European Research Studies Journal
Volume XXIII, Issue 4, 2020

pp. 771-784

Econometric Analysis of Residential Trash Incineration Based on Cross-Sectional Data

Submitted 20/07/20, 1st revision 15/08/20, 2nd revision 18/09/20, accepted 31/10/20

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Abstract:

Purpose: *The objective of this paper is to determine the areas that can be a basis for government regulation to reduce illicit residential trash incineration, thus air pollution as well.*
Design/Methodology/Approach: *We used OLS estimation to examine which factors can have a significant effect on consumer behaviour, so by their regulation the incineration could be reduced. We included 10 explanatory variables in the study, our most important hypotheses were about the effects of material well-being and forestation.*
Findings: *Based on our results, whilst the welfare does not have an effect, the increase in forestation (firewood supply) has a reducing effect on illegal burning, however, it is not among the strongest factors in terms of elasticity. Of the factors examined, the greatest impact is caused by the overcrowding of dwellings: less crowded dwellings are less prone to illegal burning. In addition, power consumption, education, and population density are important variables.*
Practical Implications: *Overall, we can say that state intervention in support of education, the enlargement of the urban environment and the availability of modern energy sources can be effective means of combating illegal trash incineration. We note that our model is based on strong simplifications, so the results can significantly distort reality. More precise and more reliable data is needed to improve the estimation, so we urge that this data be included and published as soon as possible.*
Originality/Value: *As we know residential trash incineration has never been investigated from an economic angle with these kind of variables. Our work might be able to add a new approach to this field of study that highlights the opportunities and weaknesses of this topic and provides an incentive for further research.*

Keywords: *Air pollution, energy transition, regression analysis, residential heating, government policy.*

JEL classification codes: *D1, Q4, Q5.*

Paper Type: *Research Paper.*

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1. Introduction

The use of too many solid fuels, especially firewood3, and inefficient use is a big problem in Hungary. Particles released by combustion accumulate in the atmosphere and damage the health of people and other living organisms who inhale them (Agrárminisztérium; Herman Ottó Intézet, 2020). Adding to the problem is the large proportion of the population burning household trash, which not only releases particulate matter (PM) but also toxic substances into the air. According to a survey by the Central Statistical Office, "*34% of savers do not heat the apartment properly during the day, 27% heat with waste, with collected wood also, 26% do not heat in all (heatable) rooms"* (KSH, 2016, old.: 28.).

According to a statement from the National Center for Public Health (formerly the State Public Health and Medical Officer Service), solid fuels are often mixed with household trash. "*Of the household trash, the most commonly burned materials in stoves and open spaces are: plastic packaging of beverages and other PVC plastic waste, waste of textile industry, imported used clothes, artificial resin, plastic, painted fiberboard, plywood, furniture and doors, tires, cables, garden waste, coloured, glossy paper wastes"* (ÁNTSZ, 2012). In fact, trash incineration may be significantly more frequent than voluntarily declared. We can frequently read in the media about its socioeconomic pillars and everyday practices. According to a 2016 report prepared in the northern Hungarian region "*the stoves of Borsod, Heves, Szabolcs (and even Jász-Nagykun-Szolnok county) absorb everything: clothes, PET bottles, wet wood, lacquered parquet, sawdust, green plants or even dead rabbits… anything from which a few calories can be extracted*." "*Anyone who burns not only municipal waste, waste wood, and so on, has usually returned from gas to wood*." "*According to the experience in northern Hungary, 30 percent of the population burns municipal waste; even in cities, it is rife, especially in family-married areas. There are settlements where waste collection could even be suspended"* (Szira, 2016).

Such incineration is against the law, as during the incineration of waste a number of substances are released that are harmful to health, such as:

- carbon monoxide, which is formed during the imperfect combustion of carbon compounds;
- nitrogen oxides resulting from the oxidation of the nitrogen content of air and trash;
- hydrogen chloride and hydrogen fluoride acid gases, the amount of which depends on the chlorine and fluorine content of the trash;

[3]*To understand the importance of (solid) biomass in the European Union and Hungarian energy supply, see: Janiszewska – Ossowska, 2020.*

- sulfur dioxide, which depends on the sulfur content of trash, brown coal and lignite;
- toxic, carcinogenic combustion products of plastics: volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), dioxins, furans, phthalates, ketones, aldehydes, organic acids, alkenes and other organic compounds;
- metals in trash, a significant part of which is deposited on dust particles after incineration, increasing their hazardousness (ÁNTSZ, 2012).

