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# *Potential for increasing the efficiency of public administration in municipal institutions based on the relationship between the unemployment rate and the shadow economy*

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***Abstract:*** Effective regulation of the labour market depends to a large extent on the quality of public administration. The Covid-19 pandemic highlighted the problem of unemployment in regions, which led to the spread of the shadow economy. The article aims to research the relationship between the unemployment rate and the shadow economy in Lithuanian regions over the period 2000-2019, to reveal the regional disparities in terms of the above-mentioned economic variables and submit recommendations to municipal authorities on how to reduce the strength of the relationship under consideration. Pearson and MCD correlation coefficients revealed that the relationship between the unemployment rate and the shadow economy is negative in all Lithuanian regions. An increase/decrease in the unemployment rate leads to a decrease/increase in the size of the shadow economy. The hypothesis proposing that "the municipalities with a high unemployment rate tend to have a stronger relationship with the size of the shadow economy" was only partly confirmed. The strongest relationships between the unemployment rate and the size of the shadow economy were found in Visaginas and Marijampolė municipalities, meanwhile only the calculated median values indicated that the unemployment rate in Visaginas amounted to 11.8 percent, and in Marijampolė – to 11.2 percent over the period under consideration. The two above-mentioned municipalities are among the municipalities with the highest unemployment rate, but lag behind Lazdynai (15 percent), Ignalina (14.9 percent.), Kalvarija (14.6 percent), Akmenė (14.5 percent), Jurbarkas (14 percent), and Zarasai (14 percent) municipalities. Considering the results, cooperation between the Employment Service and Lithuanian municipalities should be improved with a view to identifying whether a person registered with the Employment Service has applied to a municipality for social support; the State Labour Inspectorate, the Employment Service and the State Tax Inspectorate should also improve their cooperation to establish the principles for exchange of the data on the activities of the labour force assigned to risk groups.

**Keywords**: inter-institutional cooperation, public administration, unemployment rate, shadow economy, regional analysis, entropy method.

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## Introduction

The European Commission calls on the member states to take action to address the problems of unemployment, skill shortages and inadequate social policies by making full use of the EU funding. The member states should, in particular, support job creation schemes, facilitate the population's transition from unemployment to employment, and strengthen economic and social resilience (Haseeb et al., 2019). The EU governments are under constant pressure to improve the performance of their public sector while curbing expenditure growth (Androniceanu & Georgescu, 2022; Androniceanu et al., 2022; Ciobanu & Androniceanu, 2018). Not only unemployment and a prospering shadow economy are forcing public authorities to take greater account of employment problems in the labour market; the COVID-19 pandemic has been further raising the number of the unemployed in regions administered by municipalities (Androniceanu & Marton, 2021). In the event of crises and emergencies, the current system of public administration fails to effectively regulate the labour market flows and ensure full employment, which is why it is necessary to find innovative solutions aimed at regulating the labour market through the relationship between the unemployment rate and the shadow economy.

Sometimes the phenomenon of the shadow economy tends to be viewed too simplistically – it is just considered to be caused by a lack of tight control by the authorities. The actual size of the shadow economy, however, depends on a variety of factors, such as economic and social situation, tax burden, labour market regulation, labour taxation, the efficiency of the public sector, the pursuit of social welfare, the unemployment rate, and many others (Barkauskaitė, 2014).

Rising unemployment rates force an increasing share of the labour force to search for a job in the informal sector. Nevertheless, extremely high unemployment rates may limit employment opportunities even in the informal sector. Previous scientific studies provide quite controversial results on the relationship between the unemployment rate and the shadow economy. On one hand, some studies record higher scopes of the shadow economy as a percentage of GDP under high unemployment rates (Dell'Anno, Solomon, 2008; Alexandru et al., 2010; Mauleon, Sarda, 2016, etc.); on the other hand, an increase in the number of the unemployed could even coincide with decreasing size of the shadow economy (Giles, Tedds, 2002). In addition, since the shadow economy is a highly complex phenomenon, its dynamics can be explained not merely by the unemployment rate, but by labour opportunities in general as well as the overall situation in the labour market (Schneider, 2012). Hence, the relationship between the unemployment rate and the shadow economy still calls for deeper scientific consideration.

Thus far, the relationship between the unemployment rate and the shadow economy has been mainly analyzed at a national (Giles, Tedds (2002) – Canada; Dell'Anno, Solomon (2008) – the USA; Dobre, Alexandru (2009) – Spain; Alexandru

(Davidescu) (2012) – Romania, etc.) or broad regional level (Bajada, Schneider (2009) – OECD countries; Schneider (2012) – OECD countries; Mauleon, Sarda (2016) – EU countries; Sahnoun, Abdennadher (2019) – developed and developing countries, etc.), but the studies addressing the situation in regions within a single country are scarce. *The main purpose* of this article is to model the relationship between the unemployment rate and the shadow economy in Lithuanian regions and submit recommendations to municipal authorities on how to reduce the strength of the relationship under consideration. For fulfilment of the defined purpose, the following *objectives* were set: 1) to review previous scientific findings on the relationship between unemployment and the shadow economy; 2) to select and substantiate the methodology of the research; 3) to model the relationship between the unemployment rate and the shadow economy in Lithuanian regions. *The methods* of the research include comparative and systematic literature analysis, correlation analysis (the Pearson and MCD correlation coefficients), expert evaluation, and entropy method.

## 1. The relationship between unemployment and the shadow economy: theoretical background

As it was noted by Bajada and Schneider (2009), the unemployment rate tends to move in the opposite direction to the contraction in aggregate economic activity. During the periods of an economic contraction, the output is declining, businesses are downsizing, and some are even going bankrupt, which leads to a rise in the unemployment rate. Although the unemployed are paid welfare benefits, their real income falls sharply, which may push the unemployed workforce to start working informally in the sector of the shadow economy (Bental et al., 2012).

