Housing Affordability in Slovakia: what Factors Affect it?

Viera Labudová[1] | *University of Economics in Bratislava, Bratislava, Slovakia*
Ľubica Sipková[2] | *University of Economics in Bratislava, Bratislava, Slovakia*

Abstract

Housing affordability represents a challenge everyone faces when covering the costs of their current or potential housing on the one hand and costs unrelated to their housing within the limits of their own income on the other hand. At the international level, two approaches are used to measuring the housing affordability: the ratio approach and the residual approach. According to Eurostat's definition, a household is considered "overburdened" when the total housing costs ("net" of housing allowances) represent more than 40% of disposable income.

The primary objective of this paper was to define the relevant factors affecting the household cost burden in the Slovak Republic and quantifying the intensity of their influence. For this purpose, a logistic regression model and a classification tree model were created, using the sample of the cross-component of the data of the statistical survey EU SILC 2016. The analysis was completed by using SAS Enterprise Guide (SAS EG) and SAS Enterprise Miner (SAS EM).

Keywords

Housing affordability, housing cost overburden rate, EU SILC, logistic regression model, decision tree model

JEL code

C35, I31, R21

INTRODUCTION

Housing is not only a basic human need, it is one of the basic social rights recognised under international legislation (Scanlon, Arrigoitia, Whitehead, 2015). The right to housing is protected by international documents, including the Universal Declaration of Human Rights, International Covenant on Economic, Social and Cultural Rights, the Convention on the Rights of the Child, the International Convention on the Elimination of All Forms of Racial Discrimination, and the Convention on the Elimination of All Forms of Discrimination against Women. While the right to housing is not among the competencies of the European Commission or other institutions of the European Union and its resolution is left completely up to the member states, there are a number of tools related to it. These include the European Social Charter, the Charter of Fundamental Rights of the EU, the EU Treaty, the EU Anti-Discrimination Legislation

[1] University of Economics in Bratislava, Faculty of Economic Informatics, Department of Statistics, Dolnozemská cesta 1, 852 35 Bratislava, Slovakia. E-mail: viera.labudova@euba.sk, phone: (+421)267295733.
[2] University of Economics in Bratislava, Faculty of Economic Informatics, Department of Statistics, Dolnozemská cesta 1, 852 35 Bratislava, Slovakia. E-mail: lubica.sipkova@euba.sk, phone: (+421)267295729.

and the EU Agency for Fundamental Rights. The right to housing is of critical importance to achieving an inclusive and competitive Europe. Access to safe and affordable housing is one of the basic prerequisites for the well-being of European citizens and society (Hegedüs, Elsinga, Horváth, 2016).

Affordability can be evaluated in various ways that lead to different conclusions as to the nature of the problem and the best solutions. Of the objective indicators of housing affordability, the most interesting indicators at EU level are to be found in the SILC survey database. The share of housing costs in disposable income refers to the expenditure on housing compared to the household's income[3]. Housing costs (including utilities) are calculated after deduction of housing allowances[4]. Those who spend more than forty percent of disposable income on housing costs are considered to be burdened with housing costs (Pittini, 2012).

1 HOUSING AFFORDABILITY

Applying the right to housing is linked to two aspects: housing accessibility and housing affordability. There is a fundamental difference between the notions of housing affordability and housing accessibility (Sendi, 2011). Affordability is a market concept related to capacity to pay. Housing is affordable for these, who can afford to pay for it, therefore using this approach they gain access to it. On the contrary, those who cannot afford to pay for housing, lack such access (Sendi, 2011). Accessibility, on the other hand, is a humanitarian concept. The notion of housing accessibility essentially implies the objective to guarantee the right to housing for everyone. Housing is not a market commodity within this concept; rather represents a right that must be guaranteed for every human being. Access to housing relates to the whole population, including those groups of people, who are often limited in the implementation of their rights to have adequate housing in various ways (Sendi, 2011).

The term housing affordability should not be confused with affordable housing, which traditionally refers to a specific kind of housing designed to be affordable for low-income groups. Affordable housing is more of an attempt to alleviate some of the need associated with identified housing affordability problems (Atfield, 2013).

The definition of "affordable housing" varies across economies, but generally it includes a financial component (the share of income devoted to housing), a standard for what constitutes minimum socially acceptable housing with a clear idea of what income groups are affected, and at what income level households should be eligible for housing assistance. The definition should accommodate a range of sizes, tenure options (purchase vs. rental), and affordability thresholds that take into account households of different sizes and incomes in the area. In many parts of the world, "affordability" is defined as housing costs that consume no more than 30 to 40 percent of household income. A basic socially acceptable standard housing unit is defined by a particular community's view of what is required for decent living and this varies by city. How much floor space is required in a standard unit reflecting consumer choices, market conditions, and regulatory constraints. The definition should also include minimum standards for basic amenities (running water, a toilet) as well as access to essential social services such as schools

[3] Housing costs are a substantial component of household expenditures. Those who allocate a large proportion of their income to housing often have to make difficult financial decisions with significant short-term and long-term implications on their live.

[4] Monthly housing costs sustained by owners include the following components: mortgage principal repayment, mortgage interest payments (net of any tax relief), gross of housing benefits, (i.e., housing benefits should not be deducted from the total housing cost), structural insurance, mandatory services and charges (sewage removal, refuse removal, etc.), regular maintenance and repairs, taxes, and the cost of utilities (water, electricity, gas and heating). Monthly housing costs sustained by renters include the following components: rent payments, gross of housing benefits (i.e., housing benefits should not be deducted from the total housing cost), structural insurance (if paid by the tenants), services and charges (sewage removal, refuse removal, etc.) (if paid by the tenants), taxes on dwelling (if applicable), regular maintenance and repairs and the cost of utilities (water, electricity, gas and heating).

and health clinics. An acceptable housing unit should also place workers no more than an hour's commute from centres of employment (Woetzel et al., 2014).

The definition of housing affordability must be based on a concrete concept of housing accessibility. This is given by the relationship between two subjects: people on the one side (specifically their incomes) and their dwelling on the other side (housing expenses and costs associated with housing). This relationship may be mathematically modelled as a ratio or a difference, which forms the formal basis of the predominant paradigm of housing affordability. In practice, there is a broad range of approaches to defining housing affordability and housing unaffordability. A relative approach is primarily used in the real estate market and is based on prototypical housing costs. This permits comparison of two or more periods, considering whether the flats sold became relatively more or less affordable (Stone, Burke, Ralston, 2011; Jewkes and Delgadillo, 2010). The subjective concept is based on the assumption that households make a choice which is the best one given their financial limitations. From this perspective, housing affordability itself does not have any importance; it is not rationally possible or socially acceptable to define a standardised level of affordability that is other than a personal choice. The ratio approach uses the ratio of housing costs to household income (Norazmawati, 2015; Stone, Burke, Ralston, 2011). Its starting point was conception based on the family budget in which household incomes were evaluated, whether they are sufficient to support all basic household expenditures, including housing costs. In the residual concept, there considered whether households after covering their total housing expenses had sufficient income for paying other expenditures (Stone, Burke, Ralston, 2011).