We are faced with a very complex problem from both a natural and social science perspective, which has moral aspects as well ("heats or dies"). In order to eliminate these problems, it is very important to educate consumers and change their attitude (Li *et al.*, 2002; Lange *et al.*, 2014). Professional forums, media appearances by experts, and comprehensible information publications can help to improve the quality of the environment. Such activities are carried out, for example, by the Levegő Munkacsoport (Air Working Group), on the website of which we can find a lot of useful information and practical advice.[4] However, everything has its limitations, as there may be many external obstacles that are not related to the individual's values and knowledge. Therefore, it is important to examine the situation from an economic point of view and to identify the factors that can influence the social and economic processes that cause the problem. Based on settlement-level cross-sectional data, this paper helps identify areas that can be a basis for government regulation to reduce illicit residential trash incineration, thus air pollution as well.

2. Studies of the Solid Fuel Combustion

The results of several studies show that air pollution is much higher in poorer, rural areas than in a more modern, urban environment. Tao *et al.* (2016) researched highly problematic air pollution in China, citing solid firing in households as its primary cause (accounting for only 13 percent of national energy consumption). Dust emissions in rural areas are higher than in urban areas. Unskilled, poorer, rural residents use more polluting energy sources. Kodros *et al.* (2018) also highlight the problems caused by burning solid fuels. An attempt was made to synthesize mortality from air pollution in the indoor and the outer environment using a variance-based sensitivity study. According to the work of Lin *et al.* (2018) the particles accumulating in the atmosphere play a central role in two major problems that threaten humanity: air pollution (about 5 million early deaths per year) and climate change (about 0.5 million early deaths per year). Their study focused on a

[4]*Do not burn that! campaign:* *https://www.levego.hu/egyeb/ne-egesd-el/?gclid=CjwKCAjwpqv0BRABEiwA-TySwSKbusAqdfK1rDKH-s3cOfC9_lrfjT-SjqRirL2_oPmu4iSHyqTwWhoC9d8QAvD_BwE*
Clean heating campaign: *http://levego.hu/kampanyok/tisztafutes/*

medium-sized European city where extreme levels of air pollution were measured. Their analysis found that 70 percent of airborne dust pollution (PM1) is caused by residential peat and wood burning. The solution could be to reduce energy consumption and use more advanced, cleaner energy sources, influenced by a number of natural, social, economic, legal and technical factors.

One such factor is consumer welfare. Based on the famous study by Shafik (1994), we can see that there is a directly proportional relationship between per capita income and household trash generation. It is also salient that the richer a region is, the lower the rate of deforestation and airborne dust concentration. That is, the increase in the well-being of families also has a positive effect on the state of the local environment. Rising earnings allow the use of more advanced, yet more expensive technologies that can also improve air quality. Li *et al.* (2016) suggest that the efficiency of modern stoves can be double that of old, obsolete equipment. This can mean up to an 80 percent reduction in the emission of small particles, and a 66 percent reduction in toxic content. It is also important to note that higher earnings are associated with higher energy consumption, which, when based on carbon-intensive resources, contributes to climate change (Lange *et al.*, 2014).

While income is undoubtedly an important component of energy consumption, it is also affected by many other economic and non-economic variables. Fu *et al.* (2014) examined the use of solid energy sources by the Irish population using spatial econometric modelling. He found the proximity of the source sites (mine, forest) to be the most important factor to consumption. Other relevant factors are gas pipeline coverage and supply-side regulations. Examining Ireland, Abott *et al.* (2016) point to an unsurprising relation: the concentration of poor quality air is higher in smaller, rural regions. In the research of Rahut *et al.* (2016) on the households of Bhutan, the distance from forests to households has a negative effect, and the distance of the cleaner alternative (LPG) market has a positive effect on firewood consumption.

