to the new nature of spending diversification will be subject of more detailed research in our future works.

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Annex

Table 1. Models specifications

Explanatory variable	Dependent variables			
The logarithm of the households' individual consumption expenditure per capita (PPP US \$, 2011 prices).	The total (within-group and between-group) entropy of households' individual consumption expenditure - function 1	Between-group entropy of households' individual consumption expenditure of - function 2	within-group (for SMRHD) entropy of households' individual consumption expenditure - function 3	within-group (for SLRHD) entropy of households' individual consumption expenditure - function 4

Table 2. Results of modeling for connection “size of spending – its entropy”, made for all countries

	Function 1		Function 2		Function 3		Function 4	
	parameter	standard error	parameter	standard error	parameter	standard error	parameter	standard error
α	0.2955	0.0408	0.0471	0.0148	-0.178	0.0245	0.4262	0.0286
β	0.1652	0.0108	0.0574	0.0039	0.1013	0.0065	0.0066	0.0076
F	234.65		215.09		244.28		0.753	

Table 3. Models specifications

Explanatory variable	Dependent variable			
The logarithm of the households' individual consumption expenditure per capita (PPP US \$, 2011 prices) for countries with amount of consumption spending exceeding level of 10051 US \$.	The total (within-group and between-group) entropy of households' individual consumption expenditure - function 5	Between-group entropy of households' individual consumption expenditure of - function 6	within-group (for SMRHD) entropy of households' individual consumption expenditure - function 7	within-group (for SLRHD) entropy of households' individual consumption expenditure - function 8

Table 4. Results of modeling for connection “size of spending – its entropy” for countries with highest spending

	Function 5		Function 6		Function 7		Function 8	
	parameter	standard error	parameter	standard error	parameter	standard error	parameter	standard error
α	0.916308	0.17624	0.213419	0.05724	0.126654	0.13649	0.576235	0.147824
β	0.015628	0.04172	0.017017	0.01355	0.028423	0.03231	-0.02981	0.034989
F	0.140		1.578		0.774		0.726	

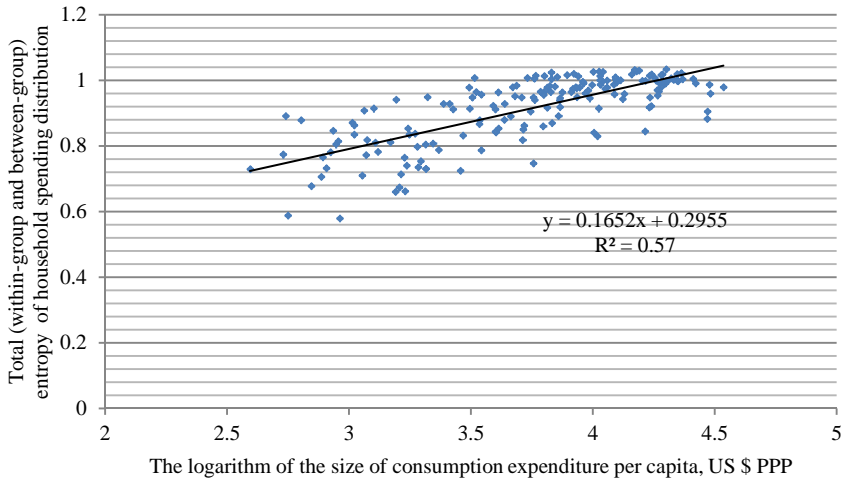
Table 5. Variables specifications

Explanatory variable	Dependent variable			
The logarithm of the households' individual consumption expenditure per capita (PPP US \$, 2011 prices) for countries with amount of consumption spending above level of 10051 US \$.	The total (within-group and between-group) entropy of households' individual consumption expenditure - function 9	Between-group entropy of households' individual consumption expenditure - function 10	within-group (for SMRHD) entropy of households' individual consumption expenditure - function 11	within-group (for SLRHD) entropy of households' individual consumption expenditure - function 12

Table 6. Results of modeling for connection “size of spending – its entropy” for countries with lower spending