One of the first definitions of housing affordability is presented by Howenstine (1983, p. 20): "The ability of the household to acquire decent accommodation by the payment of a reasonable amount of its income on shelter". The terms "the decent accommodation" and "the reasonable amount of household income" were not more concrete specified.

MacLennan and Williams (1990, p. 9) clarify the meaning of a reasonable amount of income. In a frequently cited definition of housing affordability, they defined housing affordability as: "Affordability is concerned with securing some given standard of housing (or different standards) at a price or rent which does not impose, in the eye of some third party (usually government) as an unreasonable burden on household incomes". Wong et al. (2010) and Sendi (2011) consider as a lack of this definition, the absence of identification of the term "the unreasonable burden" which would be necessary to explain its accurate and useful content.

A more precise definition explaining the unreasonable burden of a household's income is provided by Bramley and Karley (2005). They mentioned that: "Household should be able to occupy housing that meets well-established (social sector) norms of adequacy (given household type and size) at a net rent which leaves them enough income to live on without falling below some poverty standard" (per Lau, 2001, p. 1).

Another definition provides a description, how to quantify the housing affordability. "The comparison relationship between the housing expenditure (rent, mortgage) and household income is the most common way to define and measure the housing affordability" (Whitehead, 1991).

At the international level, two approaches are used to measuring the housing affordability: the ratio approach or indicator approach and the residual approach (Mulliner, 2012). Other sources also mention the reference approach (Lux et al., 2002, p. 14.).

The ratio or indicator approach is primarily applied in Australia and in international comparisons (Chaplin and Freeman, 1999). This approach is based on the calculation of the portion of income used to cover housing-related costs (the ratio method). Spending over a specific limit, is considered as the housing burden of households and on this basis, this is also used to calculate the housing burden rate. These ratios, therefore, address the question of whether households spend an unreasonably large proportion of their income on housing. While such approaches have been modified and adapted

to a variety of contexts and for specific political purposes, they may be grouped into three general types (Burke et al., 2005, p. 22):

- simple "housing cost to income" ratio,
- fixed ratio with a benchmark,
- refined ratio measures.

The residual approach analyses the amount of the specific portion of income remaining after payment of all housing-related costs (Lux et al., 2002, p. 14). The reference approach does not use any limit for defining when the housing is endangered but reflects on the situation in another sector of housing or the need to secure housing for the concrete selected group of population (Lux et al., 2002, p. 14).

With a focus on the North American usage, Hulchanski (1995) identifies six elements of measuring the housing expenditure to income ratio to measure housing affordability: description of household expenditures, analysis of trends, administration of public housing by defining eligibility criteria and subsidy levels, definition of housing need for public policy purposes, prediction of the ability of a household to pay the rent or the mortgage and as part of the selection criteria in the decision to rent or provide a mortgage. Each of the six uses is assessed based on the extent to which it is a valid and reliable measure of what it purports to measure.

Well known and practiced measurement of affordable housing is that housing costs should be less than 30% of household income (in the United States, Australia and Canada) of the occupants in the bottom 40% of household incomes. Those families who pay more than 30% (40%) of their income for housing are considered cost burdened, and may have difficulty affording necessities such as food, clothing, transportation and medical care (Gabriel et al., 2005).

Therefore, in this broad definition, affordable housing means any housing costing less than 30% of household income of the bottom 40% of the community. Nevertheless, this definition is far from being universally accepted, and poses questions on which costs should be included (such as for instance whether to consider utilities bills) (Pittini, 2012).

According to Eurostat's definition, a household is considered "overburdened" when the total housing costs ("net" of housing allowances) represent more than 40% of disposable income ("net" of housing allowances), where housing costs include mortgage or housing loans interest payments for owners and rent payments for tenants. Utilities (water, electricity, gas and heating) and any costs related to regular maintenance and structural insurance are likewise included (Eurostat, 2009).

The household cost burden (HCB) is defined as the ratio between the monthly total housing costs (HH070) multiplied by 12 and diminished by gross housing allowances (HY070G), and the annual disposable income (HY020) diminished by gross housing allowances following the formula (in percentage after multiplying by 100):

$$HCB = \frac{HH070 \cdot 12 - HY070G}{HY020 - HY070G} \cdot 100 \tag{1}$$

Household cost burden has to be calculated by an individual of the population or a subset of the population, and not by household. Individual weights are therefore used and are based on the Adjusted Cross-Sectional Weight (RB050a) (Eurostat, 2009).

One critique of housing cost burden as a standard of housing affordability is that it does not differentiate between those who have sufficient income to meet household needs after shelter expenditures and those who do not (Stone, 2006). Another critique is that spending a large proportion of income on housing does not necessarily reflect a housing affordability problem. For higher-income households, spending thirty percent of income on housing may be a deliberate decision based on preferences for more spacious and higher-quality housing (Kutty, 2005). On the other hand, for lower-income households, spending thirty

percent or more of income on housing likely represents an involuntary allocation of what are already limited economic resources (McConnell, 2013).

Within the international comparisons, indicator of housing cost overburden rate HH_OVERBURDEN (*housing cost overburden rate*) is used, which indicates percentage of the population living in household, where total housing costs (net of housing allowances) represent more than 40% of the total disposable household income (net of housing allowances).

$$HH\_OVERBURDEN = \frac{\sum_{\forall\ i\ in\ relevant\ breakdown\ with\ HCB>40\%} RB050_i}{\sum_{\forall\ i\ in\ the\ same\ breakdown} RB050_i} \cdot 100. \quad (2)$$

In calculation of HCB are used data related to the statistical unit – household. The housing cost overburden rate indicator is calculated on the level of individual person. Therefore, the personal cross sectional weights are used in its calculation RB050.

The housing costs accounted for 22% of disposable household income in the whole EU in 2016. Households in Greece (nearly 42%) and in Bulgaria (approximately 29%) used the largest amount of disposable income to cover their housing costs. Households in Cyprus (12.8%) and Malta (approximately 7.6%) used the lowest amount of their disposable income on housing. The average housing costs for the Slovak population amount to 21% of disposable income, this percentage increases on average to 36.7% if we look at people at risk of poverty (i.e. those with an equalised disposable income below 60% of the national median equalised disposable income).

One factor linked with housing affordability is the stage in the course of life (McConnell, 2013). Persons in later stages of the life course, such as households headed by older persons and married couples versus households headed by younger people or of other marital statuses, tend to allocate a lower proportion of income to housing (DeVaney et al., 2004; McConnell, 2013) and are more likely to be cost burdened than those without children (Elmelech, 2004). Households with one adult, either living alone or single parents with dependent children, spend the largest amount of their disposable income on housing. Households with a single adult below the age of 65 have housing costs that are 12.9 percentage points higher than the cost level for the general Slovak population. In households with two adults, the share of housing costs is higher than the Slovak average (1.6 percentage points higher for households with two adults with two dependent children and 2.1 percentage points higher than the Slovak average for households with two adults and three dependent children). The share of this type of expenditure in terms of disposable income is lower, probably thanks to the income of an additional adult, in households in which three adults live. The distribution of population by type of household in which they live and based on the housing cost overburden rate shows that the greatest share of persons living in households in which the housing costs burden exceeded 40 percent of their disposable income, were in households with 1 parent and with 1 or more dependent children (29.89%), in single-person households (25.76%) and in households with 2 adults and 1 dependent child (11.89%) (Table 1).