On the other hand, the participation of economic agents in the shadow economy is not determined only by the growing unemployment rate. Labour force operating in the legitimate economy can as well conduct shadow activities. In the latter case, shadow activities can be selected as additional work by full-time employees or a second job by part-time employees (Bajada, Schneider, 2009), i.e. hired labour force can become the hired black labour working for regular firms (Bental et al., 2012). This also applies to the self-employed (car repair, plumbing, child care, crafts, etc.) (Reimer, 2000; Edgkomb, Thetford, 2004, etc.), i.e. the self-employed can become suppliers in the shadow economy. In other words, even under conditions of the growing legitimate economy, both the hired and the self-employed can decide to provide themselves with temporary or permanent jobs, work part-time or full-time, and thus earn fully or partially unregistered income (Weng, 2015). What is more, the reasons for shadow activities may not be related merely to unemployment, but to the excessive tax burden (Williams, Schneider, 2013; Stankevičius, Vasiliauskaitė, 2014; Vousinas, 2017, etc.), overly complex formalization of activities and compliance costs (Williams, Schneider, 2013; Arsic et al., 2015, etc.), inefficient public sector (Vinnychuk, Ziukov, 2013; Gasparėnienė et al., 2016, etc.) and many other factors. The youth employment rate

may also stay high even under the high levels of aggregate economic activity since it might be caused by insufficient skills rather than the economy's growth rate (Axelrad et al., 2018).

Thus, since the determinants of agents' participation in the shadow economy are heterogeneous, the relationship between the unemployment rate and the shadow economy is ambiguous (Tanzi, 1999; Bajada, Schneider, 2009). Some previous research on the relationship between these two phenomena is reviewed in Table 1.

**Table 1. Review of some previous findings on the relationship between the unemployment rate and the shadow economy.**

| Author(s), year | Research method(s) | Countries and periods | Findings |
|---|---|---|---|
| Lithuanian Free Market Institute, 2016 | Statistical data analysis, analytical insights | Lithuania and EU, 2008-2013 | Rather than the unemployment rate, the population's income rate and labour taxation are key determinants of the shadow economy |
| Sahnoun, Abdennadher, 2019 | A simultaneous-equation panel data model | 38 developing and 40 developed countries, 2000-2015 | The relationship is unidirectional negative in developing countries, but bidirectional negative in developed economies |
| Alexandru (Davidescu), 2012 | VECM models, ARDL cointegration | Romania, 2000-2010 | The relationship is negative in the short run, but positive and unidirectional in the long run |
| Dobre, Alexandru, 2009 | The structural equation model (SEM) | Spain, 1970-2007 | The relationship between the shadow economy and the unemployment rate is positive |
| Alexandru et al., 2010 | Johansen and Granger approaches for cointegration, the MIMIC | USA, 1980-2009 | The relationship is strong and unidirectional in the long run |
| Bajada, Schneider, 2009 | The MIMIC | 12 OECD countries, 1991-2005 | Due to the substitution effect, changes in unemployment rate, whether positive or negative, have a similar impact on the changes in the shadow economy in the short run |
| Giles, Tedds, 2002 | Two-way Granger causality | Canada, 1976-1995 | The unemployment rate negatively correlates with the shadow economy; the relationship between the |

| Author(s), year | Research method(s) | Countries and periods | Findings |
|---|---|---|---|
| | | | variables is weak |
| Dell'Anno, Solomon, 2008 | A simple theoretical model, the MIMIC, re-examining Okun's law | USA, 1970-2004 | The relationship between the shadow economy and the unemployment rate is significant and positive |
| Schneider, 2012 | The MIMIC | 21 highly developed OECD country, 1990-2007 | Labour opportunities and the overall situation in the labour market can better explain fluctuations in the shadow economy than the unemployment rate alone |
| Kolm, Larsen, 2003 | A two-sector general equilibrium model | - | Rather than the reduction in the unemployment rate, high punishment fees for informal activities contribute to the reduction in the shadow economy |

The information in Table 1 indicates that the vast majority of previous studies on the relationship between the unemployment rate and the shadow economy confirm the existence of this relationship, but the findings concerning its direction and intensity may significantly vary (Bayar et al., 2020).

Mauleon and Sarda's (2016) study provides empirical evidence that the size of the shadow economy is a direct function of the tax and unemployment rates, which is particularly noticeable in the countries where unemployment rates are high (e.g. Greece, and Spain). The impact of the unemployment rate on the size of the shadow economy intensifies over post-recession periods (like over the post-2008 economic recession).

Sahnoun and Abdennadher (2019) state that the unemployment rate unidirectionally and negatively affects the size of the shadow economy in developing economies, while the relationship between the variables in developed economies is negative but bidirectional. The results also reveal that the relationship between the variables under consideration is sensitive to institutional quality, i.e. when institutional quality is high, the unemployment rate comparatively weakly affects the shadow economy, but when institutional quality is low, the effect is strong. The existence of the statistically significant negative relationship between the unemployment rate (both registered and ILO) in the short run was confirmed by Alexandru (Davidescu) (2012), but the author's findings at the same time propose that this relationship in the long run is positive and unidirectional. Similar results were obtained in Alexandru et al.'s (2010) research of the situation in the USA, where the existence of the relationship between the variables was confirmed, and a

unidirectional causality running from the unemployment rate to the shadow economy was identified. These findings are in line with Bajada and Schneider's (2009) results which propose that short-run fluctuations in the unemployment rate directly affect the short-run fluctuations in the shadow economy, though the possibility of the long-run effects the unemployment might have on the size of the shadow economy is not excluded.

Dell'Anno and Solomon (2008) link the positive relationship between unemployment and the shadow economy to excessive tax burden and overregulation, the two widely recognized key determinants of the informal economy (Schneider, 2012; Enste, 2018, etc.). The authors state that due to the negative impact of these two determinants, business companies have to bear higher employee hiring costs, which frequently leads to "envelope wages" and/or redundancies. The first case is a direct manifestation of the shadow economy, while the second case may reflect it indirectly if the redundant are fully or partly pushed to shadow activities (Schneider and Enste (2002) call the decision of economic agents to operate in the informal sector on account of the pressure of tax burden and overregulation the "exit option"). Apart from the impact of tax burden and state regulation, Schneider (2012) highlights the significant effects of public tax morale and argues that not merely the unemployment rate, but also labour opportunities as well as the overall situation in the labour market must be considered for assessing the fluctuations in the shadow economy. The need for an integrated approach to the labour market in terms of explaining the dynamics of the shadow economy can also be envisaged in Enste's (2003) study which reveals that the attempts to reduce the unemployment rate by shortening working hours are not effective because they lead to longer hours of work in the informal sector. The similar effects are obtained by invoking unreasonably early retirement.

