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The Concept of Low-Value in the Context of Fixed Assets[1]

Abstract: This article aims to present the possibilities of making simplifications to accounting, particularly in the recognition of fixed assets and other carrying value items, according to the principle of relevance and fair presentation. In order to achieve this aim, the authors used deductive and inductive research methods, such as a literature review, analyses of the content of financial statements, and statistical verifications of the findings.

Simplifications may be made to accounting provided that this does not distort a given entity's true financial picture, and thereby does not mislead the users of the financial statement; making it irrelevant. Establishing the levels at which some type of information should be deemed relevant is difficult but crucial in reporting and financial audit. The authors of the article propose a model to enable establishing the levels of relevance (with regard to both the financial statement as a whole and its components) in each economic entity, regardless of its size and industry in which it operates. This model was created based on the reporting data of Polish companies, constituting a correction of similar models applied in Western Europe. It facilitates the definition of an objectified level of partial relevance basically for all reporting items.

The authors used this model to research 148 companies by analysing their financial reports of 2007–2014, thereby reviewing the data of 1,184 financial statements, and other 337 smaller entities by analysing their financial reports of 2010–2017, thereby reviewing the data of 2,696 financial statements. In total, the authors analysed data from 3,880 financial statements. As a result, they drew conclusions as to the possibility of making simplifications in the recognition of fixed assets by entities. This research made it possible to establish the levels of relevance for the entities listed on WIG30, mWIG40, and sWIG80 as well as for the stock exchange companies not listed on any of the indices named, par-

1 The publication is sponsored by the funds of the Cracow University of Economics for the maintenance and development of research potential.

ticularly the partial relevance considered for depreciation (amortisation). The analysis of the research results, including the application of the Chi square test, has led to the question whether from the financial accounting point of view making one-off depreciations in the amounts of approx. PLN 10,000 (which the entities may want to practice in relation to the amendment to tax regulations) does not distort a given entity's financial picture in the view of its financial statement. The research hypothesis of the study assumes that not all entities maintaining accounting books may apply tax regulations in the field of recognition of low-value fixed assets. The analysis of the data contained in 3,880 financial statements of both larger and smaller entities has shown that the following research hypothesis should be adopted: not all entities maintaining accounting records may apply tax regulations for the recognition of low-value fixed assets.

Keywords: low-value, relevance, fair presentation, fixed assets, carrying value

JEL: M41

1. Introduction

Nowadays, the efforts are made to provide good quality economic information at almost each level of the activity of an enterprise, and the key criterion for measuring accounting quality is fair presentation of data in the general-purpose financial statement. It may be assumed that reliable information is the information free from errors and faithfully presenting the content to which it refers, which consequently presents a fair view – by means of actual accounting attributes – of the economic conditions and processes that constitute the object of measurement. What matters in the context of this development is that the 'error-free' information should not be associated with 'perfect-in-every-respect' information. Fair presentation should rather be defined as "getting close to the truth": as a result, the accounting information that is reliable is not such because it is one hundred percent true, but because, having considered all objective cognitive constrains, it is close to the truth as much as possible. Then, the use of the concept of low-value seems to be one of the crucial concepts in accounting pragmatics.

Given that accountancy is a process of measuring, recording, communicating, and checking, one can say that the purpose of accounting is appropriate measuring and recording, and then communicating the appropriate information. In order to fulfil the condition of "being appropriate," the information should have certain qualities. Among the financial statement qualities, the ones that come first usually are those two paramount features:[2] fair presentation (reliability), which was mentioned at the beginning, and materiality (defined also as relevance), which will be the subject matter of this article. Those two principles are also pointed out

2 Conceptual Assumptions of the International Standards of Accounting, up-to-date version and the intended changes are available at: http://www.ifrs.org/issued-standards/list-of-standards/conceptual-framework/#about.

by the Polish legislature with regard to reliability and quality (in Article 4(1) of the Accounting Act), as well as relevance (in Article 4(4a) of the Accounting Act).