Table 1 Distribution of the population by household type and housing cost burden (HCB) (in %), Slovak Republic, 2016

HCB	Household type								
Col Pct	10	11	12	13	5	6	7	8	9
≤ 40%	88.11	92.34	91.72	96.50	74.24	91.14	96.88	98.04	70.11
> 40%	11.89	7.66	8.28	3.50	25.76	8.86	3.12	1.96	29.89

Notes: 10 – two adults with one dependent child, 11 – two adults with two dependent children, 12 – two adults with three or more dependent children, 13 – households with dependent children, 5 – single person, 6 – two adults younger than 65 years, 7 – two adults, at least one aged 65 years or over, 8 – households without dependent children, 9 – single person with dependent children.
Source: Own processing in SAS Enterprise Guide

The housing affordability is influenced by the tenure status. In EU-28, the proportion of the population whose housing costs exceeded 40% of their disposable income was highest for tenants with market price rents (28.0%) and lowest for persons in owner-occupied dwellings with a loan or mortgage (5.4%). In Slovakia, the housing cost overburden rate for persons in owner-occupied dwellings with a loan or mortgage is 14.48%, and for tenants with market price rents 12.33% (Table 2).

Table 2 Distribution of population by tenure status and housing cost burden (HCB) (in %), Slovak Republic, 2016

HCB	Tenure status			
Col Pct	outright owner	owner paying mortgage	tenant/ subtenant paying rent at prevailing or market rate	accommodation is rented at a reduced rate or accommodation is provided free
≤ 40%	93.85	85.52	87.67	81.99
> 40%	6.15	14.48	12.33	18.01

Source: Own processing in SAS Enterprise Guide

2 ANALYTIC APPROACH

2.1 Database

Research on factors affecting affordability are mostly focusing on rent, income and housing related cost (Howenstine, 1983; Maclennan and Williams 1990; Hancock, 1993). However, other factors are almost being ignored. For example, other non-monetary factors are also playing an important role to determine one's affordability. Without the critical investigation of these other factors, the complete picture of household affordability cannot be shown and needs to be further analysed (Wong et al., 2010).

A system of criteria influencing housing affordability was identified via an extensive review of relevant housing literature. The authors postulate that housing affordability assessment must take a broader view of the wide-ranging criteria that affect households. However, the choice of variables in a multivariable analysis is limited, e.g. by the database used.

Factors of housing unaffordability were analyzed by Jing Li through revision surveys of 112 journal papers over the period from 1990 to 2013. According to Bogdon and Can's research from 1997, he considered for assessment of housing needs three dimensions: amenity, overcrowding, and affordability. The first two "are more prevalent in less developed economies where there is little land for accommodation" (Li, 2014). In this study, he concluded that: "the problem of housing affordability is associated with multi-faceted economic, social, political and demographic considerations". He related "deteriorating housing affordability with low incomes, younger households, elderly and singles" in developed economies with slower GDP growth. His summary of used keywords in housing affordability research over the last two decades contains, for example, homeownership, housing poverty, housing tenure, and demographic factors. Finally, he proposed six major components for a model of affordability: "house price, household formation, housing tenure, migration, demography, and labor".

Lux (2012) concluded that „the structure of the housing market, as measured through housing tenure and partially regionally-based differences in affordability, does influence how workers evaluate participation in the labor market". The author states a decisive effect of housing affordability on the level of structural unemployment and he warns about „the dynamic impact of regional differences in housing affordability on labor mobility concentrated within the most highly skilled segment of the labor force" (Lux, 2012). He also testified that „this relationship was stronger for the house price-to-income ratio than for the rent-to-income ratio. An examination of partial correlation coefficients confirmed the statistical significance of this relationship were control was made for other potentially important confounding variables:

interregional differences in per capita GDP, per capita disposable income, key demographic differences, unemployment rate, and average salary."

According to Nickell, there "was a statistically significant positive correlation between the share of owner-occupied housing and the level of unemployment" across 20 OECD countries during the 1989–1984 period" (Nickel, 1998).

The aim of this paper is to analyse the influence of individual and household characteristics on household cost burden (HCB). The primary objective of this paper was to define the relevant factors affecting the household cost burden in the Slovak Republic and quantifying the intensity of their influence. For this purpose, a logistic regression model and a classification tree model were created, using the sample of the cross-component of the data of the statistical survey EU SILC 2016. The analysis were completed using SAS Enterprise Guide (SAS EG) and SAS Enterprise Miner (SAS EM).

The analysis was carried out using an individual-level data extracted from EU SILC 2016 cross-sectional component provided by the Statistical Office of the Slovak Republic (EU SILC 2016, UDB 27/04/2017). Four types of data sets were used in analysis: Register of persons (R_SILC_2016), Personal data (P_SILC_2016), Household register (D_SILC_2016) and Household data (H_SILC_2016). The combination of all four data sets through the identification numbers of persons and identification numbers of households resulted in a dataset composed of 14,101 records of respondents aged 16 and over.

The household cost burden was calculated by the Formula (1). For the purposes of modelling, its values were substituted with 0 (if HCB < 40%) and 1 (if HCB ≥ 40%). Input variables described the basic characteristics of persons over the age of 16 and the characteristics of the household in which they live: At risk of poverty or social exclusion (AROPE), Household type, Self-defined current economic status (EA_SELF), People living in households with very low work intensity, Tenure status (TENURE_STAT), Dwelling type (DW_T), Region, Sex, NUTS 3 Region, Degree of urbanisation. The description of the input variables is captured in Table 3.

Table 3 Distribution of population by tenure status and housing cost burden (HCB) (in %), Slovak Republic, 2016

Original variables – description	Categories
At risk of poverty or social exclusion *	ARPT60i = 0; SEV_DEP = 0; LWI = 0;
	ARPT60i = 1; SEV_DEP = 0; LWI = 0;
	ARPT60i = 1; SEV_DEP = 1; LWI = 0;
	ARPT60i = 1; SEV_DEP = 0; LWI = 1;
	ARPT60i = 1; SEV_DEP = 1; LWI = 1;
	ARPT60i = 0; SEV_DEP = 1; LWI = 0;
	ARPT60i = 0; SEV_DEP = 0; LWI = 1;
	ARPT60i = 0; SEV_DEP = 1; LWI = 1;
Household type	single person
	two adults younger than 65 years
	two adults, at least one aged 65 years or over
	households without dependent children

Table 3 (continuation)

