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Identification of Distorted Official Hospitality Statistics' and Their Impact on DMOs' Funding's Sustainability: Case Notes from Slovakia

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Abstract: Analyzing the usability of open machine-readable registries in the context of minimizing gaps for local occupancy tax evasions in the example of Slovakia is the main purpose of this paper. The concept uses the Registry of Financial Statements' and Registry of Legal Entities' application programming interfaces (APIs) for extracting public data on companies' and entrepreneurs' business nature, in accordance with Eurostat's Statistical classification of economic activities in the European Community (NACE) and United Nations' International Standard Industrial Classification of All Economic Activities (ISIC) at the level of entities' registered address. The resulted data sets are compared with open official data that is available at the municipality level (LAU2), as gathered by the Statistical Office of the Slovak Republic's monthly surveys and municipalities' annual accounts. The comparison's outcomes indicate the deviations between the official and the possible numbers of entities with occupancy tax obligations, as well as tax revenues. The results conclude with how the incorporation of used open APIs in official processes may be beneficial for public and state institutions in the matter of potential local tax evasions, as well as for state regulated public-private partnership destination management organizations. The notes also discuss solutions for the minimization of data and the industry's official impact distortion.

Keywords: open data; occupancy tax; tax evasions

1. Introduction

The European Commission identifies occupancy tax, as one of the number of taxes that are primarily focused on the tourism sector, mostly charged on a per person, per night basis, or as a percentage of room rates, and apart from Malta, the tax itself is levied at the local government level [1].

The question of occupancy taxes necessity was raised already in the early 90s. Hiemstra and Ismail, via their statistical model, estimated the actual average United States (US) levied tax rates [2]. Lee and Ki, via spatial panel estimation of random effects, identified that accommodation service providers that are competing for similar demand without the obligation of occupancy tax are they likely to have an advantage over providers with occupancy tax obligation [3]. On the other side, Lee and Ki acknowledge that the effective use of occupancy tax for tourism promotion may outweigh the disadvantage that arises from higher customer prices [3]. Hamilton et al. analyze the impact of online travel companies' (hereinafter OTCs) impact occupancy tax collection, in particular, whether OTCs are reliable on municipalities for tax collection [4]. Kljunickov et al. raise awareness regarding the misuse of AirBnB's concept of shared economy by accommodation service providers from the perspective of tax evasions and negative impacts on price of local housing and local hospitality

industry [5]. Various recent research studies analyze the sustainability of the hospitality industry; the impact of general and special Value Added Taxes' on the industry at the national level and specific scenarios of tourist's and service providers' attitudes [6–9]. Surgiu and Surgiu list a number of pros (e.g., additional resources for financing local tourism development; local economic environments' improvement, positive effects on equity) and cons (e.g., inflation costs; distorted economic effects; and, negative change of demand toward local services) of tourism taxation, but also acknowledge that impact analysis of tourism taxation is important in supporting responsible decision making [10]. Gago et al. identify taxation's important role among public policies affecting tourism as a sector [11]. The necessity of reliable, precise governmental and public open data has been demonstrated for use in the spatial modelling of environmental risks, modelling of administrative procedures, but also in partial tourism industries [12].

From the perspective of Slovakia's national system of regular funding of local and regional destination management principals' sustainable development, occupancy tax plays a crucial determinant within the funding system's concept that was regulated by Act no. 91/2010 Coll. on Support of Tourism [13]. In accordance with § 29 of the above-mentioned Act, local and regional organizations of tourism, which mainly arise and fulfill tasks as local and regional destination management organizations (hereinafter LDMO and RDMO) by the definition of UNWTO [14], may be granted by annual state funding [13]. Among other rules, LDMOs are eligible for maximum possible funding up to the amount of collected membership fees and limited to 90 % of the annually levied occupancy tax by member local municipalities. In the case of RDMOs, the rule is same, but the limit is up to 10 % of the annually levied occupancy tax within the region's (NUTS3) municipalities.

In terms of Slovak law and regulations, accommodation service providers collect relevant data under multiple occasions [15–18]. As Sidor et al. claim, accommodation service providers report relevant data to occupancy tax multiple times on a monthly base [19]. Data collection and aggregation with decisive impact on the upper-mentioned Act's criteria in regards to municipalities' levied occupancy tax achievement is processed by the Slovak Republic's Statistical Office's (hereinafter SUSR) monthly survey [20]. An offline pdf formula with severe time requirement carries out the survey itself [20]. The outcomes of the survey in a structured or machine-readable fashion are available annually and partially quarterly at the district level (LAU1) [21]. The results at the municipality level (LAU2) are partially accessible for only nine cities [21]. Data of other municipalities' may be received after an evaluated written request. For comparison in other countries of the Visegrad group, such as Czechia, Hungary, and Poland, these outcomes are available at LAU2, with respect to data confidentiality (Czech Statistical Office, 2018; Hungarian Central Statistical Office, 2018; Statistics Poland, 2018). Annual data on levied occupancy tax is partially accessible via Slovak municipalities' annual final accounts [22–24].

Machine-readable data concerning Slovak legal entities' main business's nature in accordance with Eurostat's Statistical classification of economic activities in the European Community may be accessed by the Registry of financial statements' (hereinafter RUZ) application programming interfaces [25,26]. Additional data regarding the nature of Slovak legal entities' all declared business activities in accordance with United Nations' International Standard Industrial Classification of All Economic Activities (hereinafter ISIC) might also be retrieved from the Registry of legal entities (hereinafter RPO) [27,28]. The novelty of the approach is that, the precautionary machine based methodology for identifying all potential accommodation service providers with obligation towards local occupancy tax in Slovakia, without the necessity of web scrapping or the purchase of commercial third party data. The main aim of this paper is to open the discussion about supporting the sustainability of occupancy tax collection by municipalities and related funding based on the example of Slovak LDMOs by identifying the potential vulnerability and gaps in the current system.