It should be noted that some authors, for instance, Giles and Tedds (2002) find a negative correlation between the unemployment rate and the shadow economy and, in general, treat the relationship between the variables as weak because, according to them, in some cases an increase in the unemployment rate can coincide with a decrease in the shadow economy, but provided that the unemployed work in the informal sector, this situation can even promote the shadow economy's output. Based on the above-mentioned arguments, Giles and Tedds (2002) come to the conclusion that no net effects of the unemployment rate on the size of the shadow economy are statistically significant. Kolm and Larsen (2003) propose that rather than reduction in the unemployment rate, tight control, in particular higher fines for underground activities, may significantly contribute to reduction in the size of the shadow economy as well as real and official unemployment. This effect is possible because higher fines promote wage demands in the informal sector, but diminish those in the formal sector, which makes it profitable for businesses to leave the former and enter the latter.

On balance, vast majority of previous studies confirm the existence of at least a short-term relationship between the unemployment rate and the shadow economy, the intensity of which may depend on the level of national economic development and a phase of the economic cycle. Nevertheless, the results concerning the direction of this relationship and interaction between the variables under consideration are ambiguous. Since most studies focus on the analysis at a national or broad regional level, the research in the regions within a country is still appropriate. Economic theory does not give a clue to determine whether the expected sign of this variable is positive or negative; it has to be solved by the empirical analysis in each country (Dobre, Alexandru, 2009).

## 2. Research methodology

The empirical research is aimed at investigating the relationship between the unemployment rate and the size of the shadow economy in Lithuanian municipalities over the period 2001-2019.

The research hypothesis is formulated as follows:

(H1): *the municipalities with a high unemployment rate have a stronger relationship with the size of the shadow economy.*

In the first stage of the empirical calculations (forthcoming article), the shadow economy was explained through the MIMIC model by using the data of 60 municipalities for the period between 2001 and 2019. The entire period under consideration was divided into such sub-periods as a pre-crisis sub-period (2001-2007), a crisis sub-period (2008-2010) and a post-crisis sub-period (2011-2019), which were examined in detail. At the end of this examination, immigration and employment were found to be the most important variables affecting the size of the shadow economy.

The relationship between the size of the shadow economy (as % of GDP) and the unemployment rate in each municipality was evaluated by employing correlation analysis. The correlation analysis was applied based on both the classical Pearson correlation matrix and the robust Minimum Covariance Determinant (MCD) correlation matrix. The MCD correlation matrix is a matrix that does not lose its ability to represent the data in the presence of outliers in the data set, and is resistant to the impact of outlying observations. The MCD correlation matrix is based on an algorithm that includes different weighting of outliers (Hubert and Debruyne, 2010).

The minimum covariance determinant (MCD) was proposed by Rousseeuw (1984) and afterward, an improved form of the algorithm was presented by Rousseeuw and Van Driessen (1999). It is widely used to detect outlying observations in the dataset. This estimator aims to find $h$ observations (out of $n$) whose covariance

matrix has the lowest determinant. MCD algorithm uses Mahalonobis Distances to find the most homogeneous group of the observations.

To accept/reject the hypothesis, the expert evaluation was being performed during the period May-June 2021; the respondents were asked an open-ended question. A total of 219 experts representing 60 Lithuanian municipalities participated in the survey. The experts were required to possess the following main characteristics: a qualification/position related to the knowledge of the specific municipal situation in the labour market (a mayor, an Employment Service employee, a representative of the Ministry of Social Security and Labour of the Republic of Lithuania, a specialist from the State Tax Inspectorate, an eldership employee, a municipal employee) and experience in the area of employment. The pre-developed questionnaire was delivered electronically, and the results were processed by employing *Microsoft Excel* software.

In this paper, the entropy method is used to measure differences among Lithuanian regions according to shadow economy and unemployment. Entropy is most often defined as a measure of the system's chaos or disorder (Downarowicz & Frej, 2001). The idea of entropy was initially used in thermodynamics. Then, Shannon incorporated this concept into information theory (Shannon, 1948), and the huge success of this concept in this field fueled the applications of entropy in other research areas. One of them is economics, where the application of this concept allowed for the investigation of income inequalities and poverty reduction (Mussard et al. 2003; Chen et al., 2015), green economy (Wu, 2018; Sun, 2021; Yu et al., 2020), economic integration and specialization in production (Vechiu & Makhlouf, 2014), digital economy (Deng et al., 2020), taxation system (Dutta, & Majumder, 2015) and similar important economic issues. However, in regional development analysis, the entropy technique was most widely utilized (Bouvet, 2010; Salois, 2013; Czyz & Hauke, 2015; Liang, et al. 2017; Villas-Boas et al. 2019).

The basis for measuring the shadow economy and unemployment convergence among Lithuanian regions is the methodology used by Czyz and Hauke (2015). They analyzed the divergence in the development of regions in Poland by calculation of the Shannon entropy index.

To calculate the Shannon entropy index using the approach of Czyz and Hauke (2015), first of all, it should be emphasized that the Shannon entropy is a measure of uncertainty about the event with an appropriate probability distribution. The "events" referenced in this study are indicators of the shadow economy and unemployment, and they are denoted by x. A monotonically declining function with probability $p$ determines the information gained from the appearance of a certain event and it can be presented by function $\log 1 / p = - \log p$. It can be defined for a series of events $x_i$ with probabilities $p_i$ that

$$0 \le p(x_i) \le 1, \sum_{i=1}^{n} p(x_i) = 1, \quad (1)$$

where $x_i$ presents shadow economy and unemployment indicator for region *i*, where *i = 1, 2 ... n*.

The measure of entropy $H(x)$ is the expected value of mentioned series which can be represented in form:

$$H(x) = -\sum_{i=1}^{n} p(x_i) \log p(x_i) \quad (2)$$

or

$$H(x) = \sum_{i=1}^{n} p(x_i) \log_2 \frac{1}{p(x_i)} \quad (3)$$

It should be noted that using the logarithm function with base 2 means that information is measured in bits.

The presented formula for calculating Shannon entropy has the following characteristics:

1. It should be a positive value (H(x) ≥ 0);
2. H(x) is assumed to be 0 with $p(x_i) = 1$ for selected *i*, suggesting that there is no uncertainty among indicators.
3. When all values of $p(x_i)$ are equal for *i = 1, 2,... n*, H(x) takes the greatest value equal to $\log_2 n$. The highest value H (x) denotes a system's entire uncertainty or disorder.