Original variables – description	Categories
Household type	single person with dependent children
	two adults with one dependent child
	two adults with two dependent children
	two adults with three or more dependent children
	other households with dependent children
Self-defined current economic status	employee working full-time
	employee working part-time
	self-employed working full-time (including family worker)
	self-employed working part-time (including family worker)
	unemployed
	pupil, student, further training, unpaid work experience
	in retirement or in early retirement or has given up business
	permanently disabled or/and unfit to work
	fulfilling domestic tasks and care responsibilities
	other inactive person
Tenure status	outright owner
	owner paying mortgage
	tenant or subtenant paying rent at prevailing or market rate
	accommodation is rented at a reduced rate or accommodation is provided free
Dwelling type	detached house
	semi-detached or terraced house
	apartment or flat in a building with less than 10 dwellings
	apartment or flat in a building with 10 or more dwellings
	some other kind of accommodation
Region	Bratislava Region
	Western Slovakia Region
	Central Slovakia Region

Table 3 (continuation)

Original variables – description	Categories
Region	Eastern Slovakia Region
Sex	man
	woman
NUTS3 Region	Bratislava Region
	Trnava Region
	Trenčín Region
	Nitra Region
	Žilina Region
	Banská Bystrica Region
	Prešov Region
	Košice Region
Degree of urbanisation	densely populated area
	intermediate area
	thinly populated area

Notes: * ARPT60i = 1: person with disposable income below at-risk-of-poverty threshold (ARPT60i = 0: person with disposable income above at-risk-of-poverty threshold); SEV_DEP = 1: person is affected by severe material deprivation (SEV_DEP = 0: person is not affected by severe material deprivation); LWI = 1: person lives in households with very low work intensity (LWI = 0: person does not live in households with very low work intensity).

Source: Methodological guidelines and description of the EU-SILC target variables, own processing

2.2 Logistic regression model

A logistic regression model is a special instance of a generalised linear model. It may be used to explain (dependent) variables with other than normal distribution of probability (binomial, Poisson, exponential, gamma distribution, ...). The selection of our model for analysis was conditioned by the fact that variable of the household cost burden had a binomial distribution of probability.

The logistic regression model may be used to estimate the conditional mean value of a dependent variable $E(Y|x_i) = \pi$ (the conditional probability that a dependent variable will have a value of 1):

$$\pi = \frac{exp\ (\beta_0 + \sum_{j=1}^{k} \beta_j\, x_{ij})}{1+exp\ (\beta_0 + \sum_{j=1}^{k} \beta_j\, x_{ij})}, \tag{3}$$

where x_j (j = 1, 2, …k) are the input variables, β_0 and β_j (j = 1, 2, …k) are the unknown parameters of model. More often, the model is presented in a form used to record the generalised linear model and which expresses the relationship between function of the conditioned mean value of the dependent variable π (in the logit model it is logit: $\ln \frac{\pi}{1-\pi}$ and the linear combination of the independent

variables: $\ln \frac{\pi}{1-\pi} = \beta_0 + \sum_{j=1}^{k} \beta_j x_j = \sum_{j=0}^{k} \beta_j x_j$.

The odds $\frac{\pi}{1-\pi}$ is the probability that the observed event occurs (a person lives in a household where the total housing costs are more than 40% of the total disposable household income) and the probability that the observed event does not occur (a person lives in a household where the total housing costs do not exceed 40% of the total disposable household income).

The Odds Ratio $OR = \frac{odds_1}{odds_2}$ is used to interpret the parameters of the logistic regression model where $odds_1$ indicates the odds that the given event occurs for the first object of comparison and $odds_2$ is the odds that the given event occurs for the second object of comparison (Hosmer and Lemeshow, 2000; Agresti, 1990).

2.3 Decision tree model

In addition to the logistic regression model, the decision tree (classification tree) model was used in analyses. Classification and regression trees are suited for the analysis of complex data. Decision tree models can be effectively used to determine the most important attributes in a dataset (Breiman, 2001).

A decision tree is a structure that can be used to divide up a large collection of records into successively smaller sets of records by applying a sequence of simple decision rules. A decision tree model consists of a set of rules for dividing a large heterogeneous population into smaller, more homogeneous groups with respect to a particular target variable (Berry and Linoff, 2004; Dietterich, 1990).

Ideally, subsets at the end of the branching process, i.e. leaves, should contain only one class (category) of the specified dependent variable. In the case of a decision tree applied to data sourced from the EU SILC survey in which the inhabitants of Slovakia were the objects of investigation, the branches end at leafs, in which the predominant group were people living in households, where the housing cost burden exceeded the 40% of the disposable household income, or the category of persons for whose the housing cost burden was below threshold. The relative frequencies of categories of the explained variables influence the cleanliness of the individual nodes of leaves that can be measured by entropy:

$$H(Y) = \sum_{j=1}^{m} \frac{n_j}{n} log_2 \frac{n_j}{n}, \tag{4}$$

where n_j is the frequency of the class y_j (in our case is the size of the class of persons burdened with the housing costs and the class whose the housing costs exceed the threshold of 40% of the disposable income). In the case of a binary dependent variable, entropy acquires a maximum value of 1 (if both classes have the same frequencies) and a minimum value of 0 (if the set contains only one class).

The created decision tree was not used as a predictive model, we used its ability to classify individual cases (persons) into two classes, according to whether their housing costs could be considered as burdensome or not.

3 RESULTS

3.1 Results of the logistic regression model

For our analysis we used PROC LOGISTICS, that is the most popular SAS procedure for doing Maximum Likelihood Estimation of the logistic regression model (Allison, 2012). The results of the logistic regression analysis are presented in Tables 4–7.

The table "Model Fit Statistics" (Table 4) reports three different model fit statistics: the Akaike's Information Criterion (AIC), the Schwarz Criterion (SC) and the maximized value of the logarithm of the likelihood function multiplied by –2 (–2Log *L*). Values of these fit statistics are displayed for two different models, a model with an intercept but no predictors (covariates), and a model that includes all the specified predictors. Higher values of –2Log *L* mean a worse fit to the data. The problem with –2Log *L* is that models with more predictors tend to fit better by chance alone. The other two fit statistics avoid this problem by penalizing model that have more covariates (Allison, 2012).

Table 4 Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	6 808.464	4 603.882
SC	6 816.018	4 868.272
–2 Log L	6 806.464	4 533.882

Source: Own processing in SAS Enterprise Guide

Table 5 is "Global Zero Hypothesis Testing: Beta = 0". In this table there are three statistics with values of 2272.5814, 3100.3644 and 1502.5312. All three statistics test for the same null hypothesis: that all explanatory variables have a coefficient of 0. The associated p-values are less than 0.01, so we can reject the null hypothesis and conclude that at least one of the coefficients is not 0.

Table 5 Testing Global Null Hypothesis: BETA = 0

Test	Chi-Square	DF	p-value
Likelihood Ratio	2 272.5814	34	<.0001
Score	3 100.3644	34	<.0001
Wald	1 502.5312	34	<.0001

Source: Own processing in SAS Enterprise Guide

From the original set of fourteen input variables, only those with a statistically significant influence on the variable HCB were selected: self-defined current economic status, household type, region, dwelling type, tenure status and at risk of poverty or social exclusion (Table 6).

In the Table 7 there are coefficient estimates, their estimated standard errors, and test-statistics for the null hypothesis that each coefficient is equal to 0. Since categorical variables were involved in the model, they were replaced by dummy (indicator) variables in the model. We inserted the odds ratios (odds) for household cost burden derived from binary logistic regression in association with the 34 indicators (dummy variables) in the Table 7 too. The point estimates of the odds ratios are used to interpret the values of the estimated model parameters.