Since relevant data at LAU2 are available only for nine cities, the second aim of the paper is to test conceptual approach within the pilot cities from the perspective of:

- comparison of SUSR's data on annual number of accommodation service providers with the data retrieved from RUZ and RPO databases;
- comparison of SUSR's data on annual number of overnight stays with municipalities' data on annual levied occupancy tax; and,
- calculation of estimated occupancy tax evasions and proposal of supplementary solutions for SUSR's system that could lower the resulted deviations between the tested datasets.

2. Input Data Extraction, Harmonization, and Aggregation

The main technological approach within the concept was to aggregate all the obtained data in a structured and machine-readable fashion for subsequent calculations and spatial modelling. For this reason, PostgreSQL with the PostGIS extension was chosen as the base database [29,30]. Due to the availability of municipalities' historical regulations on occupancy tax rates and the levied amounts of taxes, the observed timeline was set between the years of 2008 and 2017. Within the subsections of the chapter, only the used datasets of the input data are available. All of the input data are publicly available and the base examples of used scripts are available for replication [31].

2.1. SUSR's Capacity and Performances of Accommodation Establishments in Selected Towns [cr1003rr]

Official data on annual number of accommodation services providers (Table 1), total bed places, visitors, and overnight stays (Table 2) for the observed timeline were separately downloaded as Excel spreadsheets from SUSR's online, subsequently extracted and then imported via a simple script using basic Python libraries into an earlier created local PostgreSQL database (hereinafter the Database) [30,31]. Two of the cities (Piešťany, Trenčianske Teplice) without any public information on their tax rates between 2008 and 2013, respectively, 2016, were left out of the testing.

Table 1. Official number of accommodation facilities in tested cities (Slovak Republic's Statistical Office's (SUSR)) [21].

City/Year	Banská Bystrica	Bratislava	Košice	Liptovský Mikuláš	Nitra	Poprad	Žilina
2008	25	96	59	66	27	30	40
2009	26	109	62	61	34	28	38
2010	28	113	63	57	33	27	35
2011	29	118	64	53	34	27	34
2012	37	136	68	86	35	40	33
2013	36	128	68	82	36	41	34
2014	32	123	67	76	35	39	33
2015	36	149	71	84	37	41	38
2016	38	151	67	78	36	40	35
2017	40	153	67	79	34	38	32

Table 2. Official number of overnight stays in the tested cities (SUSR) [21].

City/Year	Banská Bystrica	Bratislava	Košice	Liptovský Mikuláš	Nitra	Poprad	Žilina
2008	108 031	1 549 094	283 225	230 001	210 521	164 251	174 133
2009	90 473	1 331 361	220 178	163 423	166 039	117 388	155 423
2010	84 595	1 381 024	262 660	169 750	211 471	116 485	150 789
2011	84 719	1 526 549	254 233	188 577	187 233	146 004	169 737
2012	79 813	1 722 958	258 894	162 273	155 133	149 074	154 132
2013	78 756	1 919 823	285 736	184 483	171 019	162 166	146 429
2014	66 416	1 793 155	262 112	169 160	162 494	158 077	142 103
2015	73 773	2 257 218	305 620	169 807	166 551	181 139	204 143
2016	94 273	2 603 883	350 145	221 410	237 087	198 638	216 720
2017	98 775	2 719 733	367 725	238 330	294 735	194 970	202 630

2.2. Levied Occupancy Tax and Historical Tax Rates within Tested Cities

All nine pilot cities' available annual final accounts and historical records on occupancy tax regulations were reviewed and the amounts of planned and levied occupancy tax revenues (Table 3) and tax rates per overnight stay (Table 4) were noted in a simple spreadsheet [32,33]. Afterwards, the data was imported into the Database via the edited Python script that is used in Section 2.1 [31].

Table 3. Historical occupancy text rates in Euros in tested cities (source).

City/Year	Banská Bystrica	Bratislava	Košice	Liptovský Mikuláš	Nitra	Poprad	Žilina
2008	0.33	1.66	0.83	0.66	0.50	0.66	0.66
2009	0.33	1.65	1.00	0.66	0.50	0.66	0.66
2010	0.33	1.65	1.00	0.66	0.50	0.66	0.70
2011	0.33	1.65	1.00	0.66	0.50	0.66	0.70
2012	1.00	1.65	1.00	1.00	0.50	0.70	1.00
2013	1.00	1.65	1.50	1.00	0.50	0.70	1.00
2014	1.00	1.65	1.50	1.00	0.50	0.70	1.00
2015	1.00	1.65	1.50	1.00	0.50	0.70	1.00
2016	1.00	1.65	1.50	1.00	0.50	0.70	1.00
2017	1.00	1.70	1.50	1.00	0.70	0.70	1.00

Table 4. Levied occupancy tax revenues in Euros in tested cities (source) [33].

City/Year	Banská Bystrica	Bratislava	Košice	Liptovský Mikuláš	Nitra	Poprad	Žilina
2008	59 782	2 844 121	239 594	149 990	153 124	128 958	166 434
2009	42 676	2 254 248	245 491	109 376	96 379	76 579	154 071
2010	30 990	2 321 883	248 441	111 690	110 475	94 553	148 626
2011	38 306	2 414 399	264 638	123 912	103 383	98 616	145 020
2012	88 447	2 488 607	281 015	158 235	84 279	114 565	174 711
2013	101 601	2 681 408	429 927	182 070	74 340	126 607	161 336
2014	92 049	2 759 078	413 199	180 984	74 336	130 290	167 153
2015	89 455	3 166 138	523 694	184 741	76 716	141 266	241 790
2016	121 750	3 562 079	502 130	208 102	108 462	152 566	228 108
2017	123 554	4 958 342	547 420	227 110	205 288	158 378	227 665

2.3. Slovensko.Digital's Registry of Financial Statements' Application Programming Interfaces

In recent years, the civic association Slovensko.digital has been providing machine-readable access to a variety of essential open government and public administration data through structured databases (with thorough metadata) via open-source application programming interfaces (hereinafter API), with the possibility of reuse and integration by third parties under the Creative Commons Attribution 4.0 International Public License [26].