At the same time, social factors such as the age of the head of the family, the size of the family, and the number of children are positively related to wood burning, and play an important role. Conversely, if the head of the family is female, or if he or she is more highly educated, and if the family's income is higher, the rate of wood consumption is reduced. The research of van der Kroon *et al.* (2014) also support the positive effect of family size on consumption, but Kenyan women just appreciate less the advanced technologies than men (which is arising from the gender gap in earnings). Mclean *et al.* (2019), analyzing Peruvian households, identified several factors that are positively related to the use of more modern, cleaner energy sources. According to the results of the regression analysis, the prices of energy sources and the extent of their infrastructure (roads, pipelines), the degree of forestation, education and the degree of urbanization strongly influence the popularity of solid fuels.

Thus, a number of studies with different perspectives have been conducted on the effects of the use of solid fuels on the environment and health. It is striking, however, that in the richer half of the world there is little research on this topic. The causes and consequences are inside and outside the household, have natural and social scientific features, and are variable in space and time. The complexity of the processes requires a holistic approach and the inclusion of a wide variety of variables in the study. Although econometric analysis of residential use of solid energy sources is not a popular topic overall, it has been approached by many in many different ways. Nonetheless, we did not find any research that would analyze or just cover residential trash incineration, especially not with the tools of economics. With our work, we try to help fill this gap. Rainey *et al.* (2016) examined the content of 28 articles on household solid fuel in their review study. The focus of the studies was exclusively on legally usable energy sources, mainly firewood and coal.

Our work also aims to help us understand the reasons behind illegal residential incineration. We would be pleased to be able to draw the attention of researchers from various fields to this undeservedly neglected field. We believe that through all this we can improve the effectiveness of government actions, the state of the environment and thus the quality of people's lives.

3. Application of a Multivariate Linear Regression Model on Cross-Sectional Data

The settlement-level cross-sectional data were downloaded from the website of the National Spatial Development and Spatial Planning Information System (TEIR, 2020). As much of the required information is only available from the census survey, the data refer to the year of the last census, 2011. Nevertheless, we believe that the processes mediated on the basis of the data (microculture, preferences, consumer behavior) have not changed in the past 9 years, so the results can be interpreted with confidence even today. The observations apply to all, i.e. 3154 settlements in Hungary. Data were processed using Stata software version 15.1.

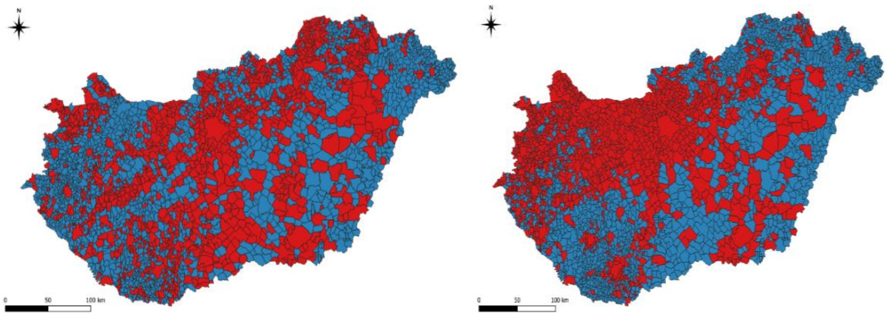
To visualize some basic data and to support the most important hypotheses, we created maps. For the map representation of the settlements we used the OpenStreetMap settlement boundary map files, the thematic maps were created with the QGIS 2.18.20 software.

Based on our preliminary examination (White test), the phenomenon of heteroskedasticity occurs, so we try to reveal the factors affecting the incineration by regression modelling with robust standard errors. The dependent variable of our model is the amount of municipal trash transported from the settlement per capita (TRASH). Behind this is the idea that the more trash is removed from the settlement, the less it is incinerated. Thus, changes that have a positive impact on trash generation are welcome. Of course, this is a strong simplification of reality, which we need to take into account when evaluating the results, but in the absence of better data, we need to content ourselves with this. To estimate consumption, we use 10 explanatory variables, ones that we think are reasonable based on the solid fuel literature.

The map on the left of Figure 1 is intended to emphasize the spatial differences of the dependent variable (Horváthné Kovács - Nagy, 2015). The map shows in red those settlements where the amount of municipal trash transported per capita is higher than the national average. In blue, we can see settlements with a lower amount than the national average, i.e. those where we assume that illegal incineration is more significant. The territorial distribution of the concentration of waste is uneven, at first glance the urban-rural, hilly-lowland, rich-poor differences are strongly mixed. Causal regularity cannot really be detected.

As most research emphasizes the impact of material well-being on fuel switching, we focus on income (Hoiser – Dowd, 1987; Shafik, 1994; An *et al.,* 2002; Arnold *et al.,* 2005). Due to the inconvenience of their use and the increased dust emissions, we consider (traditional) solid fuels as inferior goods. We expect income (INC) to be positively related to transported ("not incinerated") waste and to be one of the most important explanatory factors. In the map on the right-hand side of Figure 1, the settlements with a per capita income higher than the national average are shown in red, while the settlements with below-average values are shown in blue. That is, if our first hypothesis were to prevail very strongly in reality, the colouring of the two maps would have to be very similar. If we compare the maps, we can see some overlapping surfaces between the red areas, but we cannot read a clear connection.

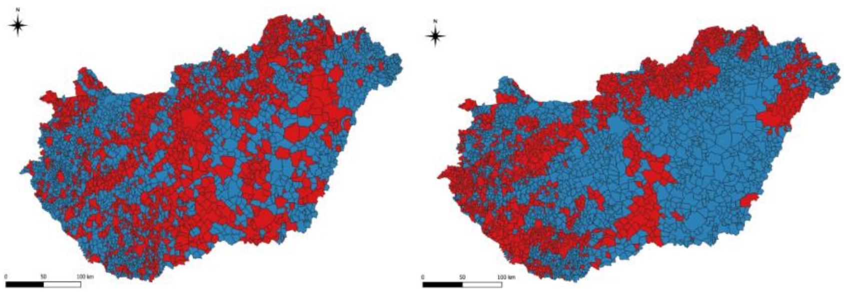
Figure 1. *Trash transported per capita per settlement compared to the national average (left); per capita income per settlement compared to the national average (right) (red/blue: above/below the national average), 2011.*



Source: *TEIR, 2020.*

We also consider the extent of forestation (FOR) as a particularly important variable (Fu *et al.,* 2014; McLean *et al.,* 2019). This can determine the abundance of firewood supply, so its price too and can affect the degree of "theft", transportation costs, and established habits. Thus, more abundant wood can make the use of firewood more popular, which also creates the possibility of trash incineration through co-fired stoves and stokers. Where it is possible to use traditional firewood, there is also a high chance that rubbish will be incinerated, and in this respect, we consider now the two materials being "synonymous" with each other. We suppose that the more opportunities there are to use more modern fuel, the less solid fuel, thus wood and trash will be burnt. Thus, certain natural, social, economic, and technical factors influence the rate of trash incineration, which we assume have a similar effect on firewood use. The map on the left of Figure 2 illustrates the dependent variable as previously described, but the map on the right shows the degree of forestation. A clear-readable pattern cannot be found between the two maps.

Figure 2. *Trash transported per capita per settlement compared to the national average (left); extent of forestation per settlement compared to the national average (right) (red/blue: quantity above/below the national average), 2011.*



Source: *TEIR, 2020.*

We assume a positive relationship between the amount of trash transported and the use of trash incineration substitute products such as natural gas (GAS) and power (POW) (Fu *et al.*, 2014; McLean *et al.*, 2019). As a solid fuel, illegal waste incineration is more common in rural areas, so the more densely populated urban areas (POPD) can have a positive effect on the amount of municipal waste transported (Abbott *et al.*, 2016; Tao *et al.*, 2016; McLean *et al.*, 2019). We suggest that combustion is also positively related to the number of households (HOU) and the size of the dwelling which is measured by the average floor area (FLOOR) (Song *et al.*, 2012).

More and bigger homes also require more energy, so the probability of trash incinerate is higher. The age of the inhabitants can also affect the amount of energy use, which is expressed in terms of the number of seniors per a hundred children (AGE) (Rahut *et al.*, 2016). We assume that older people have higher heat demand due to their poorer health and more time spent in housing, so less garbage is removed from the more aged settlements. We suggest a negative relationship between consumers' qualification and solid firing (Karimu, 2015; Rahut *et al.*, 2016; McLean *et al.*, 2019). Higher educational attainment may have a reducing effect on trash burning through higher average incomes and urban residence. Education is measured by the ratio of people with tertiary education to the total population (EDU). This can also affect the individual's knowledge and environmental awareness, which has a huge impact on heating habits.

According to a non-representative survey, both lack of knowledge and carelessness can be important causes of illicit waste burning (Lenkei, 2016). We also take into account the household (family) size, which is represented by the number of individuals per a hundred households (CROWD) (Van der Kroon *et al.*, 2014; Rahut *et al.*, 2016). We believe that the more modest the financial opportunities, or the stronger the prevalence of old habits, the more residents live under one roof. Like deprivation, a more traditional way of life can encourage residents to burn “anything” that is left over and from which they can get energy. The variables used in the analysis and their descriptive statistics (number of observations, mean, standard deviation, minimum, maximum) are summarized in Table 1. Due to the observability of elasticities, we work with a natural-based logarithmic transformation of the data. Residential trash incineration is thus estimated as a function of the following variables:

$$lnTRASH = f(lnINC, lnFOR, lnGAS, lnPOW, lnPOPD, lnHOU, lnFLOOR, lnAGE, lnEDU, lnCROWD) \quad (1)$$

The relationships between the factors are examined in a multivariate linear regression model with robust standard errors, the general formula of which can be written as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_i X_i + \varepsilon \quad (2)$$

where Y is the dependent variable; $X_1, X_2, X_3, \ldots, X_i$ are the explanatory variables; β_0 is a constant, and ε is the error term.

The definition of the model, that is the line which is suitable for describing relationships based on the ordinary least squares (OLS) method. The method seeks to minimize the sum of the squared residuals (Koop, 2008).

4. Results and Discussion

Most of the results of the model are significant (at 5 or 1 percent level). Examining the regression coefficients that can be considered significant, we can say that four developed as expected (*ln*POW, *ln*POPD, *ln*EDU, *ln*CROWD), but two did not (*ln*FOR, *ln*AGE). Our results for income (*ln*INC), gas (*ln*GAS), number of households (*ln*HOU) and size of dwellings (*ln*FLOOR) are not significant, the variables according to the model have no effect on the amount of trash transported (Table 2).

Table 1. *Abbreviation, definition and descriptive statistics of the variables used in the study*

Abbreviation	Definition	n	Mean	Std. Dev.	Min.	Max.
*ln*TRASH	Municipal trash transported per capita, t	3154	-1.658	0.420	-4.346	-0.018
*ln*INC	Income per capita, HUF	3154	13.182	0.397	10.789	14.401
*ln*FOR	Proportion of forests to total area, %	3154	-1.930	1.262	-6.908	1.196
*ln*GAS	Gas consumption per capita, 1000 m^3	3154	-2.120	1.630	-6.908	0.682
*ln*POW	Power consumption per capita, 1000 kWh	3154	0.013	0.271	-3.327	1.465
*ln*POPD	Population density, head/km^2	3154	3.806	0.881	0.450	8.015
*ln*HOU	Number of households	3154	5.812	1.332	1.946	13.617
*ln*FLOOR	Avarage floor area of dwellings, m^2	3154	4.454	0.102	4.060	4.942
*ln*AGE	Seniors per a hundred children, head	3154	5.064	0.742	-6.908	7.937
*ln*EDU	Ratio of people with tertiary education to the total population, %	3154	-2.976	0.778	-6.908	-0.931
*ln*CROWD	Number of individuals per a hundred households, head	3154	5.527	0.113	4.682	6.094