The dummy indicators created by using their self-defined current economic status had higher odds that their housing costs exceeded 40 percent of the disposable income threshold when compared to the reference category of disabled persons or persons unable to work (permanently disabled persons or persons unfit to work). The odds were up to 6.854 times higher for the self-employed working part-time

Table 6 Testing Global Null Hypothesis: BETA = 0

Effect	DF	Wald Chi-Square	p-value
Self-defined current economic status	9	75.8949	<.0001
Household type	8	580.1947	<.0001
Region	3	27.9035	<.0001
Dwelling type	4	14.0034	0.0073
Tenure status	3	151.1032	<.0001
At risk of poverty or social exclusion	7	839.8892	<.0001

Source: Own processing in SAS Enterprise Guide

Table 7 Analysis of Maximum Likelihood Estimates and Odds Ratio Estimates

	Odds Ratio Estimates				
Effect	**Parameter Estimate**	**Odds Ratio Estimate**	**Standard Error**	**Wald Chi-Square**	**p-value**
Self-defined current economic status					
Employee working full-time	0.2342	1.264	0.2640	0.7870	0.3750
Fulfilling domestic tasks and care responsibilities	1.1184	3.060	0.4512	6.1438	0.0132
Other inactive person	0.7239	2.062	0.3160	5.2477	0.0220
Employee working part-time	0.9873	2.684	0.3848	6.5825	0.0103
Self-employed working full-time	1.2360	3.442	0.2830	19.0725	<.0001
Self-employed working part-time	1.9248	6.854	0.6234	9.5329	0.0020
Unemployed	1.1153	3.051	0.2614	18.2006	<.0001
Pupil, student	0.4800	1.616	0.2866	2.8054	0.0939
In retirement or in early retirement or has given up business	0.8023	2.231	0.2679	8.9700	0.0027
Permanently disabled or/and unfit to work	Reference category				
Household type					
Two adults with one dependent child	–0.5080	0.602	0.2253	5.0862	0.0241
Two adults with two dependent children	–1.2673	0.282	0.2272	31.1175	<.0001
Two adults with three or more dependent children	–2.1108	0.121	0.2709	60.7045	<.0001
Households with dependent children	–2.3383	0.096	0.2320	101.6072	<.0001
Single person	0.9970	2.710	0.2275	19.2090	<.0001

Table 7 (continuation)

Odds Ratio Estimates					
Effect	**Parameter Estimate**	**Odds Ratio Estimate**	**Standard Error**	**Wald Chi-Square**	**p-value**
Permanently disabled or/and unfit to work	Reference category				
Household type					
Two adults younger than 65 years	–0.4863	0.615	0.2309	4.4342	0.0352
Two adults, at least one aged 65 years or over	–1.0158	0.362	0.2640	14.8029	0.0001
Households without dependent children	–1.9340	0.145	0.2455	62.0709	<.0001
Single person with dependent children	Reference category				
Region					
Bratislava Region	0.5421	1.720	0.1361	15.8696	<.0001
Western Slovakia Region	0.3562	1.428	0.1088	10.7139	0.0011
Central Slovakia Region	–0.0391	0.962	0.1175	0.1105	0.7395
Eastern Slovakia Region	Reference category				
Household type					
Detached house	0.1013	1.107	0.0942	1.1576	0.2820
Semi-detached or terraced house	0.7172	2.049	0.2839	6.3800	0.0115
Apartment or flat in a building with less than 10 dwellings	0.1840	1.202	0.1543	1.4228	0.2329
Some other kind of accommodation	1.1253	3.081	0.4106	7.5123	0.0061
Apartment or flat in a building with 10 or more dwellings	Reference category				
Tenure status					
Outright owner	0.6920	1.998	0.3069	5.0846	0.0241
Owner paying mortgage	2.1942	8.973	0.3297	44.2985	<.0001
Tenant or subtenant paying rent at prevailing or market rate	1.4653	4.329	0.3252	20.3051	<.0001
Accommodation is rented at a reduced rate or accommodation is provided free	Reference category				
AROPE					
ARPT60i = 0; SEV_DEP = 0; LWI = 0	–3.1266	0.044	0.2044	234.0613	<.0001
ARPT60i = 0; SEV_DEP = 0; LWI = 1	–2.6165	0.073	0.4005	42.6785	<.0001
ARPT60i = 0; SEV_DEP = 1; LWI = 0	–2.5514	0.078	0.2630	94.1201	<.0001
ARPT60i = 1; SEV_DEP = 0; LWI = 0	–0.0208	0.979	0.1994	0.0109	0.9169

Table 7 (continuation)

Odds Ratio Estimates					
Effect	**Parameter Estimate**	**Odds Ratio Estimate**	**Standard Error**	**Wald Chi-Square**	**p-value**
Accommodation is rented at a reduced rate or accommodation is provided free	Reference category				
AROPE					
ARPT60i = 1; SEV_DEP = 0; LWI = 1	0.3753	1.455	0.2371	2.5062	0.1134
ARPT60i = 0; SEV_DEP = 1; LWI = 1	–2.5011	0.082	0.6549	14.5859	0.0001
ARPT60i = 1; SEV_DEP = 1; LWI = 0	–0.9246	0.397	0.2701	11.7141	0.0006
ARPT60i = 1; SEV_DEP = 0; LWI = 0	–0.0208	0.979	0.1994	0.0109	0.9169
ARPT60i = 1; SEV_DEP = 1; LWI = 1	Reference category				

Source: Own processing in SAS Enterprise Guide

and 3.06 times higher for the persons in the category of persons fulfilling domestic tasks and care responsibilities than the odds were for the reference category. Given the type of household in which a person lives, the highest housing cost burden is faced by persons living in households with 1 adult and at least 1 dependent child (reference category). For nearly all other considered types of households, the odds that the HCB variable exceeded the 40% of available income threshold were lower. Only single-member households had greater odds that the housing costs would be a burden for some of them.

