SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2019
ORGANIZATION AND MANAGEMENT SERIES NO. 140

# IDENTIFICATION OF BUDGETARY SOURCES OF RISK IN POLISH SMART CITIES. PRACTICAL APPROACH

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**Abstract:** The main aim of the article is to identify budgetary sources of risk in managing a smart city. This task is carried out on the basis of budgetary data concerning local government units in Poland. The conducted research and considerations are limited to cities with poviat (district) rights, assuming that these are the units with the greatest potential in terms of being "smart". In the course of research, the budgetary risk is divided into two categories: (1) operational, relating to the level of total expenditures and revenues and the current budget balance, and (2) strategic, relating to the economic situation, budget inflows from income tax on natural and legal persons and indebtedness of the analyzed units. In addition, budgetary risk is considered in two regional and local research perspectives, using classic risk assessment measures, such as the coefficient of variation, standard deviation and range. The analysis and assessment shows that, among the operational sources of risk threatening the development of smart cities, the most serious is the large revenue disparity in individual voivodeships and cities with poviat rights and a high level of budget deficit in more than a dozen or so analyzed units. In the case of strategic sources, the most important threat is the above-average level of indebtedness of a significant part of cities with poviat rights, which constitutes a significant financial burden in subsequent periods, hindering the creation and development of smart cities in Poland.

**Keywords:** risk management, budgetary sources of risk, operational and strategic risk, smart city.

## 1. Introduction

A smart city in the literature and in economic practice is associated with and identified as a city providing its inhabitants an above-average quality of life (Ober et al., 2018; Osika, 2018), which is directly related to access to state-of-the-art technologies and technical infrastructure (Karwot et al., 2016; Kaźmierczak et al., 2018; Szymańska, Korolko, 2015) and social infrastructure (Appio, 2019). In a smart city, the highest standards in terms of categories such as the following (IESE, Cities in Motion, 2018; IESE Cities in Motion, 2019;

Masik, Studzińska, 2018) https://www.forbes.com/sites/iese/2018/07/13/the-smartest-cities-in-the-world-in-2018) are met:

- human capital (development, attraction and cultivating talents) (Rożałowska, 2016),
- social cohesion (agreement and coexistence of various social groups in the city) (Stryjakiewicz, Męczyński, 2015),
- economics,
- environment (Ignac-Nowicka, 2018),
- management (Matusek, Wolny, 2018; Sojda et al., 2018; Wolniak, 2017),
- urban planning (Bruska, 2012),
- management (Stawasz, Sikora-Fernandez, 2015),
- logistics (Orłowski et al., 2016),
- internationalization,
- IT and ICT (Li, Liao, 2018),
- transport and mobility (ease of movement and access to public services) (Dohn et al., 2019; Kożuch et al., 2018).

However, belonging to the group of smart cities requires not only consistency in action and creativity, but, above all, financial resources for the production, maintenance and development of the aforementioned social and technical infrastructure. Without financial support, smart urban development is possible to a very limited extent, if at all, which is also confirmed by the geographical analysis of the location of smart cities in the world. Most of such units appear on fully civilized continents with a high level of economic and social development, i.e. in Europe, Australia and North America (mainly in the USA). Definitely less smart cities exist in Asia and South America, and in the least developed Africa there are hardly any. Economic factors are therefore important sources of risk for the creation and growth of smart cities (Jankowska, 2015). It is not possible to describe all those aspects in one article, so the author focused only on very small part concerning the financial aspect of Polish local governments unit (Anand, Navío-Marco, 2018).

Bearing these circumstances in mind, the main purpose of this article is to identify budgetary sources of risk in managing a smart city. In the empirical part, this task is carried out on the basis of budgetary data concerning local government units in Poland. Budgetary sources of risk are considered in two operational and strategic dimensions. The first dimension refers to the revenues, expenditures and budget balance of the analyzed units as indicators of current opportunities and threats to the creation and development of smart cities. The second dimension covers general economic factors, such as: economic situation and inflows to the state budget from central taxes (personal income tax and corporate income tax) and individual factors, specific to a given unit in the form of level of indebtedness, determining the spending of financial resources on the creation and development of smart cities in the future (Engelbert et al., 2019).

Apart from the risk analysis dimensions described above, the article uses a dichotomous research perspective, taking into account the functioning of the analyzed units in the voivodeship structures (regional perspective) and as independent economic entities (individual perspective).

The summary of the article formulates conclusions about the sources of budgetary risk in a universal perspective and referring to current economic conditions. Moreover, the units burdened with the lowest (highest) budgetary risk and the highest (lowest) chances for effective creation and development of smart cities in Poland are indicated.

## 2. Methodology

As already mentioned, a smart city is characterized by above-average possibilities of satisfying the needs of its inhabitants, therefore further analysis focuses on the study of Polish cities with poviat rights. These are well-developed cities with a large number of inhabitants and significant experience in managing a local government unit. Another reason for choosing such a research sample is the fact that in the rankings of smart cities of national and international range there are only those Polish cities which have the status of a city with poviat rights (Sikora-Fernandez, 2018). Currently, there are 66 such units in Poland and their budgets have been analyzed in the context of budgetary risk related to the creation and development of smart cities.