According to IAS conceptual assumptions as well as US GAAP assumptions, relevant information is useful and complete at the same time. Information is useful when it is capable of making a difference in the users' decision-making in relation to a situation in which they would not have such information. Useful information also allows us to consider alternative forms of activity. Materiality, in turn, means that among a great quantity of events taking place in an economic entity, one should choose those that may be useful in making decisions by the users: the financial statement should include all the information that directly facilitates making decisions by the users of this information, or may influence these decisions. The term 'relevance' (materiality) may be associated with the scope of information that should be disclosed for the general unspecified methods of use: information can be recognised as relevant if learning it may be significant for its users, and thereby, if its omission or misrepresentation may change the assessment or decision of its users.

The Accounting Act provides underlying guidelines as to which data should be disclosed (recognised as relevant) in the financial statement form with a minimal scope of data to disclose. On the other hand, even within the framework of this form, one can make simplifications when a certain amount/event/transaction are not relevant. If they have an irrelevant impact, they can be simplified or even omitted in the financial statement. However, based on the principle of materiality, making simplifications is possible only when it does not distort a given entity's picture. Therefore, it should be emphasised that the principle of fair presentation should take precedence over the principle of materiality (Alexander, Jermakowicz, 2006).

In practice, it is often not easy to say which events taking place in an enterprise significantly influence the situation of a given entity (are relevant/material), and should therefore be considered in the financial statement, and in relation to which simplifications can be applied. As a rule, establishing the levels of relevance should be made with consideration of the specificity of business activity conducted by a given company, its economic situation, and factors such as the quality of its accounting system and internal control.

2. The concept of materiality in an accounting system

The materiality threshold is considered in practice by individuals as the amounts calculated as a specified percentage of the balance sheet total. In majority of cases, it is 1% or 2% of the balance-sheet total. Such an approach may entail a variety of risks, though. Thus, the proposition is to calculate the materiality threshold not on the basis of one criterion, but on the basis of four parameters: the balance-sheet total, equity, operating revenue from the sale of goods and services, and gross fi-

nancial result. Selection of different parameters when establishing the materiality threshold means that the proposed model of calculating materiality may be applied by production and service or trade units, smaller and larger units, generating high and low profit margins from sales. In accordance with our proposition, the overall materiality is calculated as an arithmetic average of four figures (all factors have identical weights assigned) which are (Hołda, 2013: 333):

– 1% of balance-sheet total,
– 1.4% of equity,
– 0.8% of the sum of revenues from sales of goods and services,
– 8% of gross financial result.

Materiality calculated this way refers to the financial statement as a whole, which will constitute a valuable threshold for simplifications or errors. The concept of materiality does not only involve the statement as a whole but also its particular items (e.g. goods) or item groups (e.g. inventories). Hence, apart from calculating the overall materiality to indicate an acceptable maximum error (simplification) in reference to the whole financial statement, it is advisable to establish the level of partial (detailed) materiality related to the particular items or item groups of the financial statement. The partial materiality is calculated according to the following formula:

$$I_p = I_o * \sqrt{\frac{\text{the amount of the item or item group of the financial statement}}{\text{element of the financial statement in which a certain item occurs}}},$$

where: I_p – partial materiality; I_o – overall materiality, element of the statement – balance sheet, profit and loss account, flow-of-funds account.

For instance: in the event of general relevance of intangible assets; property, plant and equipment; short-term investments, inventories, short-term receivables or active accruals, in the formula for the partial relevance, the denominator will constitute the balance-sheet total. In the case of costs, though (e.g. depreciation, external services, the costs of manufacturing of the sold goods, the rest of the operational costs, or financial costs, or revenues), the denominator in the formula for the partial relevance will constitute the sum of revenues of a given entity from sales of goods and services.

The methodology of calculating materiality based on the objective criteria proposed herein may be used in relation to each reporting item and each economic entity, regardless of the size of the entity, industry within which it operates, or the specificity of its activity. The design of the model and its application have already been described in publications of A. Hołda (Hołda, 2013: 333; Hołda, Pociecha, 2004: 50–52), therefore, in this article, the model will be applied without duplicating detailed information about its genesis.