The Shannon entropy index I(x) is created and utilized as a measure of divergence across Lithuanian regions based on studied variables (shadow economy and unemployment) x on the basis of the entropy indicator H(x). I(x) is the Shannon entropy index derived as follows:

$$I(x) = H(x)_{max} - H(x) = \log_2 n - \sum_{i=1}^{n} p(x_i) \log_2 \frac{1}{p(x_i)}$$

$$= \sum_{i=1}^{n} p(x_i) \log_2 [n\, p(x_i)\,] \quad (4)$$

The Shannon entropy index should take values in the following range $0 \leq I(x) \leq \log_2 n$ and where $I(x) = 0$ means the total equality among regions, while $I(x) = \log_2 n$ denotes maximum inequality across them.

## 3. Empirical results of the research and discussion

### 3.1 Results of the correlation analysis

Table 2 shows the correlation coefficients between the size of the shadow economy (as % of GDP) and the unemployment rate in each municipality between 2001 and 2019. The correlation coefficients in the table are classified as very weak, weak, moderate, strong and very strong. 48% of the municipalities have a moderate, and 32% of them - a strong correlation relationship. However, this relationship is negative for 93% of the other municipalities, except the ones that have very weak relations.

Although the Pearson and MCD correlation coefficients in the table are similar for many municipalities, the situation is different for Molėtai and Elektrėnai. The Pearson correlation coefficient for Molėtai indicates that there is no relationship (0.01) between the variables, although the MCD correlation coefficient indicates the presence of a moderately negative (-0.43) relationship. Similarly, while the Pearson correlation coefficient for Elektrėnai is weak (-0.14), it is medium in the case of the MCD correlation coefficient (-0.43).

**Table 2. Correlations between the size of the shadow economy (as % of GDP) and the unemployment rate in Lithuanian municipalities between 2001 and 2019**

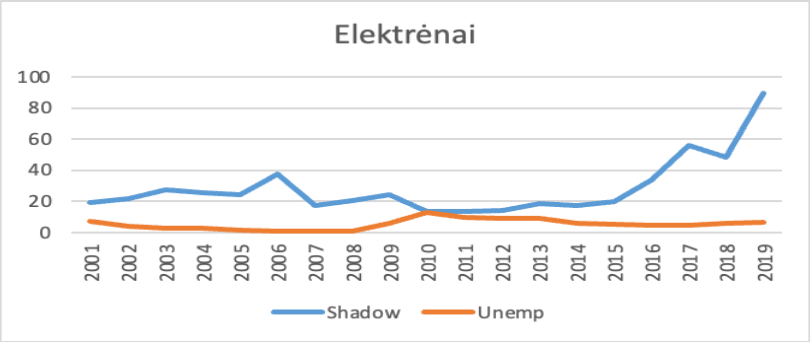
| Correlation | CLASSICAL (Pearson) | | ROBUST (MCD) | |
|---|---|---|---|---|
| Very Weak (0.0-0.19) | **Molėtai** | 0.01 | **Druskininkai** | -0.05 |
| | **Šilalė** | 0.04 | **Šilalė** | 0.07 |
| | **Druskininkai** | -0.06 | **Joniškis** | -0.17 |
| | **Elektrėnai** | -0.14 | **Rietavas** | -0.19 |
| Weak (0.20-0.39) | **Joniškis** | -0.24 | **Švenčionys** | -0.25 |
| | **Rietavas** | -0.25 | **Kazlų Rūda** | -0.25 |

| Correlation | CLASSICAL (Pearson) | | ROBUST (MCD) | |
|---|---|---|---|---|
| | **Kazlų Rūda** | -0.27 | **Kupiškis** | -0.26 |
| | **Pasvalys** | -0.31 | **Birštonas** | -0.31 |
| | **Lazdynai** | -0.32 | **Rokiškis** | -0.31 |
| | **Birštonas** | -0.32 | **Mažeikiai** | -0.33 |
| | **Prienai** | -0.34 | **Lazdynai** | -0.34 |
| | **Kretinga** | -0.36 | **Šakiai** | -0.35 |
| | **Kupiškis** | -0.36 | **Jonava** | -0.36 |
| | **Neringa** | -0.39 | **Raseiniai** | -0.36 |
| | | | **Akmenė** | -0.37 |
| **Moderate (0.40-0.59)** | **Rokiškis** | -0.41 | **Prienai** | -0.41 |
| | **Panevėžys** | -0.43 | **Utena** | -0.41 |
| | **Alytus** | -0.44 | **Elektrėnai** | -0.43 |
| | **Švenčionys** | -0.45 | **Molėtai** | -0.43 |
| | **Raseiniai** | -0.45 | **Klaipėda city** | -0.44 |
| | **Akmenė** | -0.47 | **Pasvalys** | -0.46 |
| | **Kalvarija** | -0.51 | **Radviliškis** | -0.46 |
| | **Šakiai** | -0.51 | **Pagėgiai** | -0.46 |
| | **Jonava** | -0.52 | **Panevėžys** | -0.47 |
| | **Vilkaviškis** | -0.52 | **Pakruojis** | -0.47 |
| | **Biržai** | -0.52 | **Vilkaviškis** | -0.48 |
| | **Telšiai** | -0.52 | **Telšiai** | -0.48 |
| | **Mažeikiai** | -0.53 | **Ukmergė** | -0.49 |
| | **Vilnius** | -0.54 | **Alytus** | -0.49 |
| | **Plungė** | -0.55 | **Neringa** | -0.49 |
| | **Palanga** | -0.56 | **Palanga** | -0.49 |
| | **Panevėžys city** | -0.56 | **Biržai** | -0.49 |
| | **Radviliškis** | -0.56 | **Panevėžys city** | -0.49 |
| | **Ignalina** | -0.56 | **Širvintos** | -0.51 |
| | **Klaipėda city** | -0.57 | **Kalvarija** | -0.51 |
| | **Klaipėda** | -0.57 | **Tauragė** | -0.51 |
| | **Šiauliai city** | -0.57 | **Plungė** | -0.51 |
| | **Trakai** | -0.59 | **Kretinga** | -0.54 |
| | **Vilnius city** | -0.59 | **Šilutė** | -0.55 |
| | **Skuodas** | -0.59 | **Vilnius** | -0.57 |
| | | | **Kėdainiai** | -0.58 |

| Correlation | CLASSICAL (Pearson) | | ROBUST (MCD) | |
|---|---|---|---|---|
| | | | **Jurbarkas** | -0.58 |
| | | | **Kaunas** | -0.59 |
| | | | **Ignalina** | -0.59 |
| **Strong (0.60- 0.79)** | **Kelmė** | -0.61 | **Kelmė** | -0.61 |
| | **Pagėgiai** | -0.61 | **Anykščiai** | -0.61 |
| | **Varėna** | -0.62 | **Alytus city** | -0.62 |
| | **Pakruojis** | -0.62 | **Kaunas city** | -0.63 |
| | **Širvintos** | -0.63 | **Skuodas** | -0.63 |
| | **Ukmergė** | -0.63 | **Šiauliai city** | -0.63 |
| | **Utena** | -0.63 | **Vilnius city** | -0.66 |
| | **Anykščiai** | -0.63 | **Zarasai** | -0.66 |
| | **Kaunas** | -0.64 | **Kaišiadorys** | -0.67 |
| | **Šiauliai** | -0.64 | **Varėna** | -0.68 |
| | **Jurbarkas** | -0.65 | **Trakai** | -0.71 |
| | **Kaišiadorys** | -0.68 | **Šalčininkai** | -0.72 |
| | **Tauragė** | -0.68 | **Šiauliai** | -0.74 |
| | **Alytus city** | -0.69 | **Marijampolė** | -0.75 |
| | **Kėdainiai** | -0.69 | **Klaipėda** | -0.79 |
| | **Kaunas city** | -0.71 | **Visaginas** | -0.79 |
| | **Šilutė** | -0.71 | | |
| | **Šalčininkai** | -0.72 | | |
| | **Zarasai** | -0.76 | | |
| **Very Strong (0.80-0.99)** | **Marijampolė** | -0.83 | | |
| | **Visaginas** | -0.88 | | |

Plots were drawn to examine these different situations more closely. As can be seen in Figure 1 and Figure 2, sudden increases are seen in the size of the shadow economy after 2017. These increases are related to the migration variable, which is one of the variables that determine the size of the shadow economy that rose by 496% from 2018 to 2019 for Molėtai, and by 400% from 2017 to 2019 for Elektrėnai. The Pearson correlation coefficient could not protect the resistance of the variable against the situations considered outliers. As a matter of fact, when considering the values of the Pearson correlation until 2016, it can be seen that the result obtained is the same as in the MCD correlation matrix. The existing relationship is more clearly depicted in Figures 1 and 2. The correlation coefficient for Molėtai and Elektrėnai should be evaluated based on the MCD correlation coefficient, that is, as a moderate.

**Figure 1. Plot of the shadow economy (as % of GDP) and the unemployment rate in Elektrėnai, a closer look**




When analysing the relationship between the shadow economy and the unemployment rate in Elektrėnai over the 2001-2016 period, the largest gaps between the indicators under consideration were observed comparing 2006 and 2016. One possible explanation of the negative impact in the short run can be the inability of the labour market to provide more workplaces whether they are official or 'hidden'/ unregistered (clandestine in some extent, of course) in the case of rising unemployment, which also underlines a limitation of the opportunities to work in the informal economy. According to Giles and Tedds (2002), an increase in the unemployment rate may involve a decrease in the informal economy because it is positively related to the growth rate of GDP and eventually negatively correlated with unemployment (Okun's law).

When analysing the relationship between the shadow economy and the unemployment rate in Molėtai, detailed information on the fluctuations in the indicators under consideration is provided in Figures 2 and 3.

**Figure 2. Plot of the shadow economy (as % of GDP) and the unemployment rate in Molėtai**

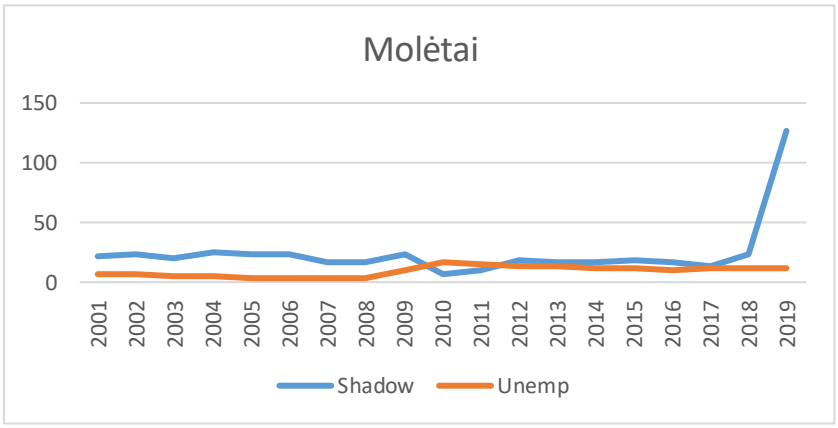
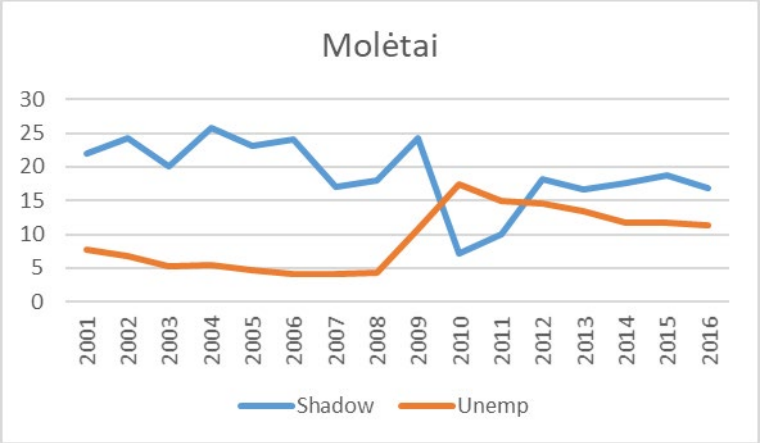


Figure 2 indicates the fluctuations in the shadow economy and unemployment rates between 2001 and 2019. The largest gap between the indicators is recorded in 2019.