In the course of the research, the following research problems were formulated:

1. What universal sources of budgetary risk (operational and strategic) influence the creation and development of smart cities in Poland from the regional and local perspective?
2. How do these sources currently influence the creation and development of smart cities in Poland?
3. What diversity in budgetary risk characterizes cities with poviat rights in regional and local terms?
4. Which of the analyzed cities with poviat rights have the lowest budgetary risk for the creation and development of smart cities in Poland?
5. Which of the analyzed cities with poviat rights is characterized by the highest budgetary risk hindering the creation and development of smart cities in Poland?

In the article the research is limited only to the first stage of risk management which is risk identification. The results are presented as a risk checklist with further recommendations at next stages of risk management in Polish smart cities.

In the process of budgetary risk assessment, classic measures of variability were used to determine the level of variability of the studied phenomena, which included: range, standard deviation and coefficient of variability. These measures are characterized below.

The range is the difference between the maximum and minimum value of the analyzed variable. It is calculated as follows:

$$R = x_{\max} - x_{\min} \tag{1}$$

where:

$x_{max}$ – maximum value of the analyzed variable,

$x_{min}$ – minimum value of the analyzed variable.

The value of range allows to evaluate the absolute diversity of the analyzed feature in a given community.

Standard deviation allows to assess the degree of concentration of the value of the analyzed variable around the arithmetic mean. The higher its value, the more distant the actual values of the analyzed variable are from their arithmetic mean. Thus, the diversity and level of the analyzed risk are higher. They are calculated as follows:

$$S = \sqrt{\frac{(x_i - \bar{x})^2}{N}} \tag{2}$$

where:

$x_i$ – the value of the analyzed variable,

$\bar{x}$ – the arithmetic mean for the value of the analyzed variable,

$N$ – the size of population.

The coefficient of variation is a relative measure of variation allowing to assess what part of the arithmetic mean is the standard deviation. The higher its value, the higher is the variation of the analyzed variable and the higher is the level of the analyzed risk. It is calculated as follows:

$$V = \frac{s}{\bar{x}} \tag{3}$$

where:

$\bar{x}$ – the arithmetic mean for the value of the analyzed variable,

$s$ – the standard deviation.

In the next two chapters, the budgetary risk was analyzed taking into account the above mentioned measures and research perspectives, i.e. regional and local.

## 3. Sources of budgetary risk for smart city candidates from a regional perspective

In this chapter, the sources of budgetary risk are analyzed from a regional perspective, which refers to voivodeships and includes an assessment of:

- financial independence assessed in the context of the level and share of own revenues in total revenues,
- the budgetary equilibrium as assessed in terms of the budget balance and its relation to total revenues,
- current profitability per capita referring to total revenues per capita,
- strategic profitability per capita referring to investment and property revenues per capita.

The results of the analysis concerning financial independence are presented in Table 1 and Figure 1.

**Table 1.**
*Structure of budget revenues of cities with poviat rights in 2016-2017 in Poland [in %]*

| Source of revenue | Value of share in 2016 | Value of share in 2017 |
|---|---|---|
| Own revenues | 72.27% | 76.65% |
| General subsidy | 14.06% | 14.39% |
| Earmarked subsidies | 11.11% | 12.91% |
| EU subsidies | 2.56% | 3.01% |
| **Total** | **100%** | **100%** |

Source: own compilation on the basis of data from the Ministry of Finance.

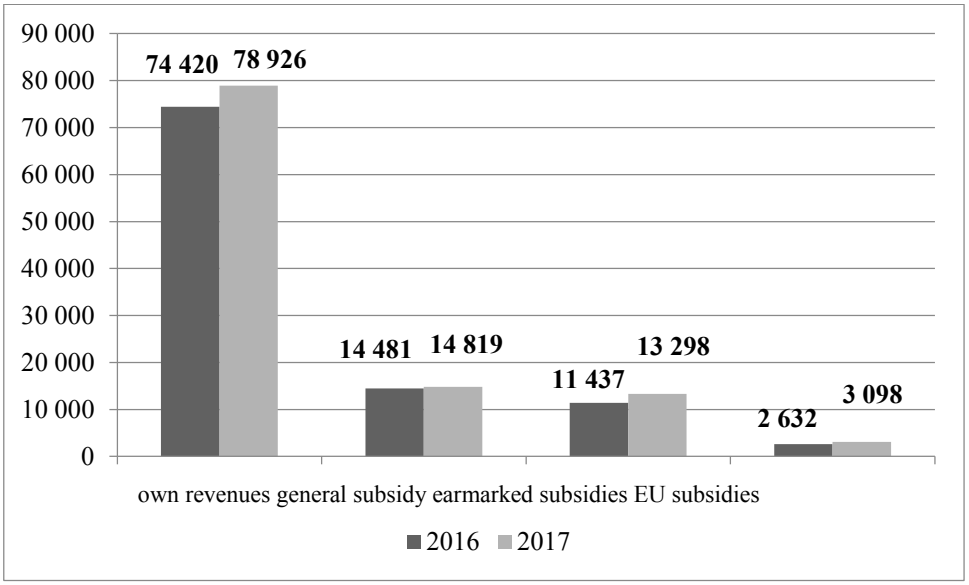


**Figure 1.** Sources of revenues of cities with poviat rights in Poland in 2016-2017 [in PLN mln]. Source: own compilation on the basis of data from the Ministry of Finance.

Financial independence of cities with poviat rights in Poland should be assessed very highly due to the above-average share of own revenue in the total revenue structure amounting to 72-77% and growing in time. The average share of own revenue for all territorial local government units (gmina, poviat and voivodeship) in Poland in 2017 was about 48%, which allows to state that, in the analyzed aspect, the budgetary structure of cities with poviat rights was favorable and conducive to the creation and development of smart cities, as these are units characterized by a high level of financial independence.

In the analyzed period, the level of revenues in all budget categories also significantly increases, which proves the increase in development opportunities and the level of wealth of these local government units. Total revenues of cities with poviat rights increased in 2016-2017 by almost 7%, with the greatest growth dynamics characterized by earmarked subsidies (increase by 16.27%) and EU subsidies (increase by 17.70%). The value of own revenues of the most important item in the budgets of cities with poviat rights also increased by over 6%.

Both tendencies, identified and described above, do not pose a threat to the aspiration of cities with poviat rights to become smart cities and, if they are maintained in the future, they will certainly constitute an opportunity for their development in general terms, at this stage not yet referring to individual units having the status of cities with poviat rights in Poland. In accordance with the above, the source of budgetary risk in the form of lack of financial independence exists, but in the current economic conditions its level is low.

However, it should be stressed here that own revenues of cities with poviat rights are strongly dependent on the economic situation. In 2017, these cities obtained over 44% of their own revenues from shares in central taxes, i.e. in the personal income tax (40.68%) and in the corporate income tax (3.7%). This means that a serious threat to their development, and thus to the possibility of creating smart urban solutions, is the slowdown in the pace of economic growth and economic downturn. This threat may be realized in the near future due to the decreasing rate of growth of Gross Domestic Product (GDP) in the recent years, which is presented in Figure 2.

Nevertheless, the amount of budgetary inflows from personal and corporate income tax increased systematically over time (Fig. 3), which directly and positively influenced the level of own revenues of cities with poviat rights in the analyzed period.

In the light of the above results, it can be stated that the sources of budgetary risk in cities with poviat rights are: changes in the economic situation, fluctuations in the level of financial independence expressed as a share of own revenues in total revenues and changes in the amount of central taxes supplementing the budgets of these units (personal income tax and corporate income tax) caused by absolute changes (value of inflows) and/or relative changes (percentage value of shares in these taxes). In the analyzed period – despite the existence of these threats – only the risk related to the economic downturn was realized, which, however, did not significantly affect the level of revenues realized in 2016-2017 in cities with poviat rights.

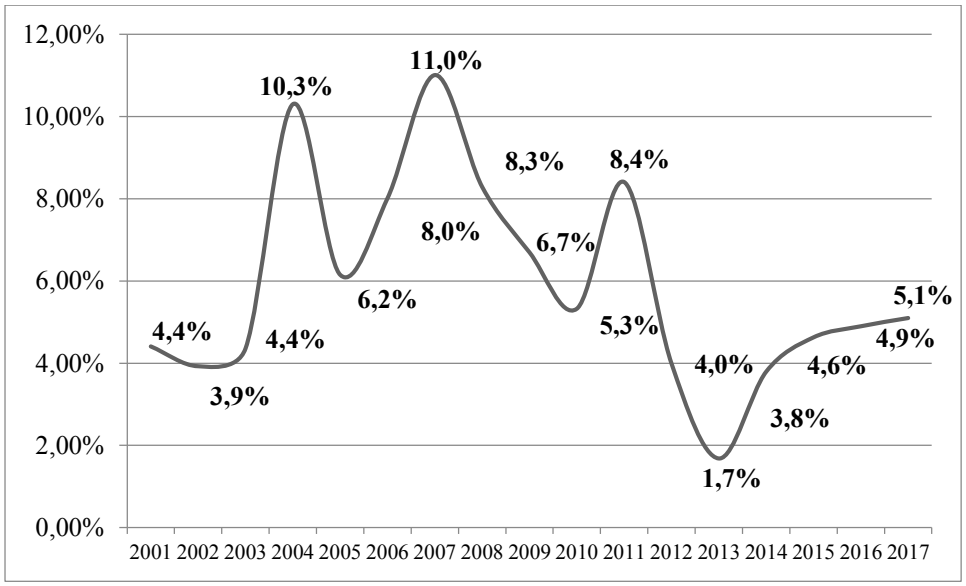


**Figure 2.** Changes in the GDP in Poland in the years 2001-2017 [in %]. Source: own compilation based on data of the Statistics Poland.

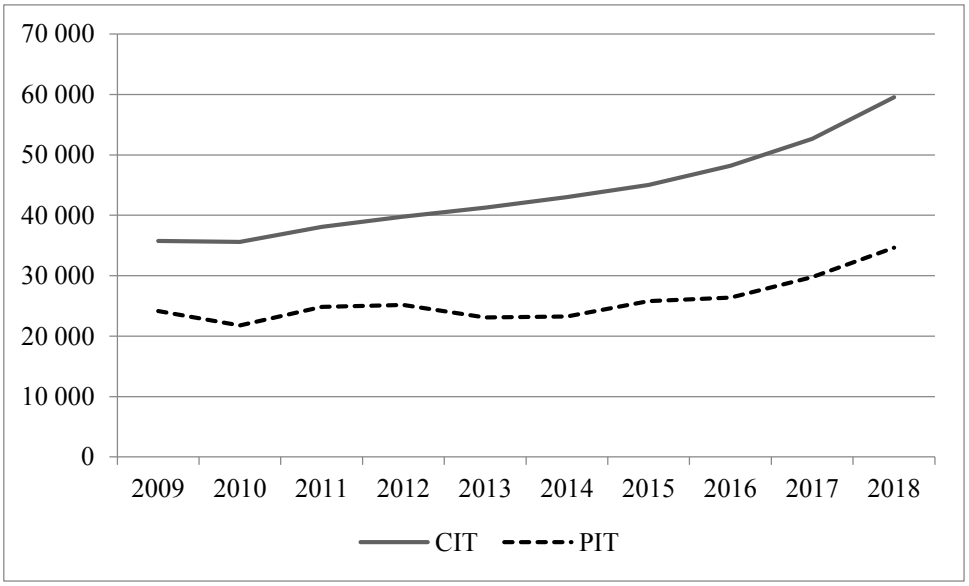


**Figure 3.** Budgetary inflows from corporate income tax (CIT) and personal income tax (PIT) in Poland in 2009-2018 [in PLN mln]. Source: own compilation based on data of the Statistics Poland.

Despite favorable general conditions, it is worth looking at the financial results in cities located in particular voivodeships. These results are presented in Table 2, together with an assessment of their territorial diversity.

**Table 2.**
*Revenues and expenditures of cities with poviat rights per capita, including voivodeships, in 2017 [in PLN]*

| Voivodeship | Population | Revenues | Expenditures | Difference (revenues-expenditures) | Difference in revenues |
|---|---|---|---|---|---|
| Lower Silesia | 933,493 | 6,079.11 | 6,074.44 | 4.68 | 0.08% |
| Kuyavia-Pomerania | 764,906 | 5,409.99 | 5,342.23 | 67.76 | 1.27% |
| Lublin | 526,151 | 5,769.86 | 5,884.47 | -114.61 | -1.95% |

Cont. table 2.

| | | | | | |
|---|---|---|---|---|---|
| Lubusz | 263,325 | 5,731.53 | 5,543.03 | 188.49 | 3.40% |
| Łódź | 819,524 | 5,568.90 | 5,642.36 | -73.46 | -1.30% |
| Lesser Poland | 959,423 | 6,405.88 | 6,459.65 | -53.77 | -0.83% |
| Masovia | 2,219,649 | 8,269.33 | 8,178.83 | 90.50 | 1.11% |
| Opole | 118,722 | 7,232.52 | 7,208.21 | 24.31 | 0.34% |
| Subcarpathia | 343,736 | 5,999.51 | 6,158.71 | -159.20 | -2.58% |
| Podlaskie | 429,056 | 5,895.98 | 6,163.22 | -267.24 | -4.34% |
| Pomerania | 839,529 | 6,147.73 | 6,102.84 | 44.90 | 0.74% |
| Silesia | 2,560,863 | 5,303.15 | 5,317.40 | -14.26 | -0.27% |
| Świętokrzyskie | 197,704 | 6,205.03 | 6,416.26 | -211.23 | -3.29% |
| Warmia-Masuria | 294,184 | 5,903.91 | 5,707.54 | 196.37 | 3.44% |
| Greater Poland | 782,122 | 6,274.29 | 6,157.42 | 116.86 | 1.90% |
| West Pomerania | 553,673 | 5,496.80 | 5,589.30 | -92.51 | -1.66% |
| **Arithmetic mean** | **787,878.75** | **6,105.84** | **6,121.62** | **-15.78** | **-0.25%** |
| **Minimum** | **118,722.00** | **5,303.15** | **5,317.40** | **-267.24** | **-4.34%** |
| **Maximum** | **2,560,863.00** | **8,269.33** | **8,178.83** | **196.37** | **3.44%** |
| **Range** | **2,442,141.00** | **2,966.18** | **2,861.42** | **463.60** | **7.78%** |
| **Standard deviation** | **662,034.68** | **716.66** | **704.92** | **130.08** | **2.16%** |

Source: own compilation on the basis of data from the Ministry of Finance.

The data presented in Table 2 shows that the highest level of revenues of cities with poviat rights per capita was recorded in the Masovia Voivodeship (over PLN 8 thousand) and the Opole Voivodeship (over PLN 7 thousand). In the remaining voivodeships, the level of these revenues ranged from PLN 5 thousand to PLN 6 thousand. The lowest level of revenues per capita was recorded in the following voivodeships: Silesia, Kuyavia-Pomerania and West Pomerania (below PLN 5.5 thousand). The range between the maximum and minimum total revenues per capita was PLN 2,966.18, which constituted over 48% of the average value of such revenues and indicated a significant level of diversity of cities with poviat rights functioning in particular voivodeships. This, in turn, may have a significant impact on the cities' aspirations to become smart cities and constitute an active source of budgetary risk. In half of the voivodeships in cities with poviat rights, there was a deficit in budgets ranging from 0.03% to 4.34% of the total budgetary revenues. Such diversity allows to confirm the existence of more favorable conditions for the development of smart cities in the most affluent voivodeships, including those with the highest level of revenues and budgetary surplus, i.e. the following voivodeships: Masovia, Opole, Greater Poland, Lower Silesia and Pomerania.