The Registry of Financial Statements' (hereinafter RUZ) API provides a very user friendly Structured Query Language (hereinafter SQL) based access point to gateway data of the Ministry of Finances of Slovak Republic's Registry of financial statements' eXtensible Markup Language API [34]. The platform also provides regular updates of data changes and a possibility of bulk dumps of the whole dataset.

Within the scope of the notes, RUZ data, amongst others, cover, for each legal entity, the date of establishment and termination, registered address, and Eurostat's Statistical classification of economic activities in the European Community (hereinafter NACE) [25]. For the extraction of annual quantities of accommodation service providers (Table 5) within the tested municipalities, a basic PostgreSQL query has been used. The query follows relevant NACE code (55100 Hotels and similar accommodation; 55 200 Holliday accommodations; and, 55300 Camping grounds, in accordance with the relevant timestamps of establishment or termination.

Table 5. Number of accommodation facilities in tested cities within the Registry of Financial Statements' (RUZ) database.

City/Year	Banská Bystrica	Bratislava	Košice	Liptovský Mikuláš	Nitra	Poprad	Žilina
2008	36	236	57	66	28	20	31
2009	37	249	57	62	28	22	30
2010	40	264	56	66	29	20	30
2011	44	278	60	63	26	19	31
2012	48	303	65	67	28	18	34
2013	51	333	75	74	28	19	37
2014	49	342	80	85	29	20	41
2015	44	359	87	85	29	19	44
2016	45	372	94	93	29	18	42
2017	46	388	102	93	32	19	42

2.4. Slovensko.Digital's RPO API

The RPO API is an alternative to SUSR's registries. The same as the RUZ API, it provides a SQL based access point, but all the identification and classification information regarding legal entities was aggregated from 47 official registries (e.g., Business Register, Registry of tradesmen, etc.) [28]. Within the scope of the paper, RPO contains information on legal entities' registered address and all the declared subjects of business activity, partially copying the UN's ISIC methodology's tags' description relevant for accommodation services. For both of the variables, the data are available with validity and suspension timestamps. In order to extract the relevant data, a basic approach of multiple queries was chosen. The first query extracted all business activities (hereinafter BA) with relevant key word combinations corresponding to commercial accommodation services [31]. Afterwards the extract was sorted by timestamps of validity and suspension, and at the same time joined with legal entities' addresses and status, both being sorted by validity timestamps. The final extract was sorted into a simple table covering annual number of legal entities declaring the provision of accommodation services at the municipality level (Table 6).

Table 6. Number of accommodation facilities in tested cities within the Registry of legal entities (RPO) database.

City/Year	Banská Bystrica	Bratislava	Košice	Liptovský Mikuláš	Nitra	Poprad	Žilina
2008	935	3 468	2 238	1 857	502	412	1 431
2009	952	3 744	2 244	1 812	533	381	1 378
2010	971	4 067	2 255	1 825	549	378	1 362
2011	994	4 382	2 314	1 752	553	385	1 335
2012	1 029	4 909	2 414	1 741	587	386	1 355
2013	1 073	5 604	2 583	1 702	682	383	1 371
2014	1 099	6 055	2 702	1 679	674	381	1 333
2015	1 089	6 738	2 770	1 627	681	383	1 304
2016	1 162	7 663	2 844	1 622	703	382	1 318
2017	1 287	8 659	2 948	1 646	772	396	1 308

2.5. Finalazitaion of the Base Data Set

After basic data format cleaning, all of the extracted data was joined as one dataset. Each municipality inherited RUZ's identification code that originates in SUSR's general databases and every variable received a logical text abbreviation identity (Figure 1).

Columns	Type	Description
municipality_id	integer	Unique identification number of municipalities used by SUSR and RUZ
city	text	Name of the city
var_type	text	Abbreviation of input data's variables following a three positional logical concept. n_acc_susr – n stands for variable type (number); acc represents category's abbreviation (accommodation) and susr represents the source database.
2008–2017	numeric	Numerical value of the variable within the given year.

Figure 1. The final extract datasets description.

3. Approach of Statistical Modeling

For a better understanding of the overall distortion between source databases, data extracts that were obtained by the base PostgreSQL script's [31] modification at the national level between years 1998 to 2007 were tested via built-in Python modules OLS Regression Analysis and the ANOVA test. The basic overview of data on the annual number of accommodation service providers (hereinafter n_acc) grouped by data sources shows extreme differences mainly for the RPO data (Table 7). In comparison with RUZ and SUSR, RPO reaches, at the same size of observation (N), extremely higher values of Standard deviation (SD), Standard error (SE), 95% confidence level (95 % Conf.), and Interval (Table 7).

Table 7. Summary statistics of source data groups' at national level.

Source	N	Mean	SD	SE	95% Conf.	Interval
RPO	20	40 170	14 945.2	3 341.849	33 449.82	46 890.18
RUZ	20	1 609.5	535.2206	119.679	1 368.835	1 850.165
SUSR	20	2 873.9	626.4254	140.073	2 592.225	3 155.575

Even though the samples are independent and all three samples are from a normally distributed population, the ANOVA test's obligatory assumption of groups' equal Standard deviation cannot be fulfilled (Table 8). For this reason, the one-way ANOVA test's associated p-value cannot to be considered to be valid (Table 8).

Table 8. Results of the one-way ANOVA tests of source data groups' at the national level.

F-Value	p-Value
128.52776849735147	$7.546566927916095 \times 10^{-22}$

For this reason, the Ordinary Least Squares (OLS) fitted regression model was used, with the number of accommodation service providers as the dependent variable (Figure 2); for high values, RPO was used as the Intercept. From the perspective of OLS results, the overall model at F(Df Model: 2, Df Residuals: 2) and p-value of almost 0 (Prob(F-statistic) indicates enormous differences for the groups' means. The p-values (p>|t|) between groups show no differences and the overall variance is significant.

Dep. Variable:	n_acc			**R-squared:**		0.819
Model:	OLS			**Adj. R-squared**		0.812
Method:	Least Squares			**F-statistic:**		128.5
Date:	Friday, 8 February 2019			**Prob (F-statistic):**		7.55×10^{-22}
Time:	10:14:52			**Log-Likelihood:**		−627.46
No. Observations:	60			**AIC:**		1261
Df Residuals:	57			**BIC:**		1267
Df Model:	2					
	coef	**std err**	**t**	**p>|t|**	**[0.025**	**0.975]**
Intercept	4.017×10^4	1932.35	20.788	0.000	3.63×10^4	4.4×10^4
C(source)[T.ruz]	-3.856×10^4	2732.75	−14.111	0.000	-4.4×10^4	-3.31×10^4
C(source)[T.susr]	-3.73×10^4	2732.75	−13.648	0.000	-4.28×10^4	-3.18×10^4
Omnibus:		11.386		**Durbin-Watson:**		0.263
Prob(Omnibus):		0.003		**Jarque-Bera (JB):**		13.678
Skew:		−0.762		**Prob(JB):**		0.00107
Kurtosis:		4.775		**Cond. No.**		3.73

Figure 2. Ordinary Least Squares (OLS) regression results.

Via post-hoc testing an ANOVA model was created, which also indicates enormous variance of the groups (sum_sq) (Table 9). The unsystematic variation in the data for residuals is also enormous (sum_sq) (Table 9).

Table 9. ANOVA model results.

	sum_sq	df	mean_sq	F	PR(>F)	eta_sq	omega_sq
Source	1.92×10^{10}	2	9.6×10^{9}	128.5278	7.55×10^{-22}	0.818503	0.809557
Residual	4.26×10^{9}	57	7.467932×10^{7}				

For better visualization of the distorted linear relationship between the input data sources, a Three-Dimensional (3D) Multi Linear Regression plot was elaborated in Python (Figure 3), where SUSR data was set as the response variable and RUZ and RPO data as the predictor variables. As the plot indicates, even though the number of accommodation service providers that were recorded by SUSR and in RUZ annually grow, the number of relevant entities identified in RPO grow at a much larger scale.

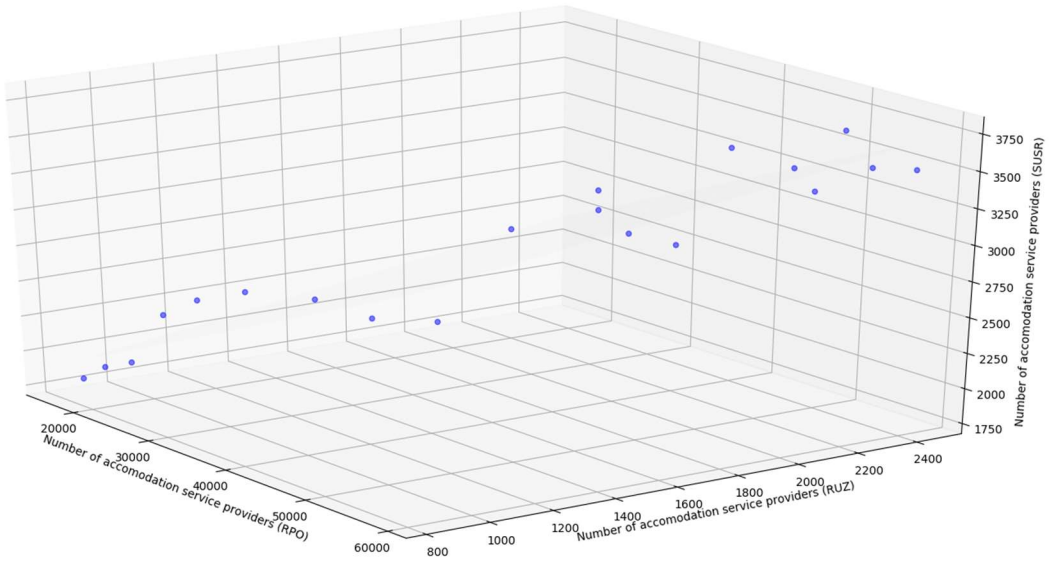

Figure 3. Multilinear regression plot between SUSR, RUZ, and RPO data.

General observations at the national level only show a statistical distortion in the analyzed registries and they do not cause a significant problem at first sight. On the other side, these distortions at the municipality level directly affect the number of entities with obligations of reporting local occupancy tax collection. For this reason, the following section is focusing on data at the municipality levels.