Source: *Own study.*

Table 2. *Estimated results of the regression analysis with robust standard errors*

Variable	Coefficient	Robust Std. Err.	P >|t|
*ln*INC	0.0250	0.0342	0.4650
*ln*FOR	0.0191	0.0066	0.0040
*ln*GAS	0.0067	0.0061	0.2730
*ln*POW	0.1746	0.0338	0.0000
*ln*POPD	0.0523	0.0137	0.0000
*ln*HOU	0.0110	0.0087	0.2060
*ln*FLOOR	0.0184	0.0859	0.8300
*ln*AGE	0.0294	0.0146	0.0450
*ln*EDU	0.0456	0.0190	0.0160
*ln*CROWD	-0.7111	0.0952	0.0000
Constant	1.6331	0.6113	0.0080

Note: *Prob > F = 0.000;* $R^2 = 0.125$
Source: *Own study.*

One of our most important hypotheses, relating to income (*ln*INC), is that an increase in welfare reduces illegal burning by allowing the use of more modern, cleaner, and at the same time more expensive technologies. Wealthier consumers can afford to give up uncomfortable and dirty sources of energy. In the absence of a significant result, we reject this hypothesis: according to this income has no effect on trash incineration in Hungary today. It is possible that the income effect is overridden many times by other factors, but it is also possible that our outcome variable is, in fact, unsuitable for mapping the relations due to the strong abstraction.
The degree of forestation in the region (*ln*FOR) has a positive effect on the amount of waste transported, which contradicts our hypothesis. The phenomenon may be explained by the fact that larger forests mean more supply, which - keep other variables unchanged - reduces the price of firewood. The locally available raw material also keeps transportation costs low and makes residents of these areas more

likely to replace trash with wood than residents of more barren areas. Abundant wood also creates more opportunities for illegal trade and theft, which, although arguably, also helps replace trash. It is likely that these reasons may be behind the positive relationship.

As the result is not significant, we reject our hypothesis related to natural gas consumption (*ln*GAS). Trash incineration can theoretically be replaced by natural gas, but in practice, this does not seem to be the case. In contrast, the more electricity (*ln*POW) the households consume, the less waste they incinerate. On the one hand, incineration can be replaced by electricity (radiators, electric heaters, air conditioners, heat pumps). On the other hand, more electricity-intensive (typically richer) households often lack a device suitable for mixed combustion, so even if they wanted to, they would not be able to burn "anything". We also found a positive relationship for population density (*ln*POPD). More advanced heating systems in more densely populated urban regions (e.g. district heating, central heating) limit the possibility of combined combustion.

The results for the number of households (*ln*HOU) and for the size of the dwelling (*ln*FLOOR) are not significantthe variables have no effect on trash incineration. The relationship between the age of the inhabitants (*ln*AGE) and the municipal waste transported also contradicts our initial assumption. The relationship between the two variables is positive, for which we cannot find a well-founded explanation. One possible explanation is that older people put on more clothes, thereby requiring less heating (Csutora *et al.*, 2018). It is conceivable that the older generations did not have a really high temperature at home in their childhood and have not demanded it ever since. This can also lead to older people heating less, so they also burn less garbage than younger ones. To understand the exact reasons, a deeper and more detailed examination is needed.

According to our results, higher education (*ln*EDU) has a reducing effect on waste incineration. This is not surprising, as higher education is usually accompanied by an urban environment and greater environmental awareness. Our hypothesis that the more people living in a household (*ln*CROWD), the higher the rate of illegal firing seems to be justified. It is conceivable that although the specific energy demand of a more crowded household is lower, household waste appears to a greater extent in consumption. This may be caused by a more modest income forcing more and more people under one roof, but the result may also carry a regional message. The larger families, the traditional way of life is mostly characteristic of rural areas. The incineration of household waste (which not so long ago meant only natural materials) could also be part of the traditional heating culture developed here.

After running the model, we examine whether we have to reckon with the phenomenon of multicollinearity (Kovács, 2008). It is conceivable that the explanatory variables involved in the study affect not only the dependent variable but also each other, thus amplifying each other's effect and distorting our estimation.

Multicollinearity testing is performed using the variance inflation factor (VIF). Based on the results in Table 3, we can see only a weak (VIF < 2), non-problematic multicollinearity.

Table 3. *Variance inflation factors for testing multicollinearity*

Variable	VIF	1/VIF
*ln*POPD	3.05	0.33
*ln*HOU	2.73	0.37
*ln*EDU	2.66	0.38
*ln*INC	2.56	0.39
*ln*CROWD	1.73	0.58
lnGAS	1.57	0.64
*ln*FLOOR	1.52	0.66
*ln*POW	1.43	0.70
*ln*AGE	1.23	0.81
*ln*FOR	1.11	0.90
Mean VIF	1.96	-

Source: *Own study.*

5. Conclusions and Recommendations

From the results of practical significance, we now draw conclusions that can help plan state interventions. Among the examined factors, the largest marginal effect is caused by the number of individuals per hundred households (-0.71). According to this, less crowded homes are less prone to illegal firing. In order to formulate an official measure related to this, we need to look more closely at these factors. Larger family size is an incomprehensible phenomenon in itself, o which may be caused by poverty, and by the preservation of traditions. The former is relevant for state policy. Income can also play a major role in reducing congestion and enhancing the energy transition. The need for a well-designed, fair and efficient economic, social and fiscal policy that promotes wage growth is thus a current, legitimate demand at all times. Successful implementation of these tools can indirectly change consumer behavior and improve the quality of the environment.

Our second largest variable is electricity consumption (0.18). If households could consume more electricity, they could reduce waste incineration. The pipeline network enabling consumability covers all settlements in the country, so there is no further room for manoeuver in this area (KSH, 2019). Reducing and keeping electricity prices low, and indirectly helping to increase incomes, can also lead to higher consumption and thus a cleaner environment.

Population density (0.05) and education (0.05) also have a significant effect on consumer choice. The average values of both variables are higher in the cities, so the urbanization processes, which are dynamic in themselves, can bring about changes in the right direction for our topic. In addition, campaigns and workshops to increase knowledge and awareness can play an important role. As a first step, it would be important to assess what information consumers have about the impact of firing on environmental quality and human health.

We have rejected our hypothesis about income, namely, it is not enough to entrust the solution of the problem to a fortunate economic situation, increasedprosperity, free markets and social processes--a state role is also needed to stimulate beneficial circumstances. Our second most important hypothesis seems false, but it draws our attention to a number of important things. It seems that in areas with abundant wood, trash incineration is more likely. If we think according to the hierarchical order of the “energy ladder” model, this is a logical assumption. So, if we are able to increase the availability of a higher source of energy, consumers will choose to switch to a more environmentallyand health-friendly alternative. Reducing the price of firewood can be a good way to reduce illegal firing, which can reduce the release of toxic substances into the atmosphere, but it can easily be a significant increase in particulate matter emissions in this way. To reduce dust pollution from biomass, a hypothetical tool could be to reduce the price of pipeline gas. Using it does not allow particulate matter to enter the air, but increases greenhouse gas emissions.

The complexity of the situation could be illustrated by a number of other examples, but even these few thought experiments suggest that we are facing a cross-disciplinary issue that cannot be addressed without the involvement of different aspects in the design of policies. Both regionally and according to the vertical stratification of society, different strategies may be needed, so several different studies are likewise required. In addition to quantitative studies, we can really understand the behaviour and heating habits of individual consumer groups through qualitative research (questionnaires, in-depth interviews) that can capture softer information. Exploring these kinds of peculiarities is an important task, and in this way only can we treat society not as a homogeneous mass, and instead tailor the most effective policies to each group.

Finally, we draw attention once again to the fact that the dependent variable of our model stands for very strong abstractions. Our results may be highly skewed, however, we could not have acted otherwise without better data. Knowing the importance of the topic, and seeing the results of our research, it is clearly important to get more reliable data as soon as possible, with which we can make more accurate estimates.

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