Financial results in strategic terms (property and investment) presented in Table 3 confirm the above conclusions. The group of voivodeships in which property and investment expenditures per capita were the highest (above PLN 900) again included the Masovia and Opole voivodeships. It should be added, however, that the cities with poviat rights which invested intensively also included units located in less affluent and less developed voivodeships, such as: Podlaskie, Subcarpathia and Świętokrzyskie. In the mentioned voivodeships, however, the development took place at the expense of the increase in debt, because the mentioned units showed the highest level of budget deficit in relation to total revenues.

**Table 3.**
*Property and investment expenditures of cities with poviat rights per capita, including voivodeships, in 2017 [in PLN and in %]*

| Voivodeship | Property expenditures per capita [in PLN] | Share of property expenditures in total expenditures [in %] | Investment expenditures per capita [in PLN] | Share of investment expenditures in total expenditures [in %] |
|---|---|---|---|---|
| Lower Silesia | 873.18 | 14.4% | 686.68 | 11.3% |
| Kuyavia-Pomerania | 689.11 | 12.9% | 600.30 | 11.2% |
| Lublin | 769.52 | 13.1% | 700.53 | 11.9% |
| Lubusz | 799.66 | 14.4% | 792.85 | 14.3% |
| Łódź | 694.37 | 12.3% | 577.02 | 10.2% |
| Lesser Poland | 753.79 | 11.7% | 693.16 | 10.7% |
| Masovia | 1,025.72 | 12.5% | 946.56 | 11.6% |
| Opole | 918.22 | 12.7% | 891.54 | 12.4% |
| Subcarpathia | 960.40 | 15.6% | 945.13 | 15.3% |
| Podlaskie | 1,228.75 | 19.9% | 1,208.21 | 19.6% |
| Pomerania | 810.55 | 13.3% | 692.23 | 11.3% |
| Silesia | 666.00 | 12.5% | 604.60 | 11.4% |
| Świętokrzyskie | 951.54 | 14.8% | 906.52 | 14.1% |
| Warmia-Masuria | 735.96 | 12.9% | 659.76 | 11.6% |
| Greater Poland | 837.88 | 13.6% | 776.14 | 12.6% |
| West Pomerania | 847.68 | 15.2% | 785.38 | 14.1% |
| **Arithmetic mean** | **847.65** | **13.87%** | **779.16** | **12.73%** |
| **Minimum** | **666.00** | **11.67%** | **577.02** | **10.23%** |
| **Maximum** | **1,228.75** | **19.94%** | **1,208.21** | **19.60%** |
| **Range** | **562.75** | **8.27%** | **631.19** | **9.38%** |
| **Standard deviation** | **141.17** | **1.90%** | **161.25** | **2.27%** |
| **Coefficient of variation** | **16.65%** | **13.70%** | **20.69%** | **17.80%** |

Source: own compilation on the basis of data from the Ministry of Finance.

The level of diversity of strategic expenditures in the analyzed voivodeships was more diversified than in the case of current expenditures (higher value of the coefficient of variation). Additionally, greater diversity was more characteristic of investment expenditures than property expenditures, which results from different level of development of the analyzed voivodeships, and consequently from different needs in the scope of maintaining the existing infrastructure and creating new one. In the studied context, the development of smart cities was undoubtedly facilitated by a high level of property and investment expenditures in units with the highest level of total revenues and a balanced budget, as well as by increasing these expenditures in less developed regions. The worst conditions and the highest budgetary risk related to the possibilities of creating smart cities are characteristic of cities with poviat rights located in Silesia, Kuyavia-Pomerania and Łódź Voivodeships. These were the units with the lowest level of total revenues per capita and the lowest level of property and investment revenues per capita.

## 4. Sources of budgetary risk for smart city candidates from a local perspective

In this chapter, the level of analysis is detailed for individual cities with poviat rights in order to examine the level of their diversity in terms of budgetary risk and to refer to their individual capacity to participate in the creation of smart cities. Thus, Table 4 presents the level of expenditures per capita in 66 cities with poviat rights in 2017.