In regards to attaining efficiency, all calculations were carried via SQL queries. Firstly, a basic back check on the ratio (rat_acc_ruz, rat_acc_rpo) of the officially operating accommodation service providers (n_acc_susr), registered accommodation service providers in RUZ (n_acc_susr), and legal entities declaring the provision of accommodation service providers within RPO (n_acc_rpo) (1).

$$\begin{array}{c} \text{Ratio of officially operating accommodation service providers and} \\ \text{accommodation service providers identified in RUZ (rat\_acc\_ruz)} = \\ \dfrac{\text{Number of accommodation service providers identified in RUZ (n\_acc\_ruz)}}{\text{Number of accommodation services providers identified by SUSR (n\_acc\_susr)}}; \\ \text{Ratio of officially operating accommodation service providers and} \\ \text{accommodation service providers identified in RUZ (rat\_acc\_rpo)} = \\ \dfrac{\text{Number of accommodation service providers identified in RPO (n\_acc\_rpo)}}{\text{Number of accommodation services providers identified by SUSR (n\_acc\_susr)}} \end{array} \quad (1)$$

Since some of the municipalities have exceptions for occupancy tax obligation (e.g., students, pensioners, disabled persons), the input data on the levied tax (tax_real) and

occupancy tax rate (tax_rate) may be used to get the number of taxable overnight stays (n_nights_real_tax_div_tax_rate) (2).

$$\text{Number of taxed overnight stays (n\_nights\_real\_tax\_div\_tax\_rate)} = \frac{\text{Total annual levied occupancy tax levied (real\_tax)}}{\text{Occupancy tax rate per overnight stays (tax\_rate)}} \quad (2)$$

For the intention of estimating the theoretical amount of levied occupancy tax based on RUZ and RPO data, the average number overnight stays per accommodation service provider (hereinafter ASP) (avg_night_per_acc_susr) was calculated (3).

$$\text{Average number of overnights per ASP for SUSR (avg\_night\_per\_acc\_susr)} = \frac{\text{Total annual number of overnight stays in SUSR (nights\_susr)}}{\text{Total annual number of ASPs in SUSR (n\_acc\_susr)}} \quad (3)$$

The results then were used to estimate the number of accommodation service providers (n_acc_tax) by the number of taxable nights (n_nights_real_tax_div_tax_rate) and the average number of overnight stays per accommodation service provider (avg_night_per_acc_susr) (4).

$$\text{Estimated number of ASPs based on levied tax and average of ASPS (n\_acc\_tax)} = \frac{\text{Number of taxed overnight stays (n\_nights\_real\_tax\_div\_tax\_rate)}}{\text{Average number of overnights per ASP for SUSR (avg\_night\_per\_acc\_susr)}} \quad (4)$$

In accordance with SUSR's monthly survey, SUSR's data should cover all overnight stays (n_nights_susr) of all accommodation facilities, regardless the operating legal entities' NACE code. Assuming the validity of SUSR's data, it is possible to estimate the ratio of taxable nights (ratio_taxable_nights) (5).

$$\text{Ratio of taxable overnight stays (ratio\_taxable\_nights)} = \frac{\text{Number of taxed overnight stays (n\_nights\_real\_tax\_div\_tax\_rate)}}{\text{Total annual number of overnight stays in SUSR (nights\_susr);}} \quad (5)$$

Based on the results (2), the initial approach was to calculate the annual number of overnight stays' estimation based on RUZ (n_acc_ruz) and RPO (n_acc_rpo) data on the number of accommodation service providers (6).

$$\begin{gathered}\text{Estimated number of overnight stays based on RUZ input data (n\_nights\_ruz)} = \\ \text{Number of accommodation service providers identified in RUZ (n\_acc\_ruz)} \\ \times \\ \text{Average number of overnights per ASP for SUSR (avg\_night\_per\_acc\_susr);} \\ \text{Estimated number of overnight stays based on RPO input data (n\_nights\_rpo)} = \\ \text{Number of accommodation service providers identified in RPO (n\_acc\_rpo)} \\ \times \\ \text{Average number of overnights per ASP for SUSR (avg\_night\_per\_acc\_susr);}\end{gathered} \quad (6)$$

Afterwards, the estimated number of taxable nights based on RUZ (n_nights_ruz) and RPO (n_nights_rpo) data and the ratio of taxable nights (ratio_taxable_nights) calculation was planned (7).

$$\begin{gathered}\text{Estimated number of taxable overnight stays based on RUZ (taxable\_nights\_ruz)} = \\ \text{Estimated number of overnight stays based on RUZ input data (n\_nights\_ruz)} \\ \times \\ \text{Ratio of taxable overnight stays (ratio\_taxable\_nights);} \\ \text{Estimated number of taxable overnight stays based on RPO (taxable\_nights\_rpo)} = \\ \text{Estimated number of overnight stays based on RUZ input data (n\_nights\_rpo)} \\ \times \\ \text{Ratio of taxable overnight stays (ratio\_taxable\_nights);}\end{gathered} \tag{7}$$

The final planned step was to calculate the theoretical volume of levied occupancy tax (8) for the achieved RUZ and RPO data (7).

$$\begin{gathered}\text{Estimated theoretical possible levied occupancy tax based on RUZ (tax\_ruz)} = \\ \text{Estimated number of taxable overnight stays based on RUZ (taxable\_nights\_ruz)} \\ \times \\ \text{Occupancy tax rate per overnight stays (tax\_rate);} \\ \text{Estimated theoretical possible levied occupancy tax based on RPO (tax\_rpo)} = \\ \text{Estimated number of taxable overnight stays based on RPO (taxable\_nights\_rpo)} \\ \times \\ \text{Occupancy tax rate per overnight stays (tax\_rate)}\end{gathered} \tag{8}$$

In the case of the RUZ dataset, the results were mixed up (Table 10) and the interim results on the ratio of number of accommodation service providers between RPO and SUSR were enormous (Table 11) as well, the initial approach (7, 8) was not carried out. Instead, the possible number of accommodation service providers (avg_acc_ruz_rpo_susr_tax) was calculated as the average between the RUZ, RPO, SUSR datasets (9) and, respectively, the number of overnight stays was calculated as well (n_nights_ruz_rpo_susr_tax) (10).