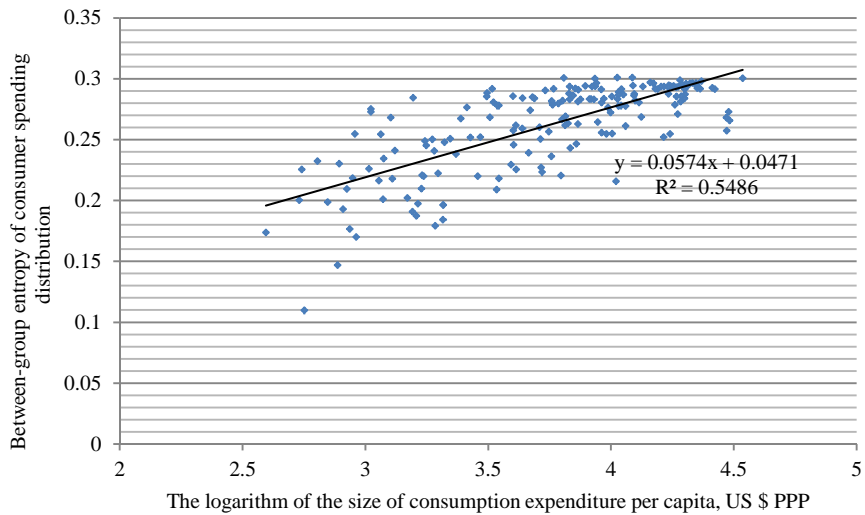
	Function 9		Function 10		Function 11		Function 12	
	parameter	standard error	parameter	standard error	parameter	standard error	parameter	standard error
α	0.149417	0.06453	-0.00326	0.02418	-0.22831	0.03716	0.380985	0.04529
β	0.20861	0.01837	0.07237	0.00688	0.116187	0.01058	0.020053	0.012892
F	128.975		110.58		120.65		2.419	

Figure 1. Linear regression for link "the absolute size of household spending — a measure of diversity of consumer spending (total entropy)"



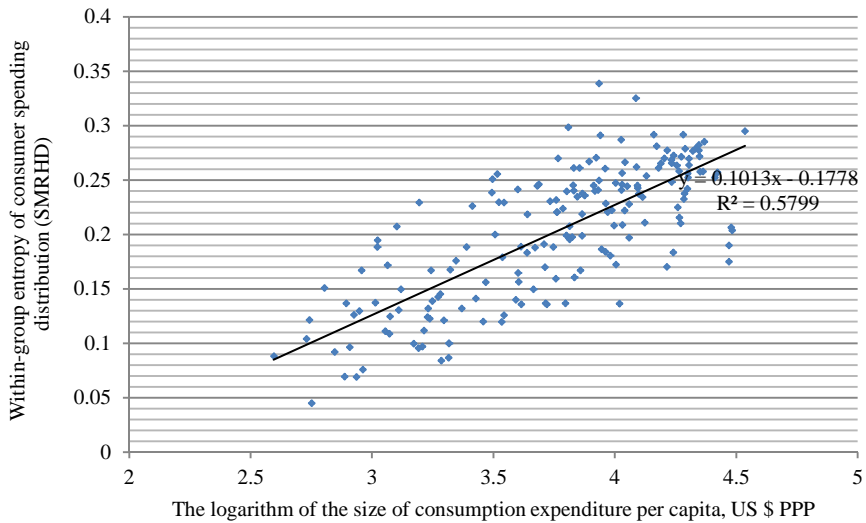
Source: own calculations based on ICP data.

Figure 2. Linear regression for link "the absolute size of consumer spending — a measure of diversity of consumer spending (between-group entropy)"



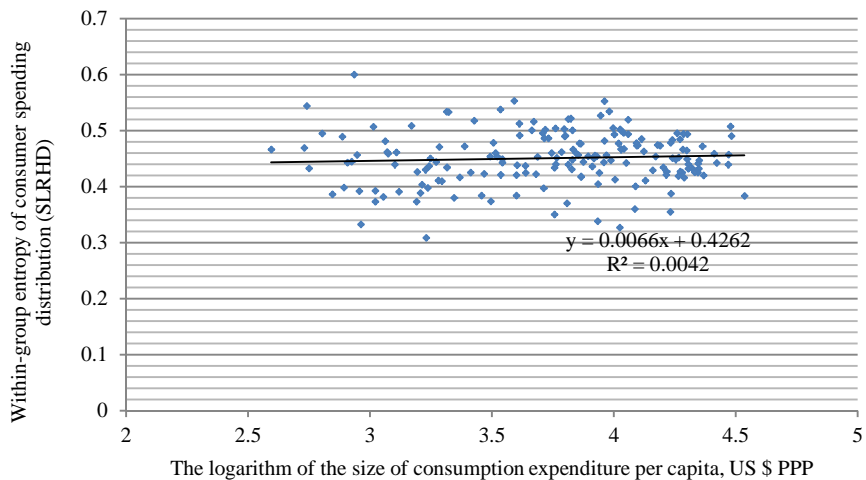
Source: own calculations based on ICP data.