**Table 4.**
*Expenditures of cities with poviat rights per capita in 2017 [in PLN]*

| Poviat | Expenditures per capita | Poviat | Expenditures per capita | Poviat | Expenditures per capita |
|---|---|---|---|---|---|
| Jelenia Góra | 4,663.99 | Radom | 4,907.64 | Jaworzno | 4,725.50 |
| Legnica | 4,753.39 | Siedlce | 5,530.81 | Katowice | 5,207.40 |
| Wrocław | 5,444.44 | Warszawa | 7,600.61 | Mysłowice | 4,270.86 |
| Wałbrzych | 4,619.08 | Opole | 6,289.99 | Piekary Śląskie | 3,988.49 |
| Bydgoszcz | 4,537.32 | Krosno | 5,433.99 | Ruda Śląska | 4,559.34 |
| Grudziądz | 5,050.83 | Przemyśl | 5,451.63 | Rybnik | 4,833.49 |
| Toruń | 4,541.88 | Rzeszów | 5,167.31 | Siemianowice Śl. | 4,339.01 |
| Włocławek | 4,878.45 | Tarnobrzeg | 4,759.01 | Sosnowiec | 3,942.24 |
| Biała Podlaska | 4,563.26 | Białystok | 4,944.76 | Świętochłowice | 4,296.04 |
| Chełm | 4,853.90 | Łomża | 4,784.76 | Tychy | 4,831.98 |
| Lublin | 5,187.03 | Suwałki | 5,025.63 | Zabrze | 4,348.34 |
| Zamość | 5,481.73 | Gdańsk | 5,240.36 | Żory | 4,252.72 |
| Gorzów Wlk. | 4,573.04 | Gdynia | 5,285.11 | Kielce | 5,464.72 |
| Zielona Góra | 4,894.96 | Słupsk | 5,134.95 | Elbląg | 4,342.06 |
| Łódź | 4,947.55 | Sopot | 6,386.35 | Olsztyn | 5,412.60 |
| Piotrków Tryb. | 5,067.09 | Bielsko-Biała | 4,927.78 | Kalisz | 4,759.70 |
| Skierniewice | 4,770.16 | Bytom | 4,526.83 | Konin | 5,791.75 |
| Kraków | 5,731.42 | Chorzów | 4,991.17 | Leszno | 5,125.17 |
| Nowy Sącz | 5,720.59 | Częstochowa | 4,743.26 | Poznań | 5,382.71 |
| Tarnów | 5,516.96 | Dąbrowa Górnicza | 5,000.00 | Koszalin | 4,585.40 |
| Ostrołęka | 5,753.98 | Gliwice | 4,811.24 | Szczecin | 4,682.98 |
| Płock | 6,296.49 | Jastrzębie-Zdrój | 4,254.35 | Świnoujście | 5,728.36 |
| **Arithmetic mean** | | | **5,029.03** | | |
| **Minimum** | | | **3,942.24** | | |
| **Maximum** | | | **7,600.61** | | |
| **Range** | | | **3,658.37** | | |
| **Standard deviation** | | | **613.53** | | |
| **Coefficient of variation** | | | **12.20%** | | |

Source: own compilation on the basis of data from the Ministry of Finance.

The presented summary shows that the diversity in the scope of expenditures in individual cities per capita was much higher than in the case of the analysis conducted at the regional level, which indicates an increase in the budgetary risk in the local aspect. The difference in the value of maximum and minimum expenditures amounted to as much as PLN 3,658.37, which constituted over 72% of the average value of these expenditures. The coefficient of variation was also higher. Cities with the highest expenditures per capita (above PLN 6 thousand) include: Warszawa, Opole, Sopot and Płock. Cities with equally good prognosis in terms of expenditures (expenditures above the average PLN 5,029.03) include: Wrocław, Grudziądz,

Lublin, Zamość, Piotrków Trybunalski, Gdańsk, Gdynia, Kraków, Tarnów, Nowy Sącz, Ostrołęka, Siedlce, Krosno, Przemyśl, Rzeszów, Suwałki, Słupsk, Katowice, Olsztyn, Konin, Leszno, Poznań and Świnoujście. Therefore, in the group of 66 cities there are 27 (about 40%) units with above-average expenditures per capita. These are large, recognizable cities, often capital cities of voivodeships, which allows their authorities to think and act realistically in terms of being "smart". Some of them already appear on the national and foreign lists of smart cities. This concerns, among others: Warszawa, Opole, Gdynia, Gdańsk, Lublin, Rzeszów or Wrocław, which confirms the strong link between the budgetary situation and the opportunities in terms of creating smart cities.

The lowest level of expenditures per capita (below PLN 4,500) was recorded in: Piekary Śląskie, Sosnowiec, Mysłowice, Siemianowice Śląskie, Świętochłowice, Zabrze, Żory and Elbląg (most cities are located in the Silesia voivodeship with the lowest level of revenues and expenditures in Poland). The cities listed above are therefore characterized by a high level of budgetary risk in terms of the possibilities of financing smart cities.

Nevertheless, already within the framework of the regional analysis, the current risk related to the high level of the budget deficit, driven by the intensification of development activities not covered by own revenues, subsidies and grants, appeared. Bearing the above in mind, Table 5 contains data on the level of budget equilibrium for individual cities with poviat rights, thus detailing the analysis to the local level.