$$\begin{gathered}\text{Number ASPs based on the mean of input data (avg\_acc\_ruz\_rpo\_susr\_tax)} = \\ \frac{\text{SUM}\left(\begin{array}{c}\text{Number of accommodation service providers identified in RUZ (n\_acc\_ruz),} \\ \text{Number of accommodation service providers identified in RPO (n\_acc\_rpo),} \\ \text{Number of accommodation services providers identified by SUSR} \\ \text{(n\_acc\_susr), Estimated number of ASPs based on levied tax and average of} \\ \text{ASPS (n\_acc\_tax)}\end{array}\right)}{\text{4 (Number of input observation data sources)}}\end{gathered} \tag{9}$$

$$\begin{gathered}\text{Estimated number of theoretical number of overnight stays (n\_nights\_ruz\_rpo\_susr\_tax)} = \\ \text{Number ASPs based on the mean of input data (avg\_acc\_ruz\_rpo\_susr\_tax)} \\ \times \\ \text{Average number of overnights per ASP for SUSR (avg\_night\_per\_acc\_susr)}\end{gathered} \tag{10}$$

The final estimation of number of overnight stays (n_nigths_est) was calculated (11) as the average of overnights stays extracted from SUSR (Table 2), and the calculated overnight stays from levied occupancy tax (2), RUZ (6), RPO (6), and theoretical number of overnight stays (10).

$$\text{Final estimation of number of overnight stays (n\_nigths\_est)} = \frac{\text{SUM}\left(\begin{array}{c}\text{Number of accommodation service providers identified in RUZ (n\_acc\_ruz),}\\ \text{Number of accommodation service providers identified in RPO (n\_acc\_rpo),}\\ \text{Number of accommodation services providers identified by SUSR (n\_acc\_susr),}\\ \text{Estimated number of ASPs based on levied tax and average of ASPS (n\_acc\_tax),}\\ \text{Estimated number of ASPs based on levied tax and average of ASPS (n\_acc\_tax)}\end{array}\right)}{\text{5 (Number of input observation data sources)}} \quad (11)$$

The last step was to determine the number of taxable nights from the final estimated overnight stays as was planned for RUZ and RPO (6), respectively, to calculate the estimated potential occupancy tax revenues (7).

4. Results

In terms of the ratio (1) of the number of accommodation services providers (hereinafter ASPs) in the RUZ dataset, as identified by their main NACE code, and ASPs, as identified by SUSR, shows certain deviations (Table 10). The deviations may be caused by the limits § 7 of the Slovak Business code with an impact on § 30 of the Slovak Trade Code. By the mentioned regulations, companies are not obligated to register their places of operation, only their seat and organizational sections must be registered within the Slovak Business registry. This may cause situations where companies that are registered in bigger cities (e.g., Bratislava, Košice) operate accommodation facilities outside the municipality of their seat and vice versa. Since there is no official methodology or system for municipalities as to how to effectively identify potential ASPs in bulk, and SUSR does not have the capacities to check every legal entity on site, the deviations may also be caused by ASPs ignorance towards SUSR's monthly survey. From the perspective of sustainable funding for local tourism and the monitoring of the overall economic impact of tourism, these deviations may distort the position of tourism within the local, regional, and national economy.

Table 10. Percentage (%) ratio of number of accommodation service providers between RUZ and SUSR.

City/Year	Banská Bystrica	Bratislava	Košice	Liptovský Mikuláš	Nitra	Poprad	Žilina
2008	144	245.83	96.61	100	103.7	103.33	102.5
2009	142.31	228.44	91.94	101.64	82.35	107.14	97.37
2010	142.86	233.63	88.89	115.79	87.88	111.11	105.71
2011	151.72	235.59	93.75	118.87	76.47	114.81	120.59
2012	129.73	222.79	95.59	77.91	80	85	118.18
2013	141.67	260.16	110.29	90.24	77.78	90.24	123.53
2014	153.13	278.05	119.4	111.84	82.86	105.13	133.33
2015	122.22	240.94	122.54	101.19	78.38	107.32	118.42
2016	118.42	246.36	140.3	119.23	80.56	105	122.86
2017	115	253.59	152.24	117.72	94.12	110.53	137.5

The outcome ratio (1) is more disturbing in the case of the extracted RPO dataset (Table 11). The enormous deviations may be caused due to the openness of the source registries, without any systematic control. Generally, anyone can register any legal type of business activity, but without any back checks at legal entities, whether the registered business activity is being carried out may cause the same issues as the upper-mentioned in the case of the RUZ dataset.

Table 11. Percentage (%) ratio of number of accommodation service providers between RPO and SUSR.

City/Year	Banská Bystrica	Bratislava	Košice	Liptovský Mikuláš	Nitra	Poprad	Žilina
2008	3 740	3 612.5	3 793.22	2 813.64	1 859.26	4 770	2 287.5
2009	3 661.54	3 434.86	3 619.35	2 970.49	1 567.65	4 921.43	2 471.05
2010	3 467.86	3 599.12	3 579.37	3 201.75	1 663.64	5 044.44	2 780
2011	3 427.59	3 713.56	3 615.63	3 305.66	1 626.47	4 944.44	2 932.35
2012	2 781.08	3 609.56	3 550	2 024.42	1 677.14	3 387.5	3 163.64
2013	2 980.56	4 378.13	3 798.53	2 075.61	1 894.44	3 343.9	3 502.94
2014	3 434.38	4 922.76	4 032.84	2 209.21	1 925.71	3 417.95	3 563.64
2015	3 025	4 522.15	3 901.41	1 936.9	1 840.54	3 180.49	3 150
2016	3 057.89	5 074.83	4 244.78	2 079.49	1 952.78	3 295	3 548.57
2017	3 217.5	5 659.48	4 400	2 083.54	2 270.59	3 442.11	3 965.63

At first sight, the calculated (2) number of taxed overnight stays (Table 12) does not bring any suspicions, but the ratio of taxable nights raises (3) a few questions. Since SUSR's monthly surveys should record all overnight stays, which is in contrast with municipalities that only record overnight stays with occupancy tax obligation, the ratio of taxable nights should theoretically never reach a ratio that is higher than 100%.