Figure 3. Linear regression for link "the absolute size of consumer spending — a measure of diversity of consumer spending (within-group entropy for SMRHD)"



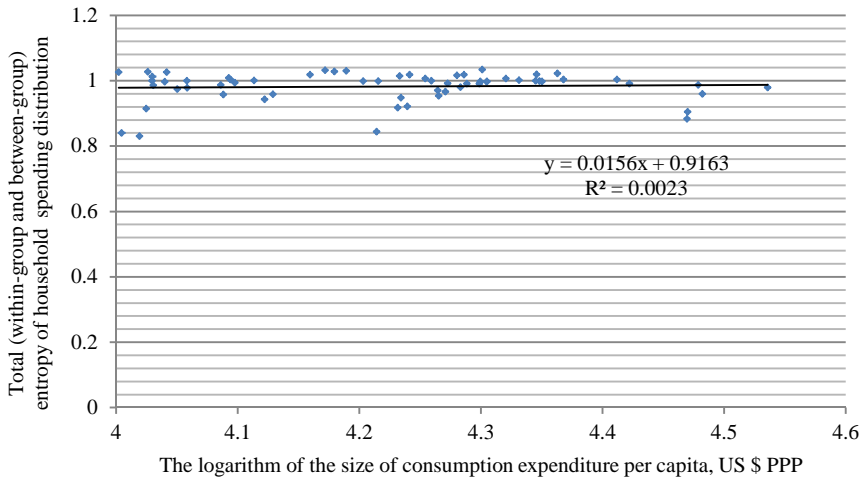
Source: own calculations based on ICP data

Figure 4. Linear regression for link "the absolute size of consumer spending — a measure of diversity of consumer spending (within-group entropy for SLRHD)"



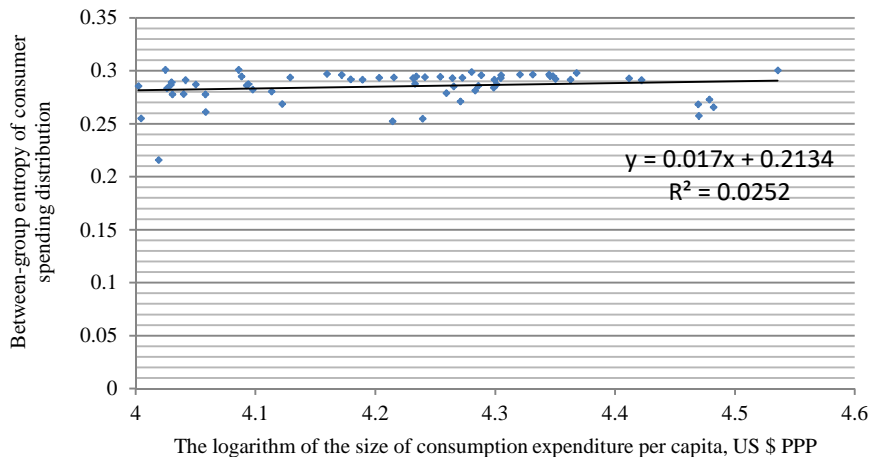
Source: own calculations based on ICP data.

Figure 5. Linear regression for link "the absolute size of consumer spending — a measure of diversity of consumer spending (total entropy)" for 63 countries with highest household spending



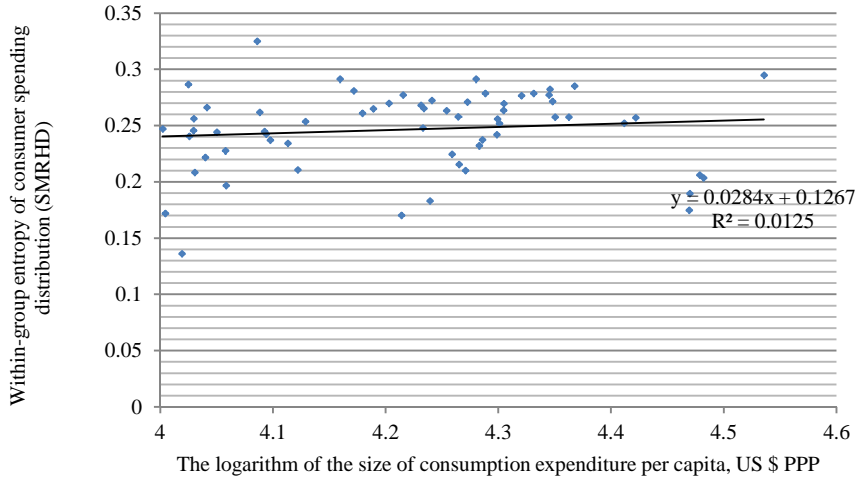
Source: own calculations based on ICP data.