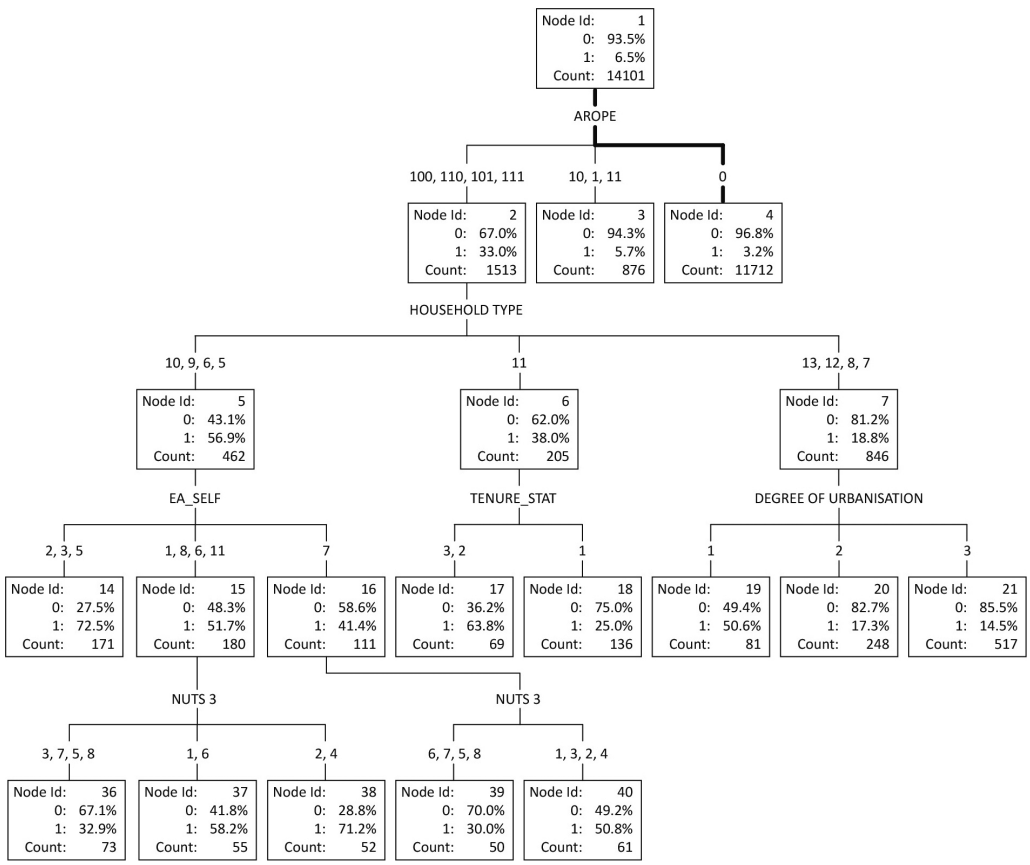
We discovered the statistically significant differences in the housing cost burden in comparison between the Bratislava Region, the Western Slovakia Region, in the Central Slovakia Region, and the Eastern Slovakia Region. The odds, that the housing cost burden exceeded the 40% of disposable household income threshold, are 1.72 times higher for inhabitants living in the Bratislava Region and 1.482 times higher than those living in the Western Slovakia Region in comparison to inhabitants living in the Eastern Slovakia Region. There exists a significant difference in the odds of housing cost burden between categories of population created by the type of dwelling and the odds for inhabitants falling in this reference category of variable. Persons living in apartment or flat in a building with 10 or more dwellings have odds that their housing costs exceed the 40 percent of disposable income and this odds are lower than for other groups categorised by their type of dwelling. The housing costs represent a significant burden for the owners paying the mortgage. Their odds that they spend more than 40% of their disposable income on housing are up to 8.973 times higher than those who rent their housing at a lower price (lower than the market price) or who have the housing free-of-charge. The odds that the housing costs represent a burden are up to four times higher for those who rent their housing at the market price compared with inhabitants who live in social housing (with a reduced rent) or have the housing free-of-charge.

There are also differences in the housing cost burden among the groups formed using the AROPE variable. The category of persons who are currently at risk of poverty, are severely materially deprived and living in households in which the work intensity is defined as low (reference category 111) have odds that their housing costs exceed 40% of their disposable household income, that are higher than the odds for other classes created by using the AROPE category of variables. The only exception are persons who are at risk of poverty but without the risk of severe material deprivation and are living in households with very low work intensity. The odds of this category were 1.455 times higher in comparison with the reference category.

3.2 Results of the decision tree model

The algorithm used in the generation of the decision tree applied a maximum of triple branching of nodes, the growth of the tree was limited by defining its maximum depth[5] (Max Depth = 5 controls the maximum depth of the tree that will be created. The root node is considered to have a depth of 0.) and the selection of branching variables was completed using the values of expected entropy. From the set of potential decision trees that were created in SAS EM, the one with the lowest misclassification rate was selected (details in Neville and de Ville, 213). Decision tree identified the most significant variables (AROPE, household type (HT), self-defined current economic status (EA_SELF), tenure status (TENURE_STAT), NUTS 3, degree of urbanisation) and their values that give the best homogeneous sets of the population. It chose the split which has the lowest entropy compared to the parent node and other splits. The tree structure of the tree contains a total of 13 leaves. Each of them provides information about the relative magnitude of the classes of persons with a housing cost burden (Figure 1). These may then be used to estimate the probability of their occurrence. The properties of persons are contained in the decision-making rules in the individual leaves.

Figure 1 Decision Tree Diagram



Source: Own processing in SAS Enterprise Miner

[5] Max Depth controls the maximum depth of the tree that will be created. The root node is considered to have a depth of 0.

From our perspective, those sets of persons for whom the probability of the housing cost burden is very high or very low were of interest (Figure 2, Figure 3).

Figure 2 Decision-making rules for leafs with the lowest number of people burdened with

Node	Depth	Observations	Percent 1
4	1	11712	0.03
3	1	876	0.06
21	3	602	0.14
14	3	171	0.73
18	3	136	0.25
43	4	119	0.24
37	4	96	0.61
36	4	84	0.4
17	3	69	0.64
42	4	68	0.53
38	4	61	0.51
20	3	57	0.19
39	4	50	0.3

if **AROPE** IS ONE OF: 0 or MISSING
then Tree Node Identifier = 4
Number of Observations = 11 712
Predicted: HH_OV=0 = 0.97
Predicted: HH_OV=1 = **0.03**

if **AROPE** IS ONE OF: 10, 1, 11
then Tree Node Identifier = 3
Number of Observations = 876
Predicted: HH_OV=0 = 0.94
Predicted: HH_OV=1 = **0.06**

Source: Own processing in SAS Enterprise Miner

The lowest number of people burdened with the housing costs (0.03) is in the node that included persons who are not at risk of poverty, severely materially deprived and living in households whose work intensity is not defined as low. The next node with the relatively lowest number of people burdened with the housing costs (0.06) included those who are not at risk of poverty but who are severely materially deprived (AROPE = 10), or living in households whose work intensity is defined as low (AROPE = 1), or who are both severely materially deprived and are living in households with the low work intensity (AROPE = 11) (Figure 2).

The highest share of persons burdened with the housing costs (0.73) is in the group of people living in any of the following types of household: households with 2 adults and 1 dependent child (HT = 10), households with 1 adult and with 1 or more dependent children (HT = 9), households with 2 adults and without dependent children, both under the age of 65 (HT = 6) or single-member households (HT = 5), are employees with the shortened working hours (EA_SELF = 2), or full-time entrepreneurs and self-employed persons (EA_SELF = 3), or unemployed persons (EA_SELF = 5) and who are at risk of poverty according to AROPE (AROPE = 100) and who are concurrently either severely materially deprived (AROPE = 110) or living in households whose work intensity is defined as low (AROPE = 101), or who are concurrently severely materially deprived and living in households with low work intensity (AROPE = 111) (Figure 3).