**Table 5.**
*Ratio of budget deficit/surplus to total revenues in cities with poviat rights in Poland in 2017 [in %]*

| Poviat | Deficit/ surplus ratio to total revenues | Poviat | Deficit/ surplus ratio to total revenues | Poviat | Deficit/ surplus ratio to total revenues |
|---|---|---|---|---|---|
| Jelenia Góra | 4.91% | Radom | -2.46% | Jaworzno | 2.33% |
| Legnica | -0.06% | Siedlce | -5.78% | Katowice | 6.22% |
| Wrocław | 0.24% | Warszawa | 1.32% | Mysłowice | -2.70% |
| Wałbrzych | -4.31% | Opole | 0.34% | Piekary Śląskie | -4.45% |
| Bydgoszcz | 3.36% | Krosno | -6.81% | Ruda Śląska | -5.97% |
| Grudziądz | 0.75% | Przemyśl | 1.37% | Rybnik | -13.30% |
| Toruń | -1.51% | Rzeszów | -3.11% | Siemianowice Śl. | -2.95% |
| Włocławek | 0.08% | Tarnobrzeg | -1.64% | Sosnowiec | -1.72% |
| Biała Podlaska | 7.19% | Białystok | -6.22% | Świętochłowice | -3.78% |
| Chełm | -5.96% | Łomża | -0.08% | Tychy | 4.50% |
| Lublin | -3.14% | Suwałki | -0.86% | Zabrze | -3.42% |
| Zamość | 0.34% | Gdańsk | 1.78% | Żory | -2.23% |
| Gorzów Wlk. | 1.70% | Gdynia | -3.19% | Kielce | -3.40% |
| Zielona Góra | 4.49% | Słupsk | 3.25% | Elbląg | -0.27% |
| Łódź | -1.16% | Sopot | 4.53% | Olsztyn | 5.23% |
| Piotrków Tryb. | 1.18% | Bielsko-Biała | 4.85% | Kalisz | -6.51% |
| Skierniewice | -8.11% | Bytom | -0.59% | Konin | -1.29% |
| Kraków | -1.10% | Chorzów | -4.07% | Leszno | -7.53% |
| Nowy Sącz | 0.89% | Częstochowa | -1.03% | Poznań | 4.60% |

Cont. table 5.

| | | | | | |
|---|---|---|---|---|---|
| Tarnów | -0.26% | Dąbrowa Górnicza | -3.09% | Koszalin | -5.78% |
| Ostrołęka | 4.53% | Gliwice | 2.59% | Szczecin | -3.39% |
| Płock | 3.52% | Jastrzębie-Zdrój | 4.77% | Świnoujście | 16.30% |
| **Arithmetic mean** | | | | | **-0.66%** |
| **Minimum** | | | | | **-13.30%** |
| **Maximum** | | | | | **16.30%** |
| **Range** | | | | | **29.59%** |
| **Standard deviation** | | | | | **4.51%** |
| **Coefficient of variation** | | | | | **-683.04%** |

Source: own compilation on the basis of data from the Ministry of Finance.

Cities with the highest deficit level (above 5%) include: Rybnik, Leszno, Kalisz, Koszalin, Siedlce, Krosno, Białystok, Chełm and Skierniewice. Three of them (Siedlce, Krosno and Leszno) were on the list of cities with the highest level of expenditures. Nevertheless, the high level of budget non-equilibrium over time may be a source of risk for them in the future, preventing them from aspiring to the title of a smart city. It can also pose a risk to: Lublin, Gdynia, Kraków, Tarnów, Rzeszów, Suwałki and Konin, which also recorded a negative budget balance. In this group, however, it will be much easier to eliminate this source for cities with a well-established reputation, such as: Gdynia, Kraków or Lublin. It should also be emphasized that all the cities with the highest per capita expenditure levels (Warszawa, Opole, Sopot and Płock) had a budget with a small surplus, which additionally promises well in terms of their potential to be "smart".

A high level of deficit was also noted in almost all cities with the lowest level of expenditures per capita (Elbląg is the exception), i.e. in: Piekary Śląskie, Sosnowiec, Mysłowice, Siemianowice Śląskie, Świętochłowice, Zabrze and Żory.

In the analysis of budgetary risks, it is worth looking at the indebtedness of individual cities with poviat rights. Table 6 presents this parameter in relative terms in relation to total revenues.

**Table 6.**
*Ratio of liabilities to total revenues in cities with poviat rights in Poland in 2017 [in %]*

| Poviat | Ratio of liabilities to total revenues | Poviat | Ratio of liabilities to total revenues | Poviat | Ratio of liabilities to total revenues |
|---|---|---|---|---|---|
| Jelenia Góra | 36.81% | Radom | 43.61% | Jaworzno | 29.24% |
| Legnica | 49.16% | Siedlce | 68.72% | Katowice | 34.37% |
| Wrocław | 64.66% | Warszawa | 33.12% | Mysłowice | 25.78% |
| Wałbrzych | 95.48% | Opole | 26.44% | Piekary Śląskie | 14.36% |
| Bydgoszcz | 53.94% | Krosno | 63.83% | Ruda Śląska | 33.02% |
| Grudziądz | 34.06% | Przemyśl | 45.37% | Rybnik | 11.34% |
| Toruń | 81.62% | Rzeszów | 56.41% | Siemianowice Śl. | 18.53% |
| Włocławek | 42.85% | Tarnobrzeg | 46.21% | Sosnowiec | 16.27% |
| Biała Podlaska | 26.19% | Białystok | 35.72% | Świętochłowice | 39.19% |
| Chełm | 47.92% | Łomża | 33.58% | Tychy | 21.66% |
| Lublin | 64.99% | Suwałki | 37.20% | Zabrze | 62.93% |