Figure 6. Linear regression for link "the absolute size of consumer spending — a measure of diversity of consumer spending (between-group entropy)" for 63 countries with highest household spending



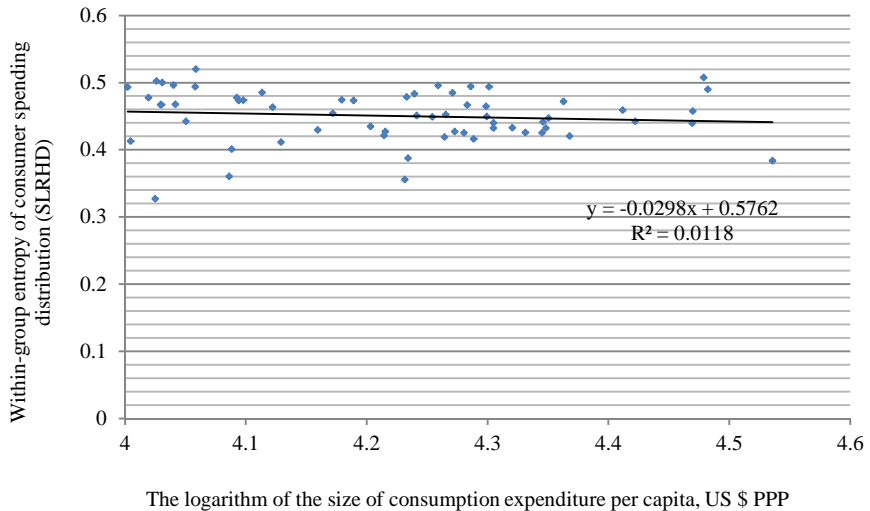
Source: own calculations based on ICP data.

Figure 7. Linear regression for link "the absolute size of consumer spending — a measure of diversity of consumer spending (within-group entropy for SMRHD) for 63 countries with highest household spending



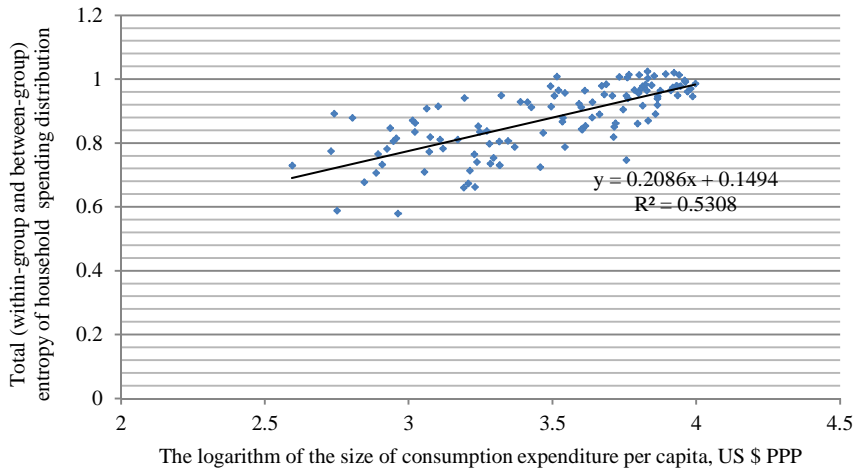
Source: own calculations based on ICP data.

Figure 8. Linear regression for link "the absolute size of consumer spending — a measure of diversity of consumer spending (within-group entropy for SLRHD)" for 63 countries with highest household spending



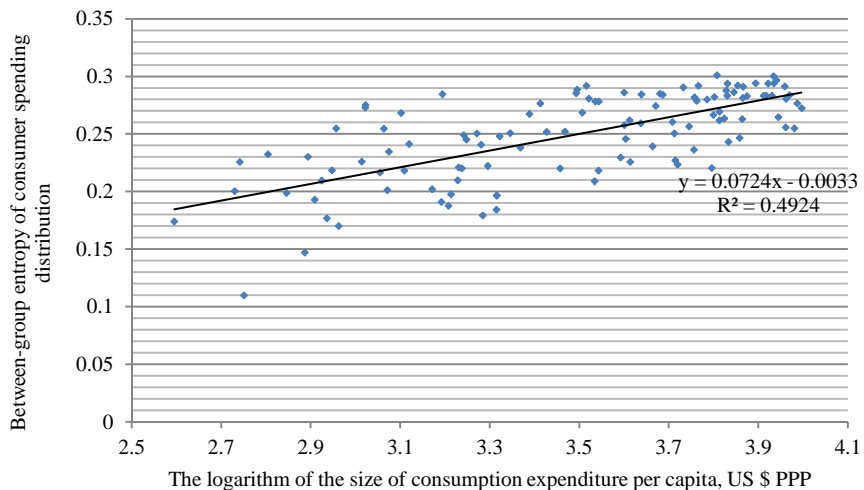
Source: own calculations based on ICP data.

Figure 9. Linear regression for link "the absolute size of consumer spending — a measure of diversity of consumer spending (total entropy)" for 115 countries with lowest household spending"



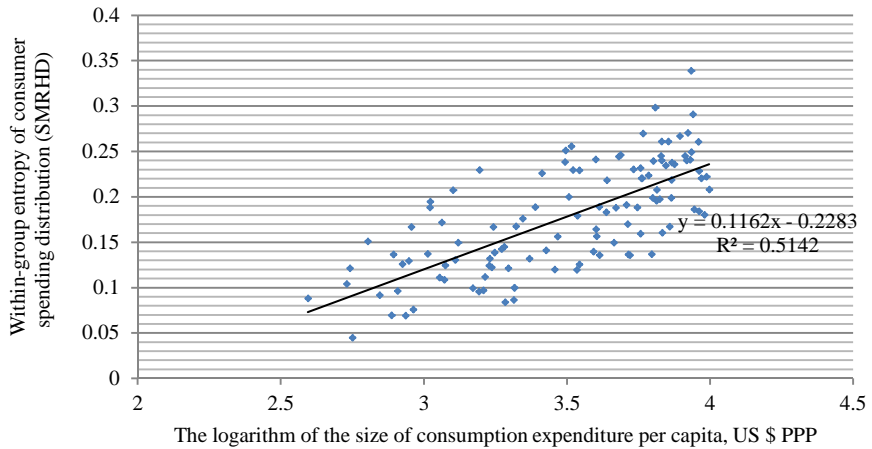
Source: own calculations based on ICP data.

Figure 10. Linear regression for link "the absolute size of consumer spending — a measure of diversity of consumer spending (between-group entropy)" for 115 countries with lowest household spending"



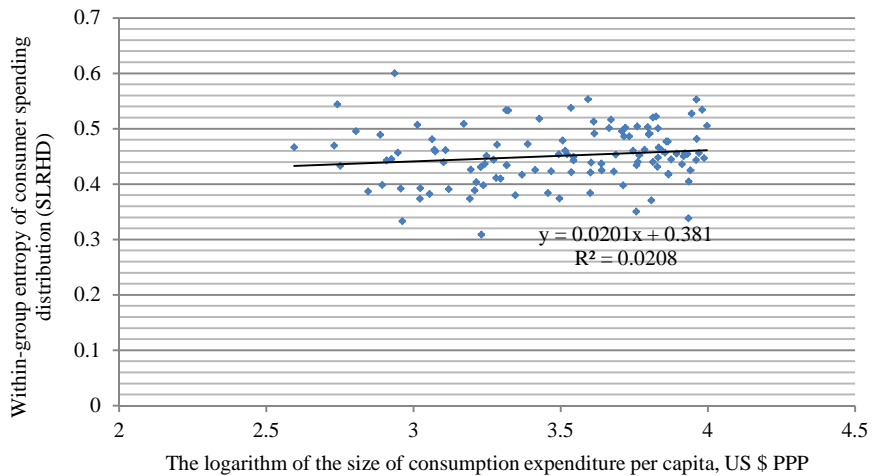
Source: own calculations based on ICP data.

Figure 11. Linear regression for link "the absolute size of consumer spending — a measure of diversity of consumer spending (within-group entropy for SMRHD)" for 115 countries with lowest household spending



Source: own calculations based on ICP data.

Figure 12. Linear regression for link "the absolute size of consumer spending — a measure of diversity of consumer spending (within-group entropy for SLRHD)" for 115 countries with lowest household spending



Source: own calculations based on ICP data.