The second group in order with the highest share of persons burdened by the housing costs (0.64) includes persons whose AROPE indicator of poverty or social inclusion are the same as the previous group. Their another common characteristic is that they live in households with 2 adults and 2 dependent children (HT = 11) and are owners of a flat and repaying a mortgage (TENURE_STATUS = 2) or tenants or sub-lessees who are paying rent or a sub-lease (TENURE_STATUS = 3) (Figure 3).

Figure 3 Decision-making rules for leafs with the highest number of people burdened with housing costs

Node	Depth	Observations	Percent 1
4	1	11712	0.03
3	1	876	0.06
21	3	602	0.14
14	3	171	0.73
18	3	136	0.25
43	4	119	0.24
37	4	96	0.61
36	4	84	0.4
17	3	69	0.64
42	4	68	0.53
38	4	61	0.51
20	3	57	0.19
39	4	50	0.3

if **HT** IS ONE OF: 10, 9, 6, 5
AND **EA_SELF** IS ONE OF: 2, 3, 5
AND **AROPE** IS ONE OF: 100, 110, 101, 111
then Tree Node Identifier = 14
Number of Observations = 171
Predicted: HH_OV=0 = 0.27
Predicted: HH_OV=1 = **0.73**

if **TENURE_STATUS** IS ONE OF: 3, 2
AND **HOUSEHOLD TYPE** IS ONE OF: 11
AND **AROPE** IS ONE OF: 100, 110, 101, 111
then Tree Node Identifier = 17
Number of Observations = 69
Predicted: HH_OV=0 = 0.36
Predicted: HH_OV=1 = **0.64**

Source: Own processing in SAS Enterprise Miner

CONCLUSIONS

The objective of our paper was to identify the factors that have a statistically significant effect on the housing cost burden on the Slovak population in 2016. A logistic model regression was used to identify and quantify the strength of their influence. The variable modelled in the regression model was the household cost burden on housing, which is used by the European Union to measure housing affordability.

By the stepwise method, indicators that had a statistically significant influence on the household burden were selected: self-defined current economic status, type of household, region, type of dwelling, ownership status, and the AROPE variable. The strength of their effects was quantified using Cramer's V (CV) coefficient. Based on its value, it may be said that variable the household cost burden is most strongly influenced by the AROPE (CV = 0.376), type of household (CV = 0.267) and self-defined current economic status (CV = 0.170). Additionally, odds ratios were estimated to facilitate a comparison of the housing cost burden between the individual groups of persons categorized based on their individual characteristics and the typology of the households in which they live.

Decision tree identified the most significant variables: AROPE, household type, self-defined current economic status, tenure status, NUTS 3 and degree of urbanisation. The decision (classification) tree was used as a classifier of persons according to their housing cost burden. It allows for the prediction of the probability of whether a person whose characteristics are expressed using the values of the input variables are burdened by housing costs. The results of the decision tree confirmed that the AROPE variable is the most influential variable, given its ability to differentiate the population according to their housing cost burden.

It is everyone's right to obtain affordable housing, while failure to attain the goal is mainly due to political struggles. Financial deregulation, coupled with an unusual rise in property prices, inappropriately targeted socio-economic, housing policies or fiscal policy together with incompetence to strategically manage affordable housing supply for low-income households with housing access problems raises two general questions: Is the housing affordability problem partly connected to the poverty issue? What other factors also account for housing affordability? Our results partially considered both of these questions. Although examined in the context of the Slovak Republic, a similar analysis of attributes determining housing affordability might be applied in international studies. The results of our analysis of household

patterns related to housing affordability may contribute to some extent to appropriate targeting of the proper regional and state government policies and for defining administrative rules about eligibility for housing programmes.

ACKNOWLEDGMENT

This article is provided as one of the outputs of the research projects: VEGA 1/0770/17: Availability and affordability of housing in Slovakia.

References

AGRESTI, A. *Categorical Data Analysis.* New York: John Wiley & Sons, 1990.

ALLISON, P. D. *Logistic Regression Using SAS: Theory and Application*, 2nd Ed. NC: SAS Institute Inc., 2012.

ATFIELD, M. *Rural Housing Affordability: A Location-Based Investigation of the Characterisitcs of those Experiencing Housing Affordability Problems in Ontario.* Canada: Queen's University Kingston, 2013.

BERRY, M. J. A. AND LINOFF, G. S. *Data mining Techniques. For Marketing, Sales, and Customer Relationship management.* 2nd Ed. Indianapolis, Indiana: Wiley Publishing, Inc., 2004.

BRAMLEY, G. AND KARLEY, N. K. How Much Extra Affordable Housing is Needed in England? *Housing Studies*, 2005, 20(5), pp. 685–715. DOI: 10.1080/02673030500213938.

BREIMAN, L. Random forests. *Machine Learning*, 2001, 45(5), pp. 5–32. DOI: 10.1023/A:1010933404324.

BURKE, T. et al. *Conceptualising and measuring the housing affordability problem. National Research Venture 3: Housing Affordability for Lower Income Australians Research Paper 1* [online]. Melbourne: Australian Housing and Urban Research Institute, 2005. [cit. 12.2.2019] <https://core.ac.uk/download/pdf/43326790. pdf>.

CHAPLIN, R. AND FREEMAN, A. Towards an Accurate Description of Affordability. *Urban Studies*, 1999, 36(11), pp. 1949–1957. DOI: 10.1080/0042098992692.

DEVANEY, S. A. et al. Life Cycle Stage and Housing Cost Burden. *Financial Counseling & Planning* [online]. 2004, 15(1), pp. 31– 9. [cit. 12.1.2019] <https://www.researchgate.net/ publication/2284 61551_Life_cycle_stage_and_housing _cost_burden>.

DIETTERICH, T. G. Machine learning. *Annual Review of Computer Science*, 1990, 4(1), pp. 255–306. DOI: 10.1146/annurev. cs.04.060190. 001351.

ELMELECH, Y. Housing inequality in New York City: Racial and ethnic disparities in homeownership and shelter-cost burden. *Housing, Theory, and Society*, 2004, 21(4), pp. 163–175. DOI: 10.1111/j.1533-8525.2001.tb00028.x.

EP. *Charter of Fundamental Rights of the European Union* [online]. Luxembourg: European Parliament, Office for Official Publications of the European Communities, 2000. [cit. 12.2.2019] <http://www.europarl.europa.eu/charter/pdf/text_en.pdf>.

EU. *Treaty on the Functioning of the European Union* [online]. European Union, 2009. [cit. 8.1.2019] <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A12012E%2FTXT>.

EUROSTAT. *Algorithms to compute social inclusion indicators based on EU-SILC and adopted under the Open Method of Coordination (OMC)* [online]. Luxembourg: Eurostat, 2009. [cit. 12.1.2019] <https://www.dst.dk/ext/747139308/0/ukraine/ENG_Algorithms-to-compute-Social-Inclusion-Indicators-based-on-EU-SILC-and-adopted-under-the-Open-Method-of-Coordination-(OMC)--pdf>.

GABRIEL, M. et al. *Conceptualising and measuring the housing Affordability problem* [online]. Australian Housing and Urban Research Institute, 2005. [cit.10.3.2019] <http://www.ahuri.edu.au/downloads/NRV3/NRV3_Research_Paper_1.pdf.>.