Table 12. Number of nights with obligatory occupancy tax within the tested cities.

City/Year	Banská Bystrica	Bratislava	Košice	Liptovský Mikuláš	Nitra	Poprad	Žilina
2008	180 100	1 713 640	288 720	227 258	307 533	194 250	250 700
2009	129 321	1 366 211	245 491	164 723	193 568	116 029	232 077
2010	93 909	1 407 202	248 441	169 227	221 878	143 262	212 322
2011	116 079	1 463 272	264 638	187 745	207 634	149 418	207 172
2012	88 447	1 508 247	281 015	158 235	169 266	163 664	174 711
2013	101 601	1 625 096	286 618	182 070	148 680	180 868	161 336
2014	92 049	1 672 168	275 466	180 984	148 672	186 128	167 153
2015	89 455	1 918 872	349 129	184 741	153 432	201 809	241 790
2016	121 750	2 158 836	334 753	208 102	216 924	217 951	228 108
2017	123 554	2 916 672	364 947	227 110	293 269	226 254	227 665

Unfortunately, the resulted ratio of taxable nights (Table 13) indicates that municipalities record more overnight stays than SUSR. None of the cities meet the criteria of having the ratio under 100 % within the observed timeline.

Table 13. Ratio of taxable nights within the tested cities.

City/Year	Banská Bystrica	Bratislava	Košice	Liptovský Mikuláš	Nitra	Poprad	Žilina
2008	166.71	110.62	101.94	98.81	146.08	118.26	143.97
2009	142.94	102.62	111.5	100.8	116.58	98.84	149.32
2010	111.01	101.9	94.59	99.69	104.92	122.99	140.81
2011	137.02	95.85	104.09	99.56	110.9	102.34	122.05
2012	110.82	87.54	108.54	97.51	109.11	109.79	113.35
2013	129.01	84.65	100.31	98.69	86.94	111.53	110.18
2014	138.59	93.25	105.09	106.99	91.49	117.75	117.63
2015	121.26	85.01	114.24	108.79	92.12	111.41	118.44
2016	129.15	82.91	95.6	93.99	91.5	109.72	105.25
2017	125.09	107.24	99.24	95.29	99.5	116.05	112.36

The first consideration of what causes this deviation was that municipalities' final annual accounts cover additionally collected occupancy tax debts from the year before. Since annual accounts identify accommodation service providers' tax debts for the given year separately, summing the levied tax revenues and debts would create an even larger gap in the ratio. This partially proves the basic distortion of SUSR's records that were obtained by the monthly survey system.

With these interim results, the calculation of taxable nights from the final estimated number of overnight stays would be distorted for years where the ratio of taxability is over 100 % (Table 13). For this reason, two modified tests were attempted to be carried oud. Firstly, the attempt to use the average annual ratio of taxability was left out of the testing. Only one of the tested cities—Bratislava—met the lesser than 100 % ratio criteria. Due to the large gap, the second calculation was carried out by the minimum ratio of taxable nights for each municipality (Table 14), which still achieved three to 11 times more than SUSR's records. Cities Banská Bystrica and Žilina were excluded from the final calculations, due to the fact that the cities' minimum ratio did not meet the lesser than 100 % criterion.

Table 14. Estimated taxable overnight stays based on minimum ratio of taxable nights.

City/Year	Bratislava	Košice	Liptovský Mikuláš	Nitra	Poprad
2008	10 178 595	2 146 853	1 303 151	755 670	1 617 403
2009	8 316 910	1 594 296	974 568	505 638	1 191 906
2010	9 015 489	1 880 472	1 090 616	681 261	1 212 072
2011	10 260 953	1 839 914	1 249 513	587 387	1 491 599
2012	11 247 128	1 842 325	671 906	501 262	1 054 523
2013	15 100 835	2 176 384	785 931	616 696	1 134 699
2014	15 778 071	2 117 606	770 015	596 215	1 133 926
2015	18 221 765	2 394 951	682 716	585 033	1 215 048
2016	23 432 465	2 983 786	956 975	880 099	1 376 575
2017	27 147 508	3 250 164	1 031 160	1 264 042	1 410 120

The final estimated possible levied occupancy tax revenues reach astronomic amounts (Table 15). To claim that these levels of revenues are exact or realistic would be a blind bold claim. However, the large gap between the ratio of the estimated and official records on occupancy tax revenues (Table 16) are a warning for the sustainability of the current system of governing data recording.

Table 15. Estimated occupancy tax revenues in Euro based on minimum ratio of taxable nights.

City/Year	Bratislava	Košice	Liptovský Mikuláš	Nitra	Poprad
2008	16 893 373	1 781 562	860 080	376 255	1 073 759
2009	13 722 902	1 594 296	647 113	251 762	786 658
2010	14 875 557	1 880 472	719 807	339 206	799 968
2011	16 930 572	1 839 914	824 679	292 465	984 455
2012	18 557 761	1 842 325	671 906	249 583	738 166
2013	24 916 378	3 264 576	785 931	308 348	794 289
2014	26 033 817	3 176 409	770 015	298 108	793 748
2015	30 065 912	3 592 427	682 716	292 517	850 534
2016	38 663 567	4 475 679	956 975	440 050	963 603
2017	46 150 764	4 875 246	1 031 160	884 829	987 084

Table 16. Percentage (%) ratio between estimated tax revenues and official tax revenues in Euro.