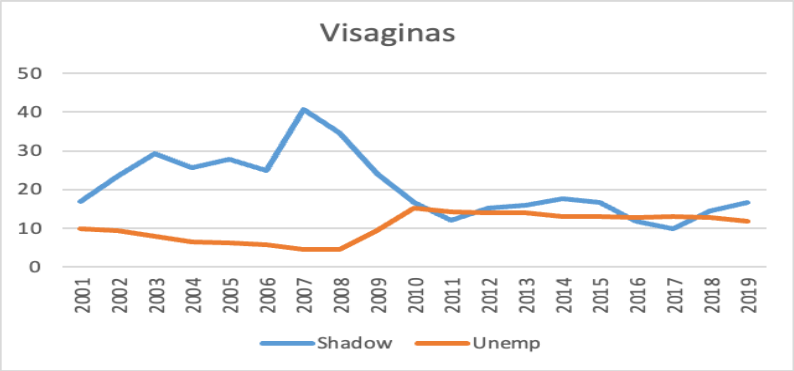
**Figure 3. Plot of the shadow economy (as % of GDP) and the unemployment rate in Molėtai, a closer look**




The workforce in the hidden economy is made up of highly heterogeneous workers; one part of the workers are classified as the unemployed because they are attributable to the official labour force, while the other part of the "hidden" workers are attributable to the group of pensioners, minors and housewives who are not considered to be the official labour force. In addition, there are people who have both formal and informal works at the same time. In this sense, the official unemployment rate can be weakly related to the shadow economy.

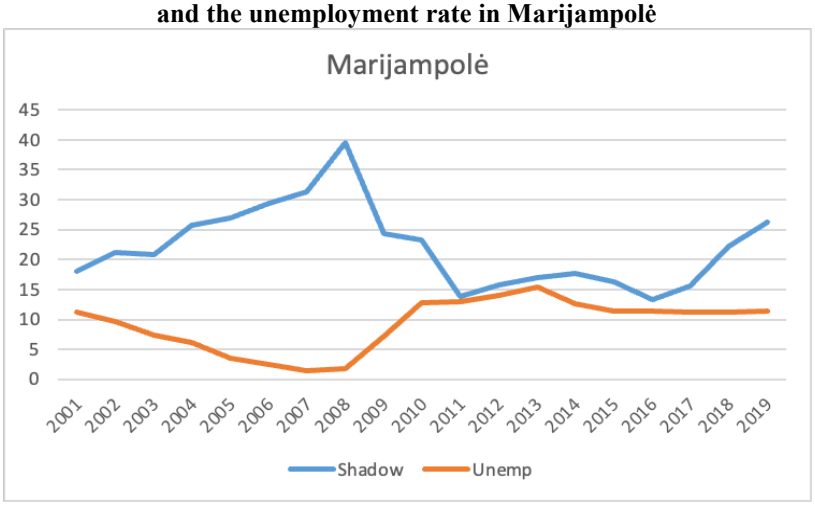
In Figure 4 and Figure 5, the plots of Visaginas and Marijampolė, which have the strongest correlation coefficients respectively, are provided. As can be seen from Figures 1, 2, 3, 4 and 5 the crisis sub-period (2008-2010) can be treated as a breakpoint. It is observed that the shadow economy tends to transfer from an increase to a decrease over the period under consideration, while the unemployment rate tends to transfer from a decrease to an increase over the same period.

**Figure 4. Plot of the shadow economy (as % of GDP) and the unemployment rate in Visaginas**




When assessing the relationship between the shadow economy and the unemployment rate by using the Pearson correlation coefficient, a very strong negative relationship (-0.88) was found between the indicators under consideration in Visaginas. The findings indicate that when the unemployment rate is fluctuating, the size of the shadow economy is moving in the opposite direction.

**Figure 5. Plot of the shadow economy (as % of GDP) and the unemployment rate in Marijampolė**




An increase in the unemployment rate leads to an expansion of the shadow economy, which underlines the positive impact of the unemployment rate on the size of the shadow economy. When the unemployment rate is high, some people become discouraged and stop looking for a new jobs. In this case, they are excluded from the labour force. The unemployment rate may therefore decrease, or stop rising, even though no underlying improvement in the labour market is observed.

For a deeper analysis of the theory of informal economy in terms of the relationship between the unemployment rate and the shadow economy, the results of the expert evaluation are used. Lithuania's economic and cultural conditions determined that as many as 93 percent of the municipalities had a negative relationship between the unemployment rate and the shadow economy.

The experts provided the following insights when explaining this phenomenon in different municipalities:

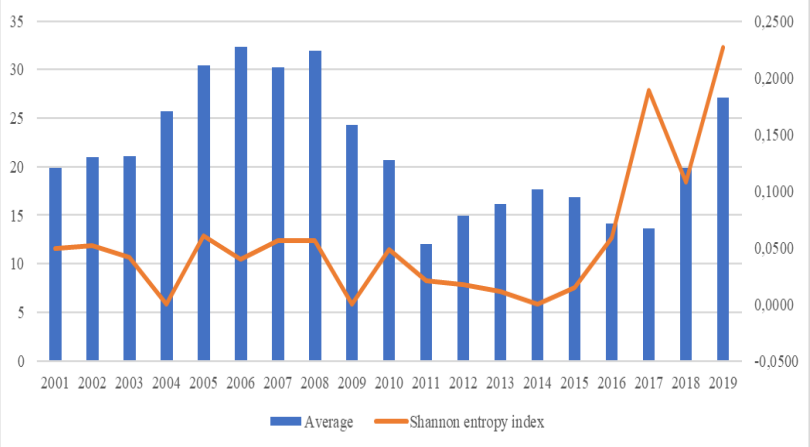
1. A flawed system of granting social benefits prevailing in Lithuania for a number of years has led to deep-rooted long-term unemployment, which creates preconditions for the shadow economy to prosper. The COVID-19 pandemic has even exacerbated this problem. One of the main indicators of exclusion - long-term unemployment - has jumped upwards (as of June 2021, the number of the long-term unemployed reached 41.9 percent). The rising curve of the number of long-term unemployed indicates that long-term unemployment is a complex phenomenon, and the COVID-19 crisis is only one of its determinants. The COVID-19 pandemic has severely hampered the application of the social inclusion and active inclusion (active labour market policy) measures and pushed them out of the legal labour market. The population that has dropped out of the labour market and receives only very little monetary support (about 20-25% of the at-risk-of-poverty threshold) is marginalized, which means that a substantial share of this population either works in the informal labour market or buy products/services from there. Social benefits are not subject to taxation, so it is convenient to receive them for a long time, and when the benefit granting expires, the status of an unemployed also expires, and a person tends to start operating illegally.
2. The amounts of wages and social benefits are similar, which promotes informal operation and tax evasion (formal wages are subject to taxation, while social benefits are not).
3. Employers have no interest in paying higher formal wages. People with many bailiffs' claims for debt repayment tend not to enter into employment contracts, which leads to a negative relationship between the registered unemployment rate and the shadow economy; thus, informal workers remain registered as the unemployed, and the unemployment rate does not fall, and the shadow labour market thrives
4. When the unemployment rate is decreasing/increasing, the level of the shadow economy is decreasing/increasing. One of the reasons for this is that during the number of years of Lithuania's independence, the number of jobs in rural areas was decreasing, which led to the soaring informal sector. Many jobs in small towns and villages disappeared. The residents choose to live on benefits and receive other non-taxable income; they also tolerate the shadow economy.