The criteria used by the Big Four, and even the former Big Six, accounting firms was the starting point for the development of the model. However, methods of calculating materiality developed and tested in countries with an established market economy do not always work in Poland's economic reality. The main problem encountered in applying Western models of calculating materiality arises from a difference in the financial structure of entities between Poland and the West: Polish companies report relatively high values of balance-sheet totals, mainly because they overstate the value of assets of limited usefulness in relation to their actual (market) value. Moreover, compared to Western countries, the share of equity in the balance-sheet total of Polish companies is relatively high and comes at the expense of profitability. Mechanical application of the criteria used in Western countries in the Polish environment has usually led to an overstatement of the initial estimate of overall materiality. For the reasons mentioned above, it seems reasonable in the Polish environment to reduce the coefficients used to determine overall materiality in the case of equity and balance-sheet total, as well as to use profit before tax rather than net profit for the calculations. The criteria for making an initial assessment of overall materiality are indicated and described in more detail in the literature referred to.

3. Critical literature review – materiality and relevance

As E.L. Hicks (1964: 158) points out, the concept and proper understanding of materiality are indispensable for accounting purposes, but while it is essential to set a materiality threshold, it is not possible to set a single, universal materiality threshold for all entities, as it is an individual issue for each entity. As long ago as in 1979, opinions were voiced (Firth, 1979: 283) that regulators should lay down guidelines for setting the materiality threshold, thereby reducing the share of auditors' subjectivity and individual judgement on this issue, but a uniform global model for materiality has not been developed. However, it is not possible to develop such a model, because in every region of the world, in every accounting system, economic realities are different, and therefore local models are most valued as they take into account the specifics of a given region or a given economy. In addition, a new challenge has recently emerged: setting materiality thresholds for disclosures not only of financial data but also for assessing materiality in relation to non-financial data (Moroney, Trotman, 2016). As indicated by the International Standard on Auditing 320 "Materiality in Planning and Performing Audit," materiality may be expressed in terms of both quantitative and qualitative characteristics of the items under review, e.g. accounting records and evidence of or compliance with prudential standards by the entity.

In practice, numerous models have been developed that can be used to estimate the materiality threshold. Many of these models were developed for use by audi-

tors, whose opinions on the financial statements depend primarily on whether the irregularities found in the financial statements are material or immaterial.

It is possible to distinguish 'single rules' models, in which several variables are used to determine the materiality threshold, with a percentage threshold being determined for each variable. An example of such a model created for the conditions of the Polish market is the aforementioned model of A. Hołda (2013). There are also models of a 'variable or size rules' type in which rather than a threshold value for each factor, a range is given, for example: 1% to 3% of Gross Profit if it is less than PLN 50,000.

In practice, models which are popular and often cited in the world literature include the model used, for example, by KPMG (McKee, Eilifsen, 2000): Materiality = 1.84 times (Greater of Assets or Revenues)$^{2/3}$ or the ACCA model (0.5–1% of turnover, 5–10% of profits reported and 1–2% of gross assets).

It should be noted that since 1 January 2020 the definition of materiality itself has been amended (or rather adapted to the changing reality). Originally, materiality was defined as: Omissions or misstatements of items are material if they could, individually or collectively, influence the economic decisions that users make on the basis of the financial statements. The new definition indicates that "Information is material if omitting, misstating or obscuring it could reasonably be expected to influence the decisions that the primary users of general purpose financial statements make on the basis of those financial statements, which provide financial information about a specific reporting entity" (IFRS, 2018).

The hypothesis put forward in this paper is part of the new definition of materiality: each enterprise should determine for itself which information may be material to the users of its financial statements, and in particular if, in terms of the recognition of low-value fixed assets in accordance with the tax law, this will not affect decisions made by the users.

4. Balance-sheet recognition of low-value fixed assets in view of the change in the limit value of one-off depreciation charges in tax regulations

In economic activity, constituents of property, i.e. property, plant and equipment items, are crucial in many respects for appropriate presentation of the economic information generated by the accounting system. Especially their value recognition and making potential simplifications may be doubtful. As for the fixed assets with low unit value, they may either fall into this category in accordance with general principles, or – according to the principle of materiality set out in Article 4(4) and (4a) of the Accounting Act – not to be considered as fixed assets at all. It is also possible

to establish for them depreciation and amortisation write-offs in a simplified manner by making one-time depreciation (under Article 32(6) of the Accounting Act). The Accounting Act provisions do not define the value criterion that determines the absolute necessity to qualify some resource as a fixed asset, but only indicate the principle of materiality or fair and faithful presentation of a given entity's financial situation. Establishment of the limit amount for presentation of low-value assets lies in the competence of the entity's director who specifies the rules for recognition of fixed assets (including intangible assets) in its accounting policy (Hołda, Staszel, 2020: 6).

In practical terms, entities often used the tax criteria for recognising fixed assets, especially the limit value for recognition of fixed asset amounting to PLN 3,500 until the end of 2017. It should be remembered, though, that the amount PLN 3,500 is the criterion for tax purposes (in accordance with Article 16d(1) of the Corporate Income Tax Act and Article 22d(1) of the Personal Income Tax Act), not necessarily for accounting purposes. According to the Act of 27 October 2017 on the amendment to the Personal Income Tax Act, the Corporate Income Tax Act, and the Act on Flat-rate Income Tax on some income generated by natural persons, the amount of PLN 3,500 applied for 17 years in tax law, often used in balance-sheet law too, was replaced with the amount of PLN 10,000.

In our opinion, the change in the tax amount for deducting fixed assets from PLN 3,500 to PLN 10,000 does not make a great change within the tax law, but has numerous implications in accounting. As regards the entities which within the framework of balance-sheet law are not using the tax recognition of fix assets at the moment (and have not adopted the limit value of PLN 3,500), thus keeping a separate balance-sheet and tax accounts for their fixed assets, the amendment to provisions will have an impact only on the aspect of tax recognition of fixed assets. These entities, though, constitute a rather small group. For the majority of economic entities that assume tax rules for recognising fixed assets, the amendment to tax regulations will entail the necessity of making changes also in their accounting policy, or also differentiating the tax deduction of fixed assets from their tax recognition.

5. Change in the balance-sheet limit value for the recognition of fixed and intangible assets

Owing to the change in tax regulations, the entities that assumed the tax limit value of PLN 3,500 for recognition of fixed assets and intangible assets will need to make a significant choice as to which new solutions of recognition of low-value assets to assume. For instance, the entities can differentiate between tax and balance-sheet recognition of fixed assets: leave the balance-sheet limit value of recognition of asset in the amount of PLN 3,500, but make one-off depreciation

of assets in the amount of PLN 10,000 for tax purposes. Leaving the low-value limit at the level of PLN 3,500 for tax purposes is possible, too. However, the tax regulations specify the current limit value in the amount of PLN 3,500, and since 2018 the maximum value has amounted to PLN 10,000. Consequently, it does not preclude the possibility of leaving – also under the Polish law – the limit of recognising fixed and intangible assets in the amount of PLN 3,500. With this solution, accounts of fixed assets kept for the balance-sheet purposes are tax accounts at the same time, and there are no changes to the accounting policy, although the drawback of the above-mentioned solution is that the entity will not use the possibility of recognition of the expenses for purchase of fixed assets in the amount of no more than PLN 10,000 directly as tax deductible expenses, which could have a great impact on lowering the tax base and, consequently, paying lower taxes. Another option to consider is the adoption of the low-value limit of PLN 10,000 for balance-sheet purposes. If an entity determines that as of January 1, 2018 it wants to assume the limit value of recognising fixed assets in the amount of PLN 10,000, then such change should be accounted for in accordance with KRS 7 as a change in its accounting policy. Then the entity retrospectively recognises the changes (i.e. such changes as if the newly adopted rule has always been applied), which requires:

– referring the effects of changes in the adopted accounting principles (policy) (i.e. changes in the rules for recognition of fixed assets) to equity (fund), presenting them as a profit (loss) of the previous years,
– restating comparative data retrospectively in the financial statements,
– presenting the effects of changes in the adopted accounting principles (policy) in the appropriate item of the statement of changes in the equity capital (fund), if obliged to do this,
– disclosure of relevant information in the notes.

The application of a full retrospective approach is associated with substantial work inputs, however, it ensures compliance with the principle of comparability of reporting data, which is set out in the Accounting Act. It should be emphasised that numerous scientific studies (Nobes, Stadler, 2015; Buk, 2016), conducted both in Poland and in the world, indicate that the change in the accounting policy applied so far may fundamentally alter the picture of a given company's financial situation.

Considering the adoption of the described solution, one more question should be asked: whether, considering both the principle of materiality and the principle of a reliable and clear picture, property, plant and equipment as well as intangible assets amounting to PLN 10,000, which will not be classified as fixed assets due to the 'irrelevant' amount, **really constitute an irrelevant item**, and whether it is reasonable to assume the limit of materiality for fixed assets or intangible assets and recognition of them in the accounting books or financial statements in the

amount of PLN 10,000. Considerations on materiality and the presentation of empirical research in this respect are included in Section 5.[3]

If entities recognise that the limit for the recognition of fixed assets at the level of PLN 10,000 is too high and will make it impossible to comply with the principle of fair presentation of the economic reality in accounting books after the adoption of such a high materiality threshold for fixed assets, they will want to take advantage of the possibilities of increasing the tax threshold for recognising fixed assets. Then, in order not to keep separate accounts of fixed assets for balance-sheet and tax purposes, entities may accept as their materiality threshold an amount higher than PLN 3,500 (e.g. PLN 5,000, PLN 7,000), but not necessarily the upper taxable limit, i.e. PLN 10,000. This solution is, of course, acceptable for tax purposes (the amount of 10,000 is the maximum amount).

When determining the optimal balance-sheet solution – in the face of a significant change in tax – which will involve simplifications, individuals should determine the level of materiality, indicating the limit for making such simplifications, without breaking the 'true and fair view' principle. Determination of the level of partial materiality, not only for fixed assets and intangible assets, but also for all assets for which the notion 'low-value' can be extended, is possible thanks to application by the authors the methodology of establishing the level of materiality presented in Section 1.

6. Materiality of the amount of PLN 10,000. Average materiality indicators for fixed assets for stock exchange listed companies – results of empirical research

In order to draw conclusions on the possibility of adopting – for the purpose of the balance-sheet law – the tax threshold for recognition of fixed assets (PLN 10,000), the levels of overall materiality and selected partial materialities for 80 randomly selected companies which are not traded on WIG30, mWIG40 or sWIG80 but belong to the smallest entities listed on the Warsaw Stock Exchange were examined. The levels of materiality were determined on the basis of separate financial statements of the aforementioned companies drawn up for the years 2007–2014. In total, the analysis covered 640 financial statements.

3 More about the meaning of the principle of materiality for financial statements also in: Kabalski, 2006.

The average level of overall materiality in the analysed financial statements of the surveyed companies amounts to PLN 1,989,000. The average level of partial materiality for property, plant and equipment amounts to PLN 762,000, and for depreciation: PLN 262,000. It should be emphasised that the analysed business entities are large enterprises listed on the WSE. The analysis of the level of materiality for these companies allows us to say that they could adopt from 1.01.2018 – for the balance-sheet purposes – the tax principles of one-off depreciation of assets to the value below PLN 10,000. However, at the end of the period, these entities should verify whether the materiality threshold has not been exceeded. For example, if in a given period a company purchased 30 fixed assets (e.g. computer sets) in the unit value of PLN 9,000 and made one-off depreciation to them, the total value of one-off depreciation would amount to PLN 270,000 (i.e. 30 items × PLN 9,000/pcs.), thus exceeding the threshold of partial materiality determined for depreciation, becoming a material (relevant) amount. In such a case, one-off depreciation of the purchased computer sets would constitute material irregularity in the financial statements.

Recognition of the amount of PLN 10,000 as a non-material amount, and thus the possibility of not including the expenditure incurred in the amount of less than PLN 10,000 in fixed assets (making a one-off write-down) in the units analysed (i.e. the smallest companies among the entities listed on the Warsaw Stock Exchange), is potentially possible, however, at the end of the financial year an analysis is required whether for sure the materiality threshold has not been exceeded. However, the smaller the enterprise, the lower the level of overall materiality determined for the data contained in its financial statement, as well as the level of partial materiality. Therefore, it can be questioned whether in the case of smaller economic entities than the companies analysed, the recognition of the amount of PLN 10,000 (regarding the recognition of fixed assets or depreciation) as irrelevant is justified.

As part of this research on the level of partial materiality concerning fixed assets and depreciation, the financial reports of 2007–2014 of 68 randomly selected stock exchange listed companies traded on the WSE (the companies are entities operating within various industries, listed on the WIG30, mWIG40, and sWIG80 indices) were also reviewed. At this stage of the research, 544 financial statements were analysed. Table 1 presents averaged indicators of partial materiality for fixed assets and depreciation in the years examined for the analysed companies with the division into companies belonging to particular WIG indices (based on the data of 544 financial statements) as well as non-WIG companies (based on the analysis of 640 financial statements).

The collected results are summarised in a breakdown table and verified using the chi-square statistical test. The chi-square test statistic value was 273.84 with a test probability $p < 0.05$, which means that the relationship between the size of the company and the level of partial materiality set for it is statistically relevant: the smaller the unit, the smaller the level of partial materiality determined for fixed assets and for depreciation.

Table 1. Averaged selected partial materiality indicators for groups of the companies listed on the Warsaw Stock Exchange [in PLN]

	WIG 30 companies	mWIG40 companies	sWIG80 companies	non-WIG companies
Partial relevance – Property, plant and equipment	42,642,000	4,062,000	1,743,000	762,000
Partial relevance – Depreciation	,777,000	1,884,000	759,000	262,000

Source: own elaboration

The results of the studies confirmed the statistically intuitive expectation that the levels of partial materiality calculated for depreciation and fixed assets significantly depend on the size of the economic entity: the smaller the unit, the smaller the level of partial materiality for depreciation, and thus the smaller the unit, the more attention should be paid whether from the accounting point of view one-off depreciation in amounts close to PLN 10,000 does not distort a given entity's picture presented in its financial statement.

The next step was to examine financial statements of 337 Polish companies (that keep their accounts in accordance with the Polish Act of Accounting) from the years 2010–2017. A total of 2,696 financial statements were analysed. This group of randomly selected companies was smaller, not listed on the WSE. The structure of assets belonging to the examined companies is presented in Table 2.

Table 2. The structure of assets belonging to the examined companies listed on the Warsaw Stock Exchange

Large entities	Number of entities
Total assets under PLN 100,000	9
Total assets from PLN 100,000 to PLN 500,000	26
Total assets from PLN 500,000 to PLN 1,000,000	36
Total assets from PLN 1,000,000 to PLN 2,000,000	39
Total assets from PLN 2,000,000 to PLN 3,000,000	39
Total assets from PLN 3,000,000 to PLN 5,000,000	54
Total assets from PLN 5,000,000 to PLN 10,000,000	57
Total assets from PLN 10,000,000 to PLN 20,000,000	45
Total assets more than PLN 20,000,000	32

Source: own elaboration

The results of the analyses have shown that:

– The average level of fixed assets in 337 companies is PLN 1,599,000.
– The average level of depreciation in 337 companies is PLN 42,000.
– The average overall materiality in the analysed financial statements of the surveyed companies amounts to PLN 18,000.

– The average level of partial materiality for property, plant and equipment amounts to PLN 14,000, and for depreciation: PLN 14,000.
– The average level of partial materiality for depreciation is PLN 2,000.

The results indicate that the value of depreciation in the amount of PLN 2,000 is a significant amount, and thus it may significantly affect the image of an entity contained in its financial statements.

Considering the fact that annual depreciation in the amount of 2,000 affects the reliability of the reporting information, or that it can lead the auditor to issue an opinion other than 'without reservations,' it is questionable whether it makes sense to raise a one-off depreciation threshold in smaller units from PLN 3,500 to PLN 10,000. