European Research Studies Journal
Volume XXIV, Special Issue 1, 2021

pp. 248-268

Microeconomic Consequences of Urban Sprawl: A Quasi-Experimental Research on Household Budgets in Poland

Submitted 23/01/21, 1st revision 11/02/21, 2nd revision 03/03/21, accepted 20/03/21

Piotr Lityński[1]

Abstract:

Purpose: *The article focuses on the microeconomic aspects of urban sprawl. The aim of the article is to propose a method of analyzing household budgets in terms of identifying gains and losses in urban sprawl. The hypothesis is that urban sprawl has a beneficial effect on the financial condition of households causing the phenomenon.*
Design/Methodology/Approach: *The research proposed a quasi-experimental approach distinguishing three stages: (1) Identification of a sample of households causing urban sprawl through questionnaire research. The questionnaire, based on PAPI method, was conducted by professionals. (2) In the databases purchased, identification of households like the sample. The financial databases of households were purchased from Central Statistical Office, Poland. Methods used: T-Test and the Gamma coefficient. (3) Comparison of identified households in the databases to the control group. The Standardized Mean Difference method and the basic income burden ratio were used.*
Findings: *The study do not confirm the hypothesis. The net costs and benefits balance shown a significant dominance of costs, i.e., 2 categories of benefits were identified, leisure and education. 16 costs were also identified, including 5 moderate, 7 large, 4 very large.*
Practical Implications: *Research findings can provide economic and social justification for public intervention in the field of urban sprawl. Research results can also form the basis for a system for monitoring the socio-economic consequences of urban sprawl.*
Originality/Value: *The conducted research does not confirm literature, as the daily operations costs are lower in rural areas than in the city center. On the contrary, it has been proven that the costs of day-to-day operation of an urban sprawl household are associated with large financial losses, especially connected to the house maintenance (sewage, heating, water, electricity, waste disposal, property repairing).*

Keywords: *Urban sprawl, spatial development, households, budgets, benefits, costs.*

JEL: *D14, G51, R14, R21, R51.*

Paper type: *Research study.*

Funding: *This work was supported by the National Science Centre, Poland under Grant no. UMO-2016/23/D/HS4/02961, ("Financial Mechanisms in the Economy Resulting from the Phenomenon of Urban Sprawl"). Spatial data: Central Center for Geodetic and Cartographic Documentation, Poland - license DIO.7211.511.2017_PL_N. Statistical data: Central Statistical Office, Poland - contract 7/GUS-DI01.601.97.2018MK.*

[1]*Cracow University of Economics, College of Public Economy and Administration, ORCID: 0000-0002-1400-5545, e-mail: litynskp@uek.krakow.pl*

1. Introduction

Several effects of urban sprawl have been discussed in academic literature in some detail, however, the most contentious issues can be reduced "to an older set of arguments, between those advocating a planning approach and those advocating the efficiency of the market" (Chin, 2002). Those who criticize sprawl tend to argue that sprawl creates more problems than it solves and should be more heavily regulated, while proponents argue that markets are producing the economically most efficient settlements possible in most situations, even if problems may exist.

However, some market-oriented commentators believe that the current patterns of sprawl are in fact the result of free market failures (Brueckner, 2000). The economic consequences of urban sprawl have already been discussed in literature since the beginning of the 20th century (Mumford, 1961). The economic costs are first and foremost, the increase of public expenses covering construction, extension, and maintenance of infrastructure and public services, extended commuting distance; the consumption of energy and market-related negative influence on the city centre (McHarg, 1969; RERC, 1974; Jackson, 1985; Downs, 1994; Bank of America, 1995; Fulton *et al*., 2002; Brueckner and Largey, 2008; Morelli and Salvati, 2010; Daneshopur and Shakibamanesh, 2011; OECD, 2012). The negative impact of sprawl on household budgets is associated mainly with the extension of the use of cars. Economic consequences of the phenomenon manifested in the increased number of vehicles per household, which led to an increase expenditure on fuel, insurance, maintenance of vehicles, the periodic purchase of new vehicles (Young *et al*., 2016).

On the other hand, urban sprawl should also be studied from the perspective of potential economic advantages. Such benefits have been noticed along with the development of mobile professions, meaning- working professionally in more than one city, the development and increasing economic importance of the Internet and other means of telecommunication. The above-mentioned conclusions are predominantly drawn during studies based on the principles of a polycentric city. Such opinions are formulated in the case when appropriate residence density (not always of high rate) is an optimum solution to land use policy which may require the expansion of city boarders- not a restrictive approach (Anas and Rhee, 2007; Anas, 2012). What more, O'Toole (2009) has argued that sprawl, thanks to the automobile, gave rise to affordable suburban neighborhoods for middle class and lower-class individuals. He notes that efforts to combat sprawl often result in subsidizing development in wealthier neighborhoods while condemning and demolishing poorer minority neighborhoods.

The microeconomic approach to urban sprawl valuation is related to the assessment of net marginal costs of households (Gordon and Richardson, 1996; Brueckner, 2000; Wassmer, 2002). This pertains to additional costs of households resulting from the location decision in suburbia. This point of view reveals the need to assess the microeconomic costs and benefits of urban sprawl to households to demonstrate the

effectiveness of sprawl. But the microeconomic consequences of sprawl are hard to be clearly evaluated because the benefits collide with the problem of costs (Chin, 2002; Wassmer, 2002). The problem arises from individual and subjective assessment of costs and benefits by households. That is why the implications of urban sprawl are dominated by a macro- or mezzo-economic viewpoint; the microeconomic level is seldom analyzed.

The aim of the article is to propose a method of analyzing household budgets in terms of identifying microeconomic net costs and benefits of urban sprawl. The materials and method used are universal in Polish conditions, and the exemplification was carried out based on households causing urban sprawl around Cracow - the second largest city in Poland. The research is based on the assumptions of quasi-experimental approaches, the results of which will enable the possibility to use in further research based on a larger number of cities in Poland. Hence, the general hypothesis was not formulated with reference to Polish urban sprawl, but to the city of Cracow, as this area was subject to empirical verification. In honoring this research assumption, the hypothesis is: urban sprawl has a beneficial effect on the financial condition of households causing the phenomenon.

2. Current State of Knowledge

Assessing urban sprawl based on the identification of household costs and benefits forces an understanding of microeconomic mechanisms. These mechanisms concern the interpenetrating economic categories of the functioning of the household: preferences and maximization of utility in terms of the place of residence, as well as budget constraints and possibilities. These mechanisms, apart from population growth and weakness in spatial policy, are one of the most important determinants of urban sprawl (Bhatta, 2010; Daneshopur and Shakibamanesh, 2011).

The problem of consumer preferences is related to the desire to maximize utility. Preferences are the pursuit of satisfying one's own needs and reflects tastes and preferences. The choice is influenced by factors such as age, family condition, taste, level of education, existential needs, socio-economic development and, above all, budget constraints. A household, having limited financial resources, must compare the usefulness of various goods and their combinations, and then select those that will give it the greatest satisfaction (O'Sullivan, 2012). Household preferences play a significant role in the emergence of urban sprawl, and therefore the premises related to utility categories and financial constraints can be classified (De Vos *et al*., 2016). Among the efforts to maximize utility, the following factors can be mentioned as urban sprawl: the drive to enlarge the living space of households; preferences for living in single-family houses and preferences for a rural location. On the other hand, factors related to budgetary constraints can be grouped into those relating to financial opportunities related to revenues and the potential to incur liabilities; the level of locally discharged public tributes, the costs of daily operation and purchase of real estate, and the lack of affordable housing in the city center.

Maximizing the utility of households from a suburban location is primarily associated with the desire to enlarge the living space. De Vos *et al*. (2016) describes this mechanism as a linear-development model. In the objective, and sometimes subjective assessment of the households of the core city, the space of their functioning related to the surface of a flat, house, plot and surroundings may be insufficient - which influences the decision to relocate to suburbia and expand development in rural areas.

Households, with the same budget, can purchase more of this space in the suburban area than in the city center, which results from lower costs of suburban real estate. At the same time, the large size of the plots of land purchased is usually the reason for the extensive development of suburbia land (Acioly and Davidson, 1996). The group of factors that maximize utility also includes the preferences of households to live in single-family houses. Nowadays, households report a higher degree of preference for living in single-family houses than in multi-family. Bhatta (2010) notes that in many countries there has been a transformation in family life, which is associated with a departure from the model of joint functioning of many generations of a family in one larger house for smaller ones for a single family. These preferences create a new demand for residential properties located in suburban areas, which shifts the boundary of urban sprawl. The preferences of living in the suburban area are also explained by another model, the so-called a systemic model that results from the anti-urban values of residents (De Vos *et al*., 2016).

Some city dwellers prefer a higher level of peace, quiet and solitude and perceive the rural lifestyle as meeting these criteria. Considering the costs associated with congestion and longer travel time to work, they decide to relocate to the suburbs, materializing the suburban location and then urban sprawl. Therefore, Barnes *et al*. (2001) show that if the living conditions in cities do not approach residential ones, this perception will not change, and spontaneous suburbanization will continue in the municipalities surrounding the city.

Consumers' preferences to achieve higher residential utility are verified by financial possibilities. Household incomes are among the primary budget constraints (Mattingly and Morrissey, 2014). From an income point of view, the city's administrative boundaries do not play a significant role. Both the labor market and the markets for goods and services are not limited by them. The basic role is played by the household remaining within the city's influence area. The larger it is in economic terms, the more strongly it affects the labor market in terms of the number and quality of jobs and the level of salaries (O'Sullivan, 2012). At the same time, the so-called the spill-over effect, related to the salaries maintained at a similar level to the core city (Hołuj, 2018). Thus, if transport costs associated with longer journeys are acceptable to entities, and household incomes do not significantly change due to relocation to suburbs, and urban sprawl continuously grow.

Financial possibilities, which include income, are supplemented with the ability to incur, and pay off liabilities. Here, in turn, the factors of urban sprawl are the

availability of external financing for the purchase of real estate, including access to mortgage loans and their low interest rates (De Decker, 2011; Hamidi *et al*., 2016). The development of mortgage banking is also attributed to the group of reasons for the dynamic development of urban areas (Bhatta, 2010). In this sense, households and businesses can purchase real estate before they have accumulated the financial resources to buy it; and the spatial growth of cities occurs in advance, i.e., before the funds are generated in the area's economy. The mortgage market is of great importance for the development of the economy and cities. Properly developed credit mechanisms dynamize the development of cities, allowing society to secure living conditions earlier. In turn, pathological credit mechanisms may result in a spatial crisis in the form of abandoned and uninhabited districts, i.e., some suburban neighborhoods in Spain and even a financial crisis on an international scale, i.e., subprime loans in the USA, which initiated the financial crisis in the first decade of the 21st century (Rosenblatt and Sacco, 2017).

Budget constraints of real estate consumers are also determined by the level of local public levies, i.e., taxes and fees (Ermini and Santolini, 2017). It should be noted that costs per capita related to social and technical infrastructure and public services are higher in suburbs than in cities. It is similar with the costs of the current maintenance of this infrastructure (Hortas-Rico, 2013). For this reason, it is recognized that the taxation of entities located outside the city should be higher to cover infrastructure costs. However, it turns out that the amount of tax rates does not depend on the specificity of the commune's spatial structure, and in many cases the taxes turn out to be lower in rural communes than in core cities. At the same time, the problem of the local tax system is the lack or low level of development levies imposed on investors who develop land (Brueckner and Kim, 2003). The lack of coverage by public levies of the costs of infrastructure development, should be led to new construction investments. Infrastructure costs are transferred to the local government, which is obligatorily compelled to meet the needs of local communities. In this light, for investors, the costs of building real estate in the suburbs turn out to be limited only to projects carried out on the plot of land owned, without considering the necessity of its connection with the surroundings. Therefore, the lack of inclusion of infrastructure costs in the investment costs of entities implementing construction projects generates extensive built-up growth in urban areas.

The group of factors related to budgetary constraints also includes the current costs of everyday functioning of households, the purchase of real estate and the lack of financially accessible houses in city centers. In general, the living costs related to the daily functioning of the household and the costs of purchasing real estate are lower in rural areas than in the city center, which encourages the choice of a suburban location (Ewing and Cervero, 2010). Most often, residents of urban areas look for a location in the city, but lower operating and real estate costs encourage them to locate in a rural site. In parallel to the relatively low cost of suburban real estate, there is a problem of the lack of affordable real estate for households in a central city (Kane *et al*., 2014). Financial availability in the context of the processes of spontaneous suburbanization

is understood as the amount of expenses for the purchase and maintenance of real estate available to a middle-income household. The lack of affordable real estate in the city that would meet the expectations of average households in terms of area and quality, encourages people to settle in rural areas that are under the economic influence of the central city (Mattingly and Morrissey, 2014).

The budgetary consequence of living in suburbs for households is also higher transport costs. The spontaneous location of buildings, causing the extension of the distance from the suburbs to the center, also results in more frequent use of the car for traveling, and consequently higher fuel consumption and excessive congestion (Travisi *et al.*, 2010; Young *et al*., 2016). In areas with low density of buildings, a greater number of vehicles per household was observed, which results in higher expenses in the scope (Litman, 2020), fuel, insurance, vehicle maintenance and periodic purchase of new vehicles. On the other hand, research by Anas (2012) indicates that sprawl may not always have a negative effect on household communication costs. In his research, the average vehicle use may be reduced due to the adaptation of the workplace location and the development of public transport.

The financial decisions of suburban households can also be explained through the prism of the Veblen paradox and the bandwagon effect. The essence of the Veblen paradox is the desire to stand out, impress the environment, arouse jealousy, build individuality, and luxury goods make it possible to achieve such a state. Hence, in the paradox' assumptions, the higher the price for a specific luxury good, the higher the level of demand for the good. One variation of the Veblen paradox regarding consumer goods is the bandwagon effect. With this effect, consumers buy some goods simply because others buy them. The increase in the availability of consumer loans, credit cards, and installment purchase forms means that these goods are often purchased on credit. This is due to the desire to imitate people with whom households want to identify. Consumers' decisions are not based on their individual preferences, but rather on the influence of other people, social trends, or local fashion.

3. Materials and Methods

The aim of the study is to identify the financial consequences for households functioning in urban sprawl conditions. The research method is based on a quasi-experimental approach, which can be used, inter alia, synthetic control method (Swianiewicz and Łukomska, 2017). The essence of such research is the identification of a control group, i.e., an abstract construct against which the consequences of the studied phenomenon are assessed. The research may therefore be based on comparing the income and expenditure of households living in urban sprawl areas with that of a control group.

The operationalization of the adopted research method is associated with two main research problems. The first problem is the identification of urban sprawl in public statistics. Polish statistics lack precise financial data for households causing urban

sprawl. The most precise data is provided payable by the Central Statistical Office, Poland (CSO), and it is a base from the Household Budget Survey (HBS). This database collects data from the annual survey, in which selected households write their income and expenses in special books. These are therefore precise figures. This database allows to filter respondents in terms of many categories. From the point of view of urban sprawl, interesting categories can be found, e.g., the year of construction of the house. Nevertheless, a limitation of the collection is the inability to indicate a specific location of the household. Location designation is limited to six categories of localities in relation to the population, i.e., over 500k; 200-499k; 100-199k; 20-99k; below 20k; village. Thus, the research proposed to first conduct a dedicated survey among households causing urban sprawl for a selected urban area, and then search for a group of households with a similar profile to the respondents in the HBS databases.

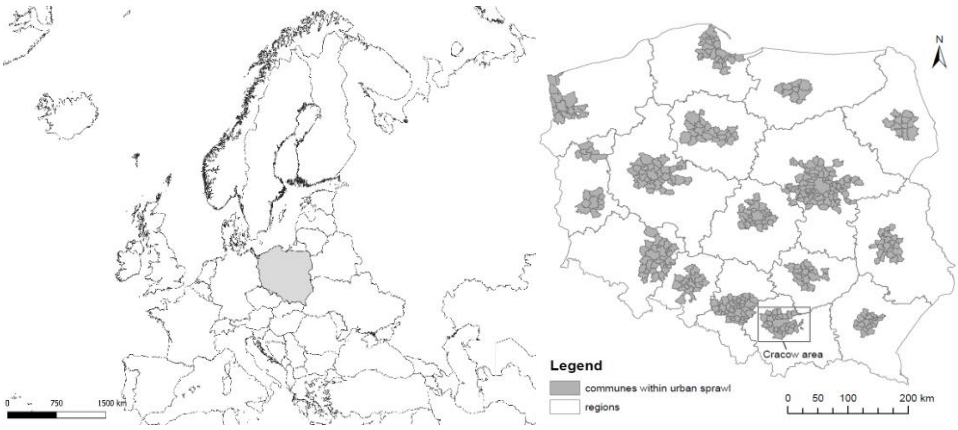
The second problem is to define the control group, i.e., against which the previously identified households should be compared. The mechanism of household preferences and maximization of utility in terms of the place of residence, as well as budgetary constraints and financial possibilities seems to be of importance here. For the selection of the control unit, identifying those households that have chosen to be in a new house/apartment in the city instead of living in a new house in the sprawl zone. So, the control group can be selected as core city households.

The adopted research method honors the operationalization problems, which relates to the necessity to implement three stages.

The first stage is a survey among households that cause urban sprawl in the area surrounding the city of Cracow, Poland. The research area is illustrated in Figure 1. Stage one aims to identify a sample of households and their finances. Such a sample will be the basis for the search for a group of households with a similar profile in the official statistics of the HBS. Thus, the first stage concerning the identification of households causing urban sprawl was made based on two address databases of the Central Center for Geodetic and Cartographic Documentation, Poland (CCGCD) for the years 2015 and 2017. The addresses of households that live in new buildings in suburbs were selected, i.e., those that appeared in the 2017 database, and which were not there in 2015. Thus, from the database of 518 addresses, 120 addresses were randomly selected.

The substantive scope of the survey concerned household income and expenditure. The structure of questions in the questionnaire corresponded to the structure of questions in the annual HBS, which will be used in the second stage of the study. The structure of the household income and expenditure surveyed is presented in Annex 1. The questionnaire in this stage was conducted in the period August-September 2018 by 7 people with professional experience at the CSO in the field of collecting financial data. The study was conducted using the PAPI method.

Figure 1. *Research area: Cracow and surrounding communes within urban sprawl, Poland*



Source: *Own study based on Lityński and Hołuj (2020)*

The second stage is searching in the purchased HBS financial databases of households' representative of those causing urban sprawl. The objective of this stage is to search for such households in the HBS databases that would be like the sample identified in the first stage. Thus, in the second stage for 2016, households from the Małopolska region were finally selected from HBS, which, apart from being in the outer zone of Cracow City, jointly meet the following conditions:

- house/apartment construction period after 2007 (HBS code is "D5_5: 6.7");
- income from non-agricultural activities (HBS code is "GRS: 1,3,4,5");
- located in communes with a population below 20k inhabitants, in villages and communes with a population of 20-99k (HBS code is "KLM: 4,5,6").

The second stage is also a comparison of the income and expenditure of the sample households with the finances of the households surveyed in the first stage. In this way, it is possible to identify those household incomes and expenditures in public statistics that can be attributed to households causing urban sprawl. The comparison of household finances from the sample with households of the HBS was carried out based on the T-Test and the Gamma coefficient (Siegel and Castellan, 1988). A total of 70 analyzes were performed. Furthermore, attention should also be paid to the difference in the data periods taken for comparison. At the time of the study, it was not possible to use a different set of variables. As the survey was conducted in the summer of 2018, and the data from the Central Statistical Office refers to January 2016, the HBS collection was updated to compare the two sets. The data on wage and inflation growth published annually by the CSO were used. The third stage uses only the HBS database and consists of comparing selected income and expenditure of households causing urban sprawl (from stage two) with the control group, i.e., similar households located

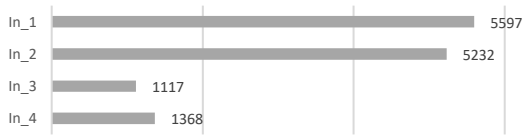
in Cracow, Poland. The purpose of the third stage is therefore to identify the net costs and benefits in the functioning of households in urban sprawl area. The selection of households for the control group was determined by two criteria: a house/apartment built after 2007, income from non-agricultural activities. The rationale for both criteria is mentioned in theory, the mechanism of household preferences and utility maximization in terms of the place of residence, as well as financial constraints and possibilities. Those households were selected which, instead of living in a new house in the sprawl zone, chose a location in a new house in the city. A new house in this case means a building built after 2007.

The comparison of both sets was made using the Standardized Mean Difference method (SMD) (Livingston *et al*., 2009). In the SMD method, the net effect is assessed in the following ranges: 0 is no effect; 0–0.2 small; 0.2-0.5 moderate; 0.5-0.8 large and statistically significant; >0.8 very high. When SMD occurs with "+" then the effect is assessed positively as net benefit, and when it occurs with "-" it is assessed negatively as net cost. Additionally, for the assessment of net cost/benefit, the basic income burden ratio (Π) was proposed. In a situation where a net cost is identified, this indicator shows the percentage ratio of loss to income, while when a net benefit is identified, referencing its effectiveness in relation to household income.

4. Results and Discussion[2]

The results of the first stage are presented in Figures 2 and 3. Figure 2 shows the average monthly income achieved by the questionnaires of the households. The highest income is obtained from contract work (In_1) PLN 5,597. Nevertheless, income from own business activity (In_2) is slightly lower, by 7% and amounts to 5,232. Some of the households causing urban sprawl also to have other income, such as renting real estate (In_4), which most often constitute an apartment in a city before they moved to the sprawl zone. For these households, this income is significant as it amounts to 24% in relation to the basic income. Moreover, the budget of these households is significantly supplied by social benefits (In_3) at the level of 20% in relation to the basic income.

Figure 2. *Average monthly household income in the sprawl zone based on the questionnaire (M_{Qu}) in PLN, 2018.*

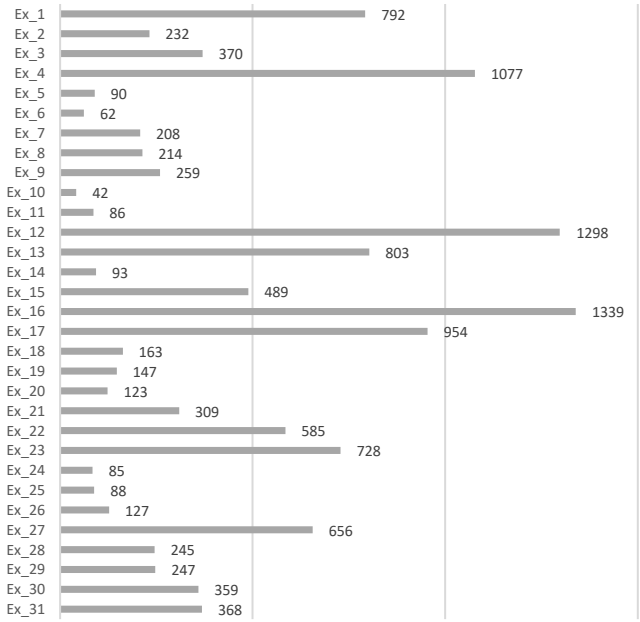


Source: *Own study*

[2]*Income and expenditures presented net in the Polish currency of PLN. During the research period, the rate of 1€ = 4.27 PLN; 1$ = 3.68 PLN (National Bank of Poland, 2020)*

Figure 3 shows the average monthly expenditure of the households. The highest expenses, which are the mortgage loans (Ex_16), amounting to PLN 1,339, and heating the house (Ex_12), amounting to PLN 1,298. Those households that do not own a house also make high level of rental expenses (Ex_4), which amount to PLN 1,077. It should therefore be noted that the highest expenditure of households causing sprawl zone is related to the maintenance of the house. A detailed overview of the means, response rates and standard deviation for the questionnaire results is provided in Annex 2.

Figure 3. *Average monthly household expenditures in the sprawl zone based on questionnaire (M_{Qu}) in PLN, 2018.*



Source: *Own study*

The results of the second stage of research are related to the use of the T-Test and the Gamma. Thus, two hypotheses are statistically tested. The zero hypothesis is that the average of the questionnaire is the same as the average of the HBS databases (H_0: $M_{Qu}=M_{SZ}$). The alternative hypothesis is that the mean of the average of the questionnaire differs from the average of the HBS databases (H_1: $M_{Qu}\neq M_{SZ}$). The incomes and expenditures for which H_0 is met are sought. Annex 2 contains the results of the T-Test and the Gamma. The research results can be divided into three groups.

The first group includes income and expenditures for which the application was withdrawn due to insufficient number in the HBS database (N_{SZ}). They are: In_4, Ex_4, Ex_6, Ex_9, Ex_15, Ex_20, Ex_23.

The second group includes expenditures for which the value of the test verifies homogeneity of variance is greater than 0.05 ($Ver._{SD}^2$), which does not give grounds for rejecting H_0. At the same time, the probability of the T-Test for these variables is less than 0.05 (p). This means that for these variables the alternative hypothesis H_1 is positively verified, i.e., the average between the questionnaire and the HBS differ significantly. From the point of view of the research procedure, these expenditures are also omitted in further analyzes and they are: Ex_2, Ex_18, Ex_25.

The third group is the incomes and expenditures for which ($Ver._{SD}^2$)>0.05, (p)>0.05 and Gamma is high, which means that the H_0 hypothesis is positively verified. This group of incomes and expenditures is considered similar, which, from the research point of view, allows it to be considered in the next stage. In the income group, these are: In_1, In_2, In_3. In the group of expenses, these are: Ex_1, Ex_3, Ex_5, Ex_7, Ex_8, Ex_10, Ex_11, Ex_12, Ex_13, Ex_14, Ex_16, Ex_17, Ex_19, Ex_21, Ex_22, Ex_24, Ex_26, Ex_27, Ex_28, Ex_29, Ex_30, Ex_31.

Annex 3 lists those incomes and expenditure variables that are subject to research in the third stage, i.e., identification of the net costs and benefits in functioning of households in sprawl zone. Annex 3 contains statistics only for data purchased from HBS.

Regarding household income, it can be assessed that they are the same in the light of SMD. The analyzed income is in the range (-0.2; +0.2). Income is therefore independent of the place of residence, and the inhabitants of the suburban area often work in the core city, earning the same salary as households in Cracow. This is confirmed by the current state of knowledge, where it is indicated that from the income point of view, the administrative boundaries of the city do not play a significant role (O'Sullivan, 2012; Mattingly and Morrissey, 2014). Both the labor market and the markets for goods and services are not limited by them, and the basic role is played by the household remaining in the city's area of influence.

Using the SMD method, it is possible to identify the net costs and benefits of living in sprawl zone, but also the expenditures for which the differences are not significant.

Two profits from living in the sprawl zone were identified and they are: Ex_30, which is expenditure on leisure, and Ex_31, which is expenditure on education. As the SMD of both variables is in the range (0.2; 0.5), it can be concluded that the benefit is moderate, i.e., on average, suburban households spend less on leisure and education. In relation to income, the profit in leisure expenses gives a benefit of 3.7% of income (Π), and in the case of education, 1.9% of income. These results are therefore a financial expression of benefits for some households that reported preferences for living in the suburban area. These areas provide opportunities not only for living, but also for relaxation, which leads to savings in the household budget. These factors are recognized in the literature (Acioly and Davidson, 1996; Barnes *et al*., 2001; Bhatta,

2010; De Vos *et al*., 2016). The added value of the presented research results is the valuation of these benefits, which are not high but still noticeable.

However, a greater group of effects than benefits are net financial costs for households from functioning in the sprawl zone. 18 expenditure variables were identified that can be assessed as unfavorable for household budgets. Considering the ranges against which the effects of the SMD method are assessed, the tested costs can be divided into three main groups. The first group of costs can be assessed as moderate, because SMD is in the range (-0.2; -0.5). There are 5 types of expenditures:

1. Clothing (Ex_3: SMD = -0.21),
2. Electronic equipment (Ex_27: SMD = -0.26).
3. Phone bills (Ex_26: SMD = -0.27),
4. Car repairs (Ex_22: SMD = -0.30),
5. Consumer loans and credits (Ex_17: SMD = -0.50).

In this group of net costs, particular attention is paid to expenditure on the repayment of consumer loans and credits, which burden the household budget to a significant extent. The average expenditure of households in the sprawl zone is over 1k PLN per month, which creates a loss of over 9.3% in relation to income (Π). These expenditures are twice as high as in the households of the control group. These data indicate the Veblen paradox and bandwagon effect. The specificity of the functioning of households in the sprawl area results in this case in the desire to stand out and impress the neighbors. Another part of sprawl society wants to imitate such families and identify with them. As a result, we observe a much higher level of purchases on credit by households in sprawl zone than by city households. The second group of net costs can be assessed as large and statistically significant, because SMD is in the range (-0.5; -0.8). There are 7 types of expenditures:

1. Property maintenance (Ex_13: SMD = -0.53),
2. Food (Ex_1: SMD = -0.56),
3. Restaurants (Ex_29: SMD = -0.58),
4. Bus tickets (Ex_24: SMD = -0.60),
5. Garbage collection (Ex_10: SMD = -0.70),
6. Electricity (Ex_8: SMD = -0.75),
7. Sports and recreation (Ex_28: SMD: -0.78).

These net costs are large in relation to the control group. Although each of the subsequent losses does not seem to be high in nominal terms, they collectively constitute a significant additional burden on the sprawl household budget. Particular attention is paid to losses in food, for which Π = 3.4%. These results indicate that sprawl households, due to their distance from retail outlets, make larger purchases for stock. Often, in such a situation, part of the food is wasted or leads to an inappropriate diet. Moving by car instead of walking, combined with a poor diet, can lead to obesity. Such a situation of the sprawl community is indicated by OECD analyzes (2018). In

this light, attention is drawn to high expenses, and consequently financial losses, of the sprawl households in the field of sports and recreation, where Π = 2.7%. These losses therefore appear to be another cost of a suburban lifestyle. The third group of net costs can be assessed as very large, because SMD exceeds (-0.8). There are 4 types of expenditures:

1. Taxes on real estate (Ex_14: SMD = -1.11),
2. Sewerage (Ex_11: SMD = -1.21),
3. Heating (Ex_12: SMD = -1.29),
4. Cold water (Ex_5: SMD = -1.35).

It should be noted that these costs result from households spending more than twice as high as in the city. Apparently, these losses do not significantly burden the household budget if we consider each variable separately (Π=~1%). When we note, however, that each of the losses mentioned concerns in fact one category, ie property expenses, and additionally, in the other group, variables; Ex_8, Ex_10, Ex_13 also relate to property maintenance, the losses of sprawl households in property turn out to be very large. Summing up these losses, exceed 5.3% of monthly income. The presented results seem to contradict the suburban lifestyle perceived in literature as more economical (Ewing and Cervero, 2010; Kane *et al*., 2014). Therefore, the assumption that the living costs related to the daily functioning of a household in sprawl zone is lower than in the city is not confirmed. There is also a group of expenditures the differences of which are not significant, i.e. SMD (-0.2; 0.2) and these are expenses:

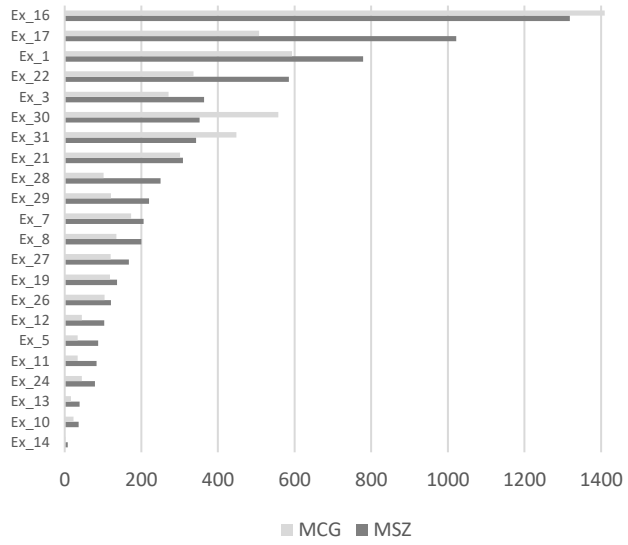
1. Mortgage loans (Ex_16: SMD = 0.11; benefit),
2. Gas (Ex_7: SMD = -0.16; cost),
3. Fuel for cars (Ex_21: SMD = -0.04; cost).

What is interesting is the amount of expenses on mortgage loans (Ex_16), the average of which is the highest among all expenses. Fig. 4 presents the average of the analyzed financial categories. Even though the expenditure on paying off mortgage loans is very high, the difference between households operating in sprawl zone and the control group was assessed as small. This situation is justified by the mechanism of budgetary constraints of households and utility maximization mentioned in the theoretical part. Hence, regardless of location, each household has a credit obligation limited by an income limit that is similar.

Also interesting are the slight differences in fuel expenditures (SMD = -0.04), which contradicts the hypothesis that the distance from suburbia to the center is extended, resulting in more frequent use of the car, higher fuel consumption and excessive expenditure (Travisi *et al*., 2010; Young *et al*., 2016; Litman, 2020). The results of the presented research are closer to the research showing that sprawl may not always have a negative effect on the communication costs of households, and the average

vehicle use may be shortened due to the adaptation of the workplace location and the development of public transport (Anas, 2012).

Figure 4. *Average monthly household expenditures in the sprawl zone (M_{SZ}) and in the control group (M_{CG}) in PLN, 2018.*



Source: *Own study.*

5. Conclusions

In the introduction, the aim of the article was assumed, which was to propose a method of analyzing household budgets in terms of identifying microeconomic net costs and benefits of urban sprawl. The proposed method is based on the assumptions of quasi-experimental approaches in which the finances of the study group are compared with the control group. The experimental area of research was Cracow with the municipalities surrounding the city with urban sprawl. In Poland, there are precise data resources on household income and expenditure, but without indicating households from sprawl zone.

Thus, the operationalization of the research method was associated with two research problems. The first problem is the identification in public statistics of households causing urban sprawl on a wide territorial scale. The second problem is identifying the control group against which to make comparisons. The first problem was solved through a dedicated survey of households causing urban sprawl around Cracow, Poland. Then, a group of households statistically consistent with the respondents was selected from the statistics. The results of the comparisons turned out to be statistically satisfactory. The second problem is to define the control group. Selected households from the core city, i.e., Cracow, were indicated as this group. The criteria for selecting

households referred to the mechanism of household preferences and maximization of utility in terms of place of residence, as well as financial constraints and possibilities. The research on comparing the study group with the control group provided statistically significant conclusions, which indicates the universal nature of the method in Polish conditions. Therefore, it can be concluded that the quasi-experimental approach based on the group of households defined as causing urban sprawl and the control group from the core city can be used in separate studies based on a larger number of cities in Poland.

A general hypothesis was also assumed in the introduction, that urban sprawl has a beneficial effect on the financial condition of households causing the phenomenon. The presented research results do not confirm this hypothesis. The net costs and benefits balance shown in the research indicates a significant dominance of costs, i.e., two categories of benefits were identified, i.e., leisure and education, which were assessed as moderate. 16 costs were also identified, including: 5 moderate, 7 large, 4 very large. The presented results add value to the current state of knowledge, especially by indicating the estimated amounts of costs and benefits for household budgets from living in the sprawl zone in the studied area. The research also verifies many other international studies in Polish conditions. These conclusions can be summarized as follows:

First, the financial opportunities related to income and the potential to incur liabilities, in the light of the conducted research, are the same among households living in the sprawl zone and in the core city. This is confirmed by the current state of knowledge, where it is indicated that from the income point of view, the administrative boundaries of the city do not play a significant role (O'Sullivan, 2012; Mattingly and Morrissey, 2014). Both the labor market and the markets for goods and services are not limited by them. The basic role is played by the household remaining within the city's influence area. It is also possible to confirm the hypothesis of Hołuj (2018) that in urban sprawl areas of large cities, the spill-over effect is observed, related to the same level of salaries to that of the core city. As the presented research additionally proves that the fuel costs incurred by households in the urban sprawl area and the core city are at a similar level, and the income does not change significantly, it can be concluded that urban sprawl will grow.

Secondly, the conducted research indicates that real estate consumers' budget constraints are not significantly affected by the level of local property taxes. Indeed, the tax relational indicators indicate a large loss of urban sprawl households in relation to the control group, but the nominal level of these expenditures are the lowest among all analyzed financial categories. Therefore, according to Brueckner and Kim (2003), the presented research indicates that the low property taxes contribute to the growth of urban sprawl.

Thirdly, the group of factors related to budgetary constraints also includes the current costs of daily household operations. The literature indicates that these costs are lower

in rural areas than in the city center, which encourages the choice of a suburban location (Ewing and Cervero, 2010; Kane *et al*., 2014). The conducted research does not confirm such a conclusion in Polish conditions. On the contrary, it has been proven that the costs of day-to-day operation of an urban sprawl household are associated with large financial losses. These losses are primarily related to the high costs of maintaining the house, including, sewage, heating, water, electricity, waste disposal, property repairing. All these categories are significantly higher than in the city. Secondly, it has been proven that losses in everyday functioning result from the suburban lifestyle. There are two categories here. The first one is large expenditures on food generating financial losses, which can be justified by making purchases in advance due to the distance from grocery stores. The second is related to the paradoxes of Veblen and bandwagon effect known in economy. It turns out that the examined sprawl households show significantly higher expenses related to the consumer credit and loans than cities ones. Also, expenses on clothing and electronic equipment are significantly higher.

Based on the research, it can be concluded that the specificity of functioning of households in the sprawl zone results in the desire to stand out and impress the subdivision. Another part of sprawl society wants to imitate such families and identify with them. As a result, in the analyzed area, a much higher level of purchases on credit by households in sprawl zone was observed than by cities households.

Fourth, the often-cited budgetary consequence of sprawl living for households is higher in transport costs (Travisi *et al*., 2010; Young *et al*., 2016; Litman, 2020), fuel, insurance, vehicle maintenance, public transport tickets. The conducted research only confirms losses in vehicle maintenance and public transport tickets. However, they do not confirm losses in fuel and insurance expenditures. While the research failed to demonstrate the statistical significance of the expenditure on vehicle insurance, the fuel expenditure was statistically significant but did not turn out to be a net cost. The research results are closer to the conclusions of Anas (2012) that urban sprawl does not adversely affect fuel costs. Average vehicle use may be reduced due to adaptation of the workplace location and the development of public transport.

References:

Acioly, C.C., Davidson, F. 1996. Density in urban development. Building Issues, 8(3), 3-25.

Anas, A. 2012. Discovering the Efficiency of Urban Sprawl. In Brooks, N., Donaghy K. and Knaap, GJ. (eds.). Urban Economics and Planning. Oxford University Press, 123.

Anas, A., Rhee, H.J. 2007. When Are Urban Growth Boundaries Not Second-Best Policies to Congestion Tolls? Journal of Urban Economics, 61(2), 263-286.

Bank of America. 1995. Beyond Sprawl: New Patterns of Growth to Fit the New California. Available at: https://www.landwatch.org/pages/perspectives/sprawl report.html.

Barnes, K.B., Morgan, J.M., Roberge, M.C., Lowe, S. 2001. Sprawl Development: Its Patterns, Consequences, and Measurement. A white paper. Towson University.

Brueckner, J., Largey, A. 2008. Social interaction and urban sprawl. Journal of Urban Economics, 64(1), 18-34.

Brueckner, J.K. 2000. Urban Sprawl: Diagnosis and Remedies. International Regional Science Review, 23(2), 160-171.

Chin, N. 2002. Unearthing the roots of urban sprawl: A critical analysis of form, function, and methodology. Working Paper Series 47. Centre for Advanced Spatial Studies of University College London, London.

Daneshpour, A., Shakibamanesh, A. 2011. Compact City: Dose it Create an Obligatory Context for Urban Sustainability? International Journal of Architectural Engineering & Urban Planning, 21(1), 110-118.

De Decker, P. 2011. Understanding housing sprawl: The case of Flanders, Belgium. Environment and Planning A, 43(7), 1634-1654.

De Vos, J., Van Acker, V., Witlox, F. 2016. Urban sprawl: neighborhood dissatisfaction and urban preferences. Some evidence from Flanders. Urban Geography, 37(6), 839-862.

Downs, A. 1994. New Visions for Metropolitan America. Washington, DC: The Brookings Institution.

Ermini, B., Santolini, R. 2017. Urban sprawl and property tax of a city's core and suburbs: Evidence from Italy. Regional Studies, 51(9), 1374-1386.

Ewing, R., Cervero, R. 2010. Travel and the built environment: A meta-analysis. Journal of the American Planning Association, 76, 265-294.

Fulton, W., Pendall, R., Nguyen, M., Harrison, A. 2002. Who Sprawls Most? How Growth Patterns Differ Across the US. Population and Environment, 23(4), 428-434.

Gordon, P., Richardson, H. 1996. Employment Decentralization in U.S. Metropolitan Areas: Is Los Angeles an Outlier or the Norm? Environment and Planning Association, 28, 1727-1743.

Hamidi, S., Ewing, R. Renne, J. 2016 How Affordable Is HUD Affordable Housing? Housing Policy Debate, 26(3), 437-455.

Hołuj, A. 2018. Ekonomiczne i ekologiczne efekty zewnętrzne w planowaniu przestrzennym, Folia Oeconomica. Acta Universitatis Lodziensis, 4(336), 143.

Hortas-Rico, M. 2014. Urban sprawl and municipal budgets in Spain: A dynamic panel data analysis. Papers in Regional Science, 93(4), 843-845.

Jackson, K. 1985. The Crabgrass Frontier: The Suburbanization of the United States. Oxford University Press.

Kane, K., York, A.M., Tuccillo, J., Gentile, L.E., Ouyang, Y. 2014. Residential development during the Great Recession: A shifting focus in Phoenix, Arizona. Urban Geography, 35(4), 486-507.

Litman, T. 2020. Understanding Smart Growth Savings. Evaluating Economic Savings and Benefits of Compact Development. Victoria BC: Victoria Transport Policy Institute. Available at: http://www.vtpi.org/sg_save.pdf.

Lityński, P., Hołuj, A. 2020. Urban Sprawl Risk Delimitation: The Concept for Spatial Planning Policy in Poland. Sustainability, 12, 2637, 1-19.

Livingston, E.H., Elliot, A., Hynan, L., Cao, J. 2009. Effect size estimation: A necessary component of statistical analysis. Archives of Surgery, 144(8), 706-712.

Mattingly, K., Morrissey, J. 2014. Housing and transport expenditure: Socio-spatial indicators od affordability in Auckland. Cities, 38, 69-83.

McHarg, I.L. 1969. Design with Nature. Garden City. New York: Natural History Press.

Mills, E.S. 1999. The Brawl Over So-Called Sprawl. Illinois Real Estate Letter.

Morelli, V.G., Salvati, L. 2010 Ad Hoc Urban Sprawl in the Mediterranean City. Dispersing a Compat Tradition? Roma: Edizioni Nuova Cultura.

Mumford, L. 1961 The City in History: Its Origins, its Transformations, and its Prospects. New York: Harcourt Brace.

National Bank of Poland. 2020. Statistics. Exchange rates. Available at: https://www.nbp.pl/homen.aspx?f=/kursy/kursyen.htm.

O'Sullivan, A. 2012 Urban Economics. New York: McGraw-Hill/Irwin.

OECD. 2012. Compact City Policies: A Comparative Assessment. OECD Green Growth Studies. Paris: OECD Publishing.

OECD. 2018. Rethinking Urban Sprawl: Moving Towards Sustainable Cities. Paris: OECD Publishing. Available at: http://dx.doi.org/10.1787/9789264189881-en.

O'Toole, R. 2009. Gridlock: why we are stuck in traffic and what to do about it. Washington, DC: CATO Institute.

Real Estate Research Corporation. 1974. Costs of Sprawl: Environmental and Economic Costs of Alternative Residential Development Patterns at the Urban Fringe. Washington, DC: US Government Printing Office.

Rosenblatt, P., Sacco, S.J. 2018. Investors and the Geography of the Subprime Housing Crisis. Housing Policy Debate, 28(1), 94-116.

Siegel, S., Castellan Jr, N.J. 1988. Nonparametric statistics for the behavioral sciences (2nd ed.). New York: McGraw-Hill Book Company.

Swianiewicz, P., Łukomska, J. 2017. Wpływ podziałów gmin i powiatów w Polsce na koszty ich funkcjonowania. Studia Regionalne i Lokalne, 1(67), 35-36.

Travisi, M.C., Camagni, R., Nijkamp, P. 2010. Impact of urban sprawl and commuting: A model study for Italy. Journal of Transport Geography, 18(3), 382-392.

Wassmer, R.W. 2002. An Economic Perspective on Urban Sprawl: With an Application to the American West and a Test of the Efficacy of Urban Growth Boundaries, Sacramento: California State University. Available at: http://citeseerx.ist.psu.edu/viewdoc/download? doi=10.1.1.542.5805&rep=rep1&type=pdf.

Young, M., Tnguay, G.A., Lachapelle, U. 2016. Transportation cos and urban sprawl in Canadian metropolitan areas. Research in Transportation Economics, 60(C), 25-34.

Annexes:

Annex 1. *Analyzed household incomes and expenditures*

Symbol	Variable (*)
	Incomes:
In_1	employment in the country and abroad (901111, 901112)
In_2	non-agricultural self-employment (902111, 902112)
In_3	social benefits (905111 - 906432)
In_4	own property rental (904111)
	Expenditures:
Ex_1	food (011)
Ex_2	stimulants: alcohol, cigarettes, drugs (02)
Ex_3	clothing and shoes (03)
Ex_4	property rental (041101)
Ex_5	cold water (044101)
Ex_6	hot water (045501)
Ex_7	gas (045211, 045221)
Ex_8	electricity (045101)
Ex_9	apartment administration, association (044411)
Ex_10	garbage collection (044201)
Ex_11	sewage services (044301)
Ex_12	heating: annual (045502, 045411)
Ex_13	property maintenance: annual (043)
Ex_14	property tax: semi-annual (142311)
Ex_15	house/apartment insurance: annual (125201)
Ex_16	mortgages (161111)
Ex_17	consumer credits and loans (161112, 16113, 161121)
Ex_18	medical services (062111, 062121, 062201)
Ex_19	medical and pharmaceutical products (061101, 061311, 061321, 061391)
Ex_20	health insurance: annual (125321)
Ex_21	fuel: gasoline, diesel, gas (072221, 072211, 072231)
Ex_22	vehicle repairs and consumables (072111, 072121, 072241, 072301)
Ex_23	vehicle insurance (125411)
Ex_24	tickets for public transport (073121, 732211)
Ex_25	TV subscription and Internet (083041)
Ex_26	phone bills (083011, 083021)
Ex_27	electronic equipment: quarterly (091111, 091121, 091131, 091211, 091221, 091231, 091311, 091321, 091331,091491)
Ex_28	sports and recreation services (094111, 094121)
Ex_29	restaurants (111111, 111112)
Ex_30	holidays, hotels, tourist trips, cinema/theater (112011, 094211, 096011, 096021, 133112)
Ex_31	education (101011, 101022, 101023, 102001, 102002, 102003, 105001)

* HBS code is shown in brackets

Annex 2. *Stage two: Average, T-Test and Gamma coefficient for households from the questionnaire and from sprawl zone of the HBS, in PLN*

Var.	M_{Qu}	M_{SZ}	$Ver._{SD}^2$	t	df	p	N_{Qu}	N_{SZ}	SD_{Qu}	SD_{SZ}	Gma.
In_1	5,597.39	5,513.19	1.563	0.18	192	0.855	99	95	2,830.24	3,538.50	0.997
In_2	5,231.87	5,120.64	1.804	0.11	52	0.911	30	24	3,113.21	4,181.11	1.000
In_3	1,117.31	1,123.34	1.229	-0.05	89	0.963	52	39	592.26	656.57	1.000
In_4	1,368.18	1,353.60	0.000	0.03	11	0.975	11	2	610.03	0.00	-
Ex_1	792.46	778.91	1.889	0.23	222	0.816	107	117	500.37	364.04	1.000
Ex_2	231.83	84.06	5.305	4.93	164	0.000	83	83	250.55	108.78	1.000
Ex_3	369.81	363.38	1.610	0.10	205	0.922	108	99	416.18	528.01	1.000
Ex_4	1,076.67	1,128.65	10.604	-0.15	6	0.889	6	2	472.51	145.10	-
Ex_5	89.67	87.61	1.003	0.30	171	0.768	100	73	45.40	45.46	1.000
Ex_6	62.03	61.38	2.707	0.03	39	0.978	38	3	36.42	59.92	-
Ex_7	207.67	206.00	4.286	0.05	155	0.956	65	92	109.41	226.52	1.000
Ex_8	213.95	200.34	1.307	1.18	219	0.237	110	111	79.48	90.86	1.000
Ex_9	259.44	94.95	4.474	2.05	23	0.052	18	7	202.12	95.56	1.000
Ex_10	42.04	36.67	1.442	1.43	202	0.155	98	106	29.26	24.37	1.000
Ex_11	86.27	83.00	1.283	0.41	135	0.686	53	84	42.41	48.04	1.000
Ex_12	1,297.67	1,237.68	1.848	0.24	79	0.812	67	14	800.82	1,088.56	1.000
Ex_13	802.84	463.65	2.478	1.92	85	0.058	55	32	897.50	570.10	1.000
Ex_14	93.19	91.42	2.947	0.12	118	0.908	90	30	59.43	102.01	1.000
Ex_15	488.53	209.26	23.807	1.29	90	0.200	85	7	569.11	116.64	1.000
Ex_16	1,338.89	1,318.34	1.612	0.16	106	0.873	76	32	559.51	710.27	1.000
Ex_17	953.96	1,021.89	3.972	-0.24	44	0.814	26	20	637.20	1,269.99	1.000
Ex_18	162.91	104.28	2.058	2.39	116	0.019	66	52	150.52	104.92	1.000
Ex_19	146.96	136.91	1.363	0.35	162	0.728	79	85	169.70	198.09	1.000
Ex_20	123.30	66.95	37.632	1.46	42	0.151	40	4	76.12	12.41	1.000
Ex_21	308.92	308.62	1.819	0.01	202	0.992	103	101	174.96	236.00	1.000
Ex_22	585.10	584.93	2.079	0.00	78	0.999	58	22	701.27	1,011.16	1.000
Ex_23	728.17	418.11	12.483	0.67	93	0.504	91	4	917.52	259.69	1.000
Ex_24	84.53	78.74	1.787	0.29	49	0.775	32	19	61.15	81.75	1.000
Ex_25	88.37	108.33	1.645	-2.99	149	0.003	104	47	40.55	31.62	1.000
Ex_26	127.11	120.66	5.313	0.40	205	0.690	104	103	150.48	65.29	1.000
Ex_27	655.71	671.20	2.281	-0.06	52	0.950	46	8	598.85	904.37	1.000
Ex_28	245.27	250.18	1.127	-0.07	67	0.942	51	18	240.54	255.34	1.000
Ex_29	247.14	220.09	1.268	0.60	105	0.550	80	27	196.44	221.19	1.000
Ex_30	359.06	352.41	4.127	0.09	133	0.931	96	39	295.17	599.63	1.000
Ex_31	368.30	342.71	1.794	0.22	74	0.823	53	23	410.47	549.86	1.000

where:

M_{Qu} – average for households in the questionnaire in PLN
M_{SZ} – average for households in the HBS from sprawl zone in PLN
$Ver._{SD}^2$ – value of the test verification homogeneity of variance
t – T-Test results
df – degrees of freedom
p – probability
N_{Qu} – the number of households in the questionnaire
N_{SZ} – the number of households in the HBS from sprawl zone
SD_{Qu} – standard deviation for households in the questionnaire in PLN
SD_{SZ} – standard deviation for households in the HBS from sprawl zone in PLN
Gma. – Gamma coefficient ($p<0.05$)

Annex 3. *Stage three: Average, SMD and other statistics for households in the HBS from sprawl zone and the control group, in PLN*

Var.	M_{SZ}	M_{CG}	Diff.	*SMD*	Π	N_{CG}	SD_{CG}	σ	SE_{SZ}	SE_{CG}
In_1	5,513.19	5,796.87	-283.68	*-0.08*	-	105	3,951.17	3,744.73	363.04	385.59
In_2	5,120.64	5,457.62	-336.98	*-0.10*	-	31	2,666.10	3,348.97	853.47	478.85
In_3	1,123.34	994.66	128.69	*0.18*	-	19	876.05	724.06	105.14	200.98
Ex_1	778.91	593.49	-185.42	*-0.56*	3.4%	134	279.96	333.67	33.66	24.18
Ex_3	363.38	270.75	-92.63	*-0.21*	1.7%	98	350.05	448.52	53.07	35.36
Ex_5	87.61	33.62	-53.98	*-1.35*	1.0%	134	17.94	39.89	5.32	1.55
Ex_7	206.00	173.20	-32.80	*-0.16*	0.6%	51	139.03	199.14	23.62	19.47
Ex_8	200.34	134.84	-65.50	*-0.75*	1.2%	131	71.99	87.19	8.62	6.29
Ex_10	36.67	22.87	-13.80	*-0.70*	0.3%	134	12.44	19.81	2.37	1.07
Ex_11	83.00	34.12	-48.88	*-1.21*	0.9%	134	17.60	40.42	5.24	1.52
Ex_12	1,237.68	535.80	-701.88	*-1.29*	12.7%	126	398.47	544.18	290.93	35.50
Ex_13	463.65	198.30	-265.35	*-0.53*	4.8%	13	212.88	500.45	100.78	59.04
Ex_14	91.42	30.10	-61.32	*-1.11*	1.1%	128	26.87	55.40	18.63	2.38
Ex_16	1,318.34	1,409.33	90.99	*0.11*	1.7%	52	872.15	806.20	125.56	120.95
Ex_17	1,021.89	507.72	-514.17	*-0.50*	9.3%	16	557.96	1,022.86	283.98	139.49
Ex_19	136.91	118.43	-18.48	*-0.11*	0.3%	95	121.97	161.76	21.49	12.51
Ex_21	308.62	301.21	-7.41	*-0.04*	0.1%	86	180.62	211.25	23.48	19.48
Ex_22	584.93	336.00	-248.93	*-0.30*	4.5%	19	597.46	834.16	215.58	137.07
Ex_24	78.74	44.40	-34.34	*-0.60*	0.6%	36	36.97	57.65	18.75	6.16
Ex_26	120.66	103.58	-17.08	*-0.27*	0.3%	117	62.73	64.22	6.43	5.80
Ex_27	671.20	479.73	-191.47	*-0.26*	3.5%	5	551.20	736.59	319.74	246.50
Ex_28	250.18	101.85	-148.33	*-0.78*	2.7%	28	108.57	190.40	60.18	20.52
Ex_29	220.09	120.61	-99.48	*-0.58*	1.8%	55	134.63	172.15	42.57	18.15
Ex_30	352.41	557.16	204.76	*0.31*	3.7%	59	696.74	660.88	96.02	90.71
Ex_31	342.71	448.43	105.72	*0.23*	1.9%	21	366.95	463.86	114.65	80.08

where:

M_{CG} – average for households in the HBS from the control group in PLN

Diff. – In_=[M_{SZ}-M_{CG}]; Ex_=[M_{CG}-M_{SZ}]; PLN

SMD – Standardized Mean Difference [Diff./σ]

Π – burden of basic income with i-*th* net cost when Diff.<0; net benefit efficiency when Diff.>0; [|$Diff._i$|/Ex_1]

N_{CG} – the number of households in the HBS of the control group

SD_{CG} – standard deviation for the control group

σ – standard deviation of the population

SE_{SZ} – standard error of the average for households in the HBS from sprawl zone

SE_{CG} – standard error of the average for household of control group