HANCOCK, K. Can Pay? Won't Pay? The Economic Principles of Affordability. *Urban Studies*, 1993, 30(1), pp. 127–145. DOI: 10.1080/00420989320080081.

HEGEDÜS, J., ELSINGA, M., HORVÁTH, V. *Policy Discussion Brief for the European Commission on housing in EU member states. Habitat for Humanity International Europe, Middle East and Africa, June, 2016* [online]. Habitat for Humanity EMEA. [cit. 18.1.2019] <https://www.habitat.org/sites/default/files/EMEA%20Policy%20Brief%20on%20Housing%20in%20EU_24112016.pdf.>.

HOSMER, D. V. AND LEMESHOW, S. *Applied Logistic Regression.* New York: John Wiley & Sons, 2000.

HOWENSTINE, E. J. *Attacking Housing Cost: Foreign Policy and Strategies.* New Jersey: Centre for Urban Policy Research, 1983.

HULCHANSKI, J. D. The concept of Housing affordability: Six contemporary uses of the housing expenditure-to-income ratio. *Housing Studies*, 1995, 10(4), pp. 471–491. DOI: 10.1080/02673039508720833.

JEWKES, M. D. AND DELGADILLO, L. M. Weaknesses of Housing Affordability Indices Used by Practitioners [online]. *Journal of Financial Counseling and Planning*, 2010, 21(1), pp. 43–52. [cit. 25.2.2019] <https://afcpe.org/assets/pdf/volume_21_issue_1/jewkes_delgadillo.pdf.>.

KUTTY, N. A new measure of housing affordability: Estimates and analytical results. *Housing Policy Debate*, 2005, 16(1), pp. 113–142. DOI: 10.1080/10511482.2005. 9521536.

LAU, K. Y. A *Comparison Of Indicators Used In Measuring Housing Affordability In Hong Kong And Their Validity. Working Paper Series 2001 / No. 2* [online]. Department of Public and Social Administration City University of Hong Kong, 2001. [cit. 25.2.2019] <http://www6.cityu.edu.hk/pol/staff/KYLau/wp0102.pdf>.

LI, J. *Recent Trends on Housing Affordability Research: Where are we up to?* [online]. Urban Research Group – CityU on Cities Working Paper series, WP No. 5/2014. [cit. 15.10.2019]. <http://www.cityu.edu.hk/cityuoncities/upload/file/original/70552015012 6143516 .pdf>.

LUX, M. et al. *Bydlení-věc veřejná: sociální aspekty bydlení v České republice a zemích Evropské unie* (in Czech). Prague: Sociologické nakladatelství, 2002.

LUX, M. AND SUNEGA, P. Labour Mobility and Housing: The Impact of Housing Tenure and Housing Affordability on Labour Migration in the Czech Republic. *Urban Studies*, 2012, 49(3), pp. 489–504. DOI: 10.1177/0042098011405693.

MACLENNAN, D. AND WILLIAMS, P. eds. *Affordable Housing in Britain and America.* York: Joseph Rowntree Foundation, 1990.

MCCONNELL, E. D. Who has housing affordability problems? Disparities in Housing Cost burden by Race, Nativity and Legal Status in Los Angeles. *Race and social problems*, 2013, 5(3), pp. 173–190. DOI: 10.1007/s12552-013-9086-x.

MULLINER, E. K. *A model for the complex assessment of sustainable housing affordability: Doctoral thesis* [online]. Liverpool: John Moores University, 2012. [cit. 5.2.2019] <http://researchonline.ljmu.ac.uk/6183/1/589785.pdf.>.

NEVILLE, P. AND DE VILLE, B. *Decision Trees for Analytics Using SAS® Enterprise Miner™*. USA, NC: SAS Institute, 2013.

NICKELL, S. Unemployment: questions and some answers. *Economic Journal*, 1998, 108(448), pp. 802–816. DOI: 10.1111/1468-0297.00316.

NORAZMAWATI, M. S. Price to Income Ratio Approach in Housing Affordability. *Journal of Economics, Business and Management*, 2015, 3(12), pp. 1190–1193. DOI: 10.7763/JOEBM.2015.V3.357.

PITTINI, A. *Housing Affordability in the EU: Current Situation and Recent Trends.* Brussels: CECODHAS European Social Housing Observatory, 2012.

SCANLON, K., ARRIGOITIA, M. F., WHITEHEAD, CH. *Social housing in Europe* [online]. Stockholm: Swedish Institure for European Policy Studies, 2015. [cit. 15.1.2019] < http://eprints.lse.ac.uk/62938/ >.

SENDI, R. *Housing accessibility versus housing affordability: Introducing universal housing care* [online]. Enhr Conference 2011, Toulouse, 5–8 July, 2011. [cit. 5.1.2019] <https://www.enhr.net/documents/2011%20France/WS14/Paper-Richard%20Sendi-WS14.pdf.>.

STONE, M. E. What is Housing Affordability? The Case for the Residual Income Approach. *Housing Policy Debate*, 2006, 17(1), pp. 151–184. DOI: 10.1080/10511482.2006.9521564.

STONE, M. E., BURKE, T., RALSTON, L. *The Residual Income Approach to Housing Affordability: The Theory and the Practice* [online]. AHURI Positioning Paper No. 139, 2011. [cit. 22.2.2019] <http://works.bepress.com/michael_stone/7>.

UN. *Convention on the Elimination of All Forms of Discrimination Against Women* [online]. New York: United Nations, 1979. [cit. 8.1.2019] <http://www.un.org/womenwatch/daw/cedaw/text/econvention.htm>.

UN. *Convention on the Rights of the Child* [online]. New York: United Nations, 1989. [cit. 8.1.2019] <https://www.ohchr.org/en/professionalinterest/pages/crc.aspx>.

UN. *International Covenant on Economic, Social and Cultural Rights* [online]. New York: United Nations, 1966. [cit. 8.1.2019] <https://treaties.un.org/doc/treaties/1976/01/19760103%2009-7%20pm/ch_iv_03.pdf.>.

UN. *Universal Declaration of Human Rights* (217 (III) A) [online]. Paris, 1948. [cit. 8.1.2019] <http://www.un.org/en/udhrbook/pdf/udhr_booklet_en_web.pdf.>.

WHITEHEAD, C. From need to affordability: An analysis of UK housing objectives [online]. *Urban Studies*, 1991, 28(6), pp. 871–887. <https://doi.org/10.1080/00420989120081101>.

WOETZEL, J. et al. *A blueprint for addressing the global affordable housing challenge* [online]. McKinsey & Company, 2014. [cit. 25.8.2019] <https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Urbanization/Tackling%20the%20worlds%20affordable%20housing%20challenge/MGI_Affordable_housing_Executive%20summary_October%202014.ashx.>

WONG, F. K. W. et al. *Measuring affordability and factors affecting affordability of elderly in Hong Kong. W110-Special Track 18th CIB World Building Congress May 2010 Salford United Kingdom* [online]. UK: CIB Publication, 2010, pp. 1–19. [cit. 21.1.2019] <http://www.irbnet.de/daten/iconda/CIB18947.pdf.>.