5. The municipal unemployment rate is usually determined by the forms and amounts of social benefits. The unemployment rate affects only the shadow economy in large municipalities because small regions are characterized by small irregularities. The phenomenon of impunity is flourishing, as the effective control of such regions is too costly for the authorities.

### 3.2 Results of the entropy method

To analyse the differences across regions in Lithuania regarding the size of the shadow economy and the unemployment rate, the entropy method is employed. The Shannon entropy index is calculated firstly for the size of the shadow economy, and the results, together with the average value of the shadow economy, are presented in Figure 6. It is very important to analyse the values of the Shannon entropy index in parallel with the average value of the shadow economy because the analysis of this type allows taking an insight into the causes of the fluctuation differences.

**Figure 6. The Shannon entropy index and the average shadow economy during the 2001-2019 period**

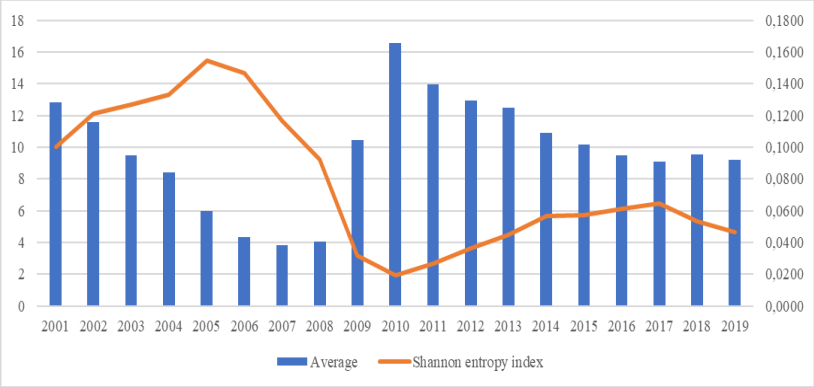



Considering the results presented in Figure 6, it can be concluded that until 2016 the Shannon entropy index recorded relatively low fluctuations and relatively low values, indicating that the differences across Lithuanian regions were low and relatively unchanged. The parallel insight into the average values of the shadow economy during the 2001-2016 period lead to the conclusion that low differences among the regions resulted from the high values of the shadow economy in the majority of the regions, especially during the period 2004-2009. Afterward, low differences among the regions resulted from a decrease in the size of the shadow economy in most of the regions (considering the fact that significantly lower values of the average shadow economy were recorded). After 2016, the value of the

Shannon entropy index rapidly increased, which indicates a sharp increase in the differences among the regions, which is caused by a further decrease in the size of the shadow economy in the majority of the regions and an increase in the size of the shadow economy in only seven regions (Elektrėnai, Vilnius district, Klaipėda, Neringa, Marijampolė, Šiauliai city, Šiauliai district). In 2018, the differences significantly diminished due to a larger size of the shadow economy in a substantial number of the regions (considering the fact that the average shadow economy increased). The last year of the observed period is characterised by sharp growth in the differences. The average shadow economy increased in a large number of the regions, especially in Elektrėnai, Trakai district, Lazdynai district, Klaipėda city, Akmenė district, Šiauliai district, Rietavas, Anykščiai and Molėtai. These regions recorded an increase in the size of the shadow economy over 50%; it was particularly high in Molėtai, where the value of this indicator grew 5.31 times in 2019 in comparison to previous year. The above-mentioned circumstances in 2019 led to a sharp increase in the differences the following year.

The same analysis was performed for the unemployment rate, and the results are presented in Figure 7.

**Figure 7. The Shannon entropy index and the average unemployment rate during the 2001-2019 period**




The first insight in Figure 7 clearly indicates that the observed period consists of two sub-periods. The first sub-period covers the years from 2001 to 2008; it is characterized by the relatively low and decreasing average unemployment rate, as well as significant differences across Lithuanian regions. Such results are determined by a continuous decrease in the unemployment rate in all the regions; the decrease is particularly sharp in Elektrėnai, Marijampolė, Kalvarija, Kazlų Rūda and Šiauliai districts, where the unemployment rate in 2008 decreased more than 80% in comparison to 2001. The differences were most significant in 2005, when the above-mentioned regions recorded the highest decrease in their unemployment rate in comparison to the previous year. The second sub-period

covers the years from 2009 to 2019 and is characterized by the relatively high and declining unemployment rates and the relatively low and increasing differences across the regions. At the beginning of this sub-period, the differences across the regions were very insignificant, and the average unemployment rate was very high (especially in 2010); in fact, the unemployment rate, which increased in all the regions, was a result of the global economic crisis. The differences, however, became significant in 2011, and emerged in parallel with a decrease in the average unemployment rate. The decrease in the unemployment rate was particularly pronounced in Šalčininkai, Vilnius district, Druskininkai, Klaipėda, Kretinga, Skuodas, Panevėžys district, Panevėžys city, Šiauliai city, Šilalė, Telšiai district, Plungė district and Rietavas, which resulted in the slight growth of the differences among the regions. The decrease in the unemployment rate in these regions exceeded 55% in 2019 in comparison to 2010, when the highest average unemployment rate was recorded. It should be noted that the slight decrease in the differences was recorded during the 2018-2019 period; the differences emerged due to a slightly higher decrease in the unemployment rate in the regions under consideration.

To compare the differences in the size of the shadow economy and the unemployment rate across Lithuanian regions, Figure 8 presents the values of the Shannon entropy index estimated for the shadow economy and the unemployment rate during the observed period.

**Figure 8. The Shannon entropy index estimated for the shadow economy and the unemployment rate**

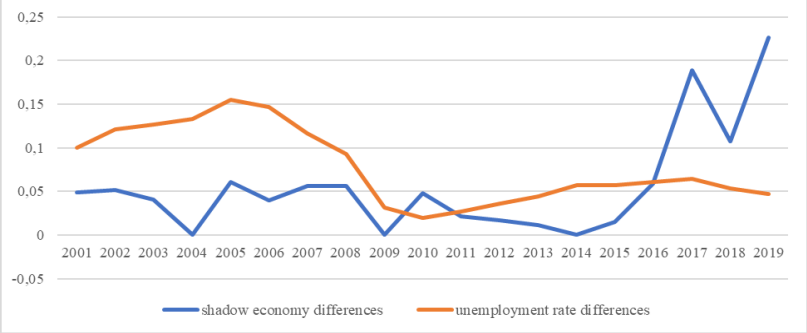



Figure 8 indicates that until 2009, the differences in the unemployment rate were significantly higher than the differences in the shadow economy, which shows that the differences in the unemployment rate were not followed by any increased differences in the size of the shadow economy. In 2010, the differences in the size of the shadow economy were slightly higher than those in the unemployment rate; the year 2010 was followed by the period of the relatively high differences in the unemployment rate rather than the differences in the shadow economy (2011-

2016). After 2016, the differences in the size of the shadow economy were much more significant than the differences in the unemployment rate.

## 4. Conclusions and recommendations

Regarding the relationship between the unemployment rate and the size of the shadow economy (as % of GDP) in Lithuanian municipalities, the correlation analysis revealed that 48% of the municipalities have a moderate, and 32% have a strong correlation between the variables. However, this relationship is negative for 93% of the other municipalities, except the ones that have very weak relations. In terms of linearity, the values of the Pearson correlation coefficient showed the strongest correlation in Visaginas and Marijampolė. The results revealed that when the unemployment rate is fluctuating, the size of the shadow economy is moving in the opposite direction. These findings can be explained by the fact that a substantial number of employees working in the shadow economy are not included in the official labour force due to the hidden nature of the shadow activities. As a result, the officially announced employment statistics do not reflect the true employment rate in the labour market, which, in its turn, leads to overestimated unemployment rates.

The study provides an insight into the actual relationship between the unemployment rate and the size of the shadow economy in Lithuanian municipalities, especially the ones where the above-mentioned relationship is very strong. It can be concluded that the "shadow"/unemployment raises/reduces unemployment/the "shadow". The research hypothesis was only partly confirmed. The strongest relationship between the size of the shadow economy and the unemployment rate was found in Visaginas and Marijampolė, meanwhile only the calculated median values indicated that the unemployment rate in Visaginas amounted to 11.8 percent, and in Marijampolė – to 11.2 percent over the period under consideration. The two above-mentioned municipalities are among the municipalities with the highest unemployment rate, but lag behind Lazdynai (15 percent), Ignalina (14.9 percent.), Kalvarija (14.6 percent), Akmenė (14.5 percent), Jurbarkas (14 percent), and Zarasai (14 percent) districts.

Several determinants can explain the relationship identified during this research: 1) the system of granting social benefits as well as the amounts of social benefits in Lithuania promote unemployment, which, in its turn, leads to the spread of the shadow economy when a substantial share of the population operate informally and at the same time receive social benefits; 2) regional exclusion in municipalities is raising the number of the unemployed, which results in good conditions for the shadow economy to flourish.

Recommendations to the Ministry of Social Security and Labour of the Republic of Lithuania were formulated as follows:

- To improve cooperation between the Employment Service and municipalities with a view to identifying whether a person registered with the Employment Service has applied to a municipality for social support. This would allow to identify persons who apply to the Employment Service only to be granted the CHI (hereinafter referred to as Compulsory Health Insurance).
- To improve inter-institutional cooperation between the State Labour Inspectorate, the Employment Service and the State Tax Inspectorate to establish the principles for exchange of the data on the activities of the labour force assigned to risk groups.
- To review the functions of the Employment Service so that they are based on real help in the areas of providing a job for jobseekers, organizing in-service training/retraining/professional qualification courses rather than providing social assistance.
- To conduct more in-depth and systematic studies to identify personal causes of long-term unemployment and to ensure more intensive work of social workers with persons at social risk and the ones possessing the status of a long-term unemployed.
- To raise wages for unskilled workers in regions and reduce the amounts of social benefits, i.e. to widen the gap between wages and social benefits.
- To reduce workplace taxes, especially in regions with the highest unemployment rates; to reduce taxes for employers and promote subsidy payments in the case of long-term employment contracts (this could prevent paying 'envelope wages'); to reduce taxes for the self-employed who operate in the market under a business certificate or an individual activity certificate. In many cases, the self-employed operate by engaging other persons who are not documented.
- To reduce the duration of the status of an unemployed with the Employment Service.
- To reduce the amount of social benefits paid for the long-term unemployed.
- To intensify the control of job search in the Employment Service; to encourage more employers to use the Employment Service since there is currently a tendency to announce only unattractive job vacancies; with consideration of regional needs, to reduce the requirements for the unemployed to participate in the active labour market programs.
- To organize training for the long-term unemployed to help them establish themselves in the labour market; if a long-term unemployed declines a few job offers, his/her status of an unemployed with the Employment Service should be cancelled, and payment of benefits/compensations should be stopped.

- In the case of commencement of a business under a business certificate or an individual activity certificate, to allow payment only of CHI and exemption from other taxes at least for the first year from the commencement of a new activity.
- To review the benefit-granting procedure and the amounts of the benefits; the benefits should not be granted to young, healthy, able-bodied people; those who receive social benefits should be required to perform community service; the amounts of the benefits should be differentiated according to the number of the community service hours; the higher is the number of the community service hours, the higher benefit a person should be entitled to; the maximum limit of the benefit would promote the need to find a paid employment job.
- To decouple state-granted health insurance from registration with the Employment Service since in the current situation many individuals seek registration with the Employment Service only to avoid paying the CHI.
- To address the transport problems by organising transportation of the former unemployed to work or reimbursing commuter costs.
- To profile the unemployed in order to identify the ones who are not ready for the labour market; this would allow to increase the effectiveness of the employment support measures granted to the unemployed seeking to return to the labour market.

**Conflict of interest:** there is no conflict of interest

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