City/Year	Bratislava	Košice	Liptovský Mikuláš	Nitra	Poprad
2008	593.98	743.58	573.42	245.72	832.64
2009	608.76	649.43	591.64	261.22	1 027.25
2010	640.67	756.91	644.47	307.04	846.05
2011	701.23	695.26	665.54	282.89	998.27
2012	745.71	655.6	424.63	296.14	644.32
2013	929.23	759.33	431.66	414.78	627.36
2014	943.57	768.74	425.46	401.03	609.22
2015	949.61	685.98	369.55	381.3	602.08
2016	1085.42	891.34	459.86	405.72	631.6
2017	930.77	890.59	454.04	431.02	623.25

5. Discussion and Concluding Remarks

Vetro et al. clearly defined the necessity of measuring open and government data's quality for further reuse [35]. The partial distortion of official data has been proven by the gap between SUSR's data on overnight stays and overnight stays based levied occupancy tax revenues and tax rates. The necessity to take control measures in terms of implementing the NACE methodology and in monitoring the actual provision of declared business operations with official registries has been partially demonstrated by the mixed up and large ratio rates between SUSR's records and the RUZ and RPO datasets.

The gaps between the data sets partially prove the unreliability of official data gathered by SUSR's survey system. Overnight stays calculated via levied occupancy tax and tax rates are, in some cases, higher than the data that was recorded by SUSR indicates. SUSR's data determines whether a candidate municipality or cluster is achieving the limit of 100 000 number of overnight stays for establishing a local DMO, which may then apply for annual funding. Based on the obtained results, the reliability SUSR's data is question. Therefore, not only the upper actual upper limit for funding based on annual occupancy tax revenues for some cities may be higher, but it is also questionable as to whether smaller areas that currently do not achieve the 100 000 limit may rely on the mercy of SUSR's official data.

At first sight, the issue is not so significant or currently devastating for the sustainability of DMO's public funding. On the other hand, even a ten percent gap in within occupancy tax revenues means less funding for municipalities and RDMOs. Additionally, every unreported and subsequently not recorded ASP and overnight stay in the system distorts the actual impact of the industry, not to mention the theoretically possible VAT evasions. Fortunately, a few alternative preventative measures could lower the level of data distortion and, at the same time, challenge the systematic gaps for possible tax evasions.

The office of Financial Administration of the Slovak Republic (hereinafter FASR) has already taken certain measures. From July 2019, all accommodation service providers will be obligated to be connected to the FASR's online system of cash registers. Subjectively, this step may bring partial positive effects and from a technological perspective may follow up wider solutions [36].

Sidor, within his earlier work, proposed measures that would tighten the possible space for data distortion [37]. In regards to formatting records of same business operations and missing information about the actual place of business operations, a simple preventative measure was proposed. All declared business operations, when recorded, should obligatorily copy the format and identification numbers of the ISIC methodology and each business operation should have its own address.

The second proposed measure was to link all of the relevant recording systems for faster and automatic dissemination regarding potential occupancy tax and relevant VAT taxpayers. The main idea was to connect the official RPO system with the Central Public Administration Portal (used also for reporting occupancy tax duties) and the FASR's online system of cash registries. Each relevant recorded business operation within the RPO would be reported to municipalities and FASR, and afterwards the obligated legal entity would be informed about its duties.

The third proposed measure was aimed at easing accommodation service providers' current obligation to report the same data multiple times (e.g., SUSR's monthly survey, municipalities recording occupancy duties, Ministry of Interior recording data about foreigners stay). The idea was to widen the Ministry of Interior's existing online accommodation book that was used only for reporting foreign overnight stays by the input data that was surveyed by municipalities and the SUSR, and then linking it with FASR's cash registry.

This way, an ASP would only have the obligation to properly account each overnight stay and all of the other processes would be automated. Most distortions in official data that was not created primarily by tax evasion efforts, but by human errors rooted within the currently exhaustive system of data reporting could be minimized. Of course, the financial investments' and positive outcomes' ratio of these measures demand a long term public discussion, including not only the government, states

institutes, public administration, and relevant associations representing ASPs, but also data scientists, and most importantly, developer communities.

Nevertheless, there are alternative options for the support of the sustainability of occupancy taxes' and related VATs' collection. The cases count with back checking SUSR's and municipalities' official records on enlisted ASP with RUZ and RPO records. ASPs that were not officially recorded will be back checked via different approaches. Firstly, geocoded RPO, RUZ records of business activities will be tested within third party APIs that primarily gather (e.g., Foursquare, Booking, Airbnb) information about ASPs. Secondly, APIs creating access to geocoded written and visual user/visitor feedback (e.g., social media platforms Facebook, Instagram, Twitter, etc.).

Partially, Google Street Maps' (GSM) visualization of address points could also be used within the identification of surroundings' change, but in the case of Slovakia GSMs, the latest update is from 2014. Last, but not least, another approach is to back check geocoded RPO data with mobile operators' data. The Ministry of Transport and Construction of the Slovak Republic already purchased this kind of data at the district level, so the access to historical data at relevant RPO address points is just a question of time and effort.

Since the proposed measures eliminate double standards (between tax payers and tax evaders) and would provide a time saving automated open service, generating knowledge with added value for both ASPs and public authorities; in terms of the "Slippery slope framework" on tax compliance by Kirchler et al., the proposed measures could support the synergistic tax climate [38]. The impact of the proposed measures on public acceptance could be, among others, monitored based on the lexicographical analysis approach that was carried out by Lozza & Castiglioni [39].

Since these alternatives' base is mainly built on open data and financially accessible samples of commercial data and commercial data that are partially already purchased by state institutions, they will be tested in the near future.

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