Cont. table 6.

| | | | | | |
|---|---|---|---|---|---|
| Zamość | 19.45% | Gdańsk | 28.35% | Żory | 52.30% |
| Gorzów Wlk. | 17.77% | Gdynia | 42.58% | Kielce | 62.39% |
| Zielona Góra | 30.69% | Słupsk | 43.59% | Elbląg | 51.56% |
| Łódź | 68.91% | Sopot | 30.86% | Olsztyn | 21.55% |
| Piotrków Tryb. | 21.47% | Bielsko-Biała | 9.23% | Kalisz | 34.11% |
| Skierniewice | 40.44% | Bytom | 26.57% | Konin | 25.27% |
| Kraków | 46.55% | Chorzów | 35.32% | Leszno | 46.86% |
| Nowy Sącz | 15.87% | Częstochowa | 38.57% | Poznań | 34.99% |
| Tarnów | 39.19% | Dąbrowa Górnicza | 43.28% | Koszalin | 54.53% |
| Ostrołęka | 30.67% | Gliwice | 23.50% | Szczecin | 45.91% |
| Płock | 50.58% | Jastrzębie-Zdrój | 7.09% | Świnoujście | 17.20% |
| **Arithmetic mean** | | | | | **38.56%** |
| **Minimum** | | | | | **7.09%** |
| **Maximum** | | | | | **95.48%** |
| **Range** | | | | | **88.39%** |
| **Standard deviation** | | | | | **17.54%** |
| **Coefficient of variation** | | | | | **45.47%** |

Source: own compilation on the basis of data from the Ministry of Finance.

In the light of the above, it should be stated that the average level of indebtedness of cities with poviat rights is high and exceeds 38% of the value of total revenues. The mean for all territorial local government units in Poland in 2017 was lower and amounted to 29.57% of total revenues. The level of indebtedness was also characterized by a very high value of range amounting to 88.39%. The lowest indebtedness was recorded in Jastrzębie-Zdrój (7.09%) and the highest in Wałbrzych (95.48%). As many as 31 out of 66 cities with poviat rights showed indebtedness exceeding the value of arithmetic mean. Apart from the already indicated Wałbrzych, these were: Legnica, Wrocław, Bydgoszcz, Toruń, Włocławek, Chełm, Lublin, Łódź, Skierniewice, Karków, Tarnów, Płock, Radom, Siedlce, Krosno, Przemyśl, Rzeszów, Tarnobrzeg, Gdynia, Słupsk, Częstochowa, Dąbrowa Górnicza, Świętochłowice, Zabrze, Żory, Kielce, Elbląg, Leszno, Koszalin and Szczecin. Such a significant number of cities with serious indebtedness indicates that their development, including the implementation of plans to create smart cities, is largely at the expense of increasing indebtedness and budgetary risk in the long-term strategic perspective. This may be particularly dangerous for those units who also have a high level of non-equilibrium in the current budget, i.e: Siedlce, Krosno, Leszno, and: Lublin, Gdynia, Kraków, Tarnów, Rzeszów, Świętochłowice, Zabrze and Żory.

## 5. Summary

In the summary of this article, an attempt was made to respond to the research problems posed in the introduction. Thus, in a universal perspective, the budgetary risk in the process of creating and developing smart cities in Poland can be divided into two categories:

- current risk of sources related to the variability of revenues, expenditures and budget balance in individual terms (for each city with poviat rights) and in territorial terms (for cities with poviat rights functioning in Poland),
- strategic risk related to the variability of the level of property and investment expenditures and the level of indebtedness of individual cities with poviat rights (individual approach) and related to the economic situation influencing the level of inflows to the central budget and local budgets on account of personal and corporate income tax.

In the light of the conducted analyses and risk assessment, it can be concluded that the most serious source of current risk is the high level of budget deficit in some cities with poviat rights and significant revenue diversity of the analyzed units in the territorial system. Identified sources of operational risk translate into strategic risk, where the most intensive source of risk is the level of indebtedness of the analyzed units and high diversity of this parameter. Due to the good economic situation, the strategic general economic risk does not constitute a serious threat to the process of creation and development of smart cities.

Among 66 cities with poviat rights, the lowest budget risk is characteristic of Warszawa, Opole and Sopot. These units are characterized by a high level of revenues per capita, property and investment expenditures, as well as a budget surplus and a low level of indebtedness. The highest budgetary risk is in turn related to: Siedlce, Krosno, Leszno, Świętochłowice, Zabrze and Żory, which have the lowest chances of creating smart solutions in the context of budgetary risk.

Regarding the identified sources of risk, it is worth formulating several management recommendations:

- in creating smart cities, more attention should be paid to the level of socio-economic development of individual units,
- priority in limiting risk should be to regulate imbalances in local government units at a regional and national level,
- economic parameters influencing the incomes of municipalities should be monitored at government level,
- municipalities themselves should secure funds for the implementation of intelligent solutions, e.g. through the use of private-public partnerships.

## Acknowledgements

This article was financed within the framework of a research subsidy from the Institute of Economics and Computer Science of the Faculty of Organization and Management of the Silesian University of Technology, awarded for expenditure in 2018 (No. 13/010/BK_19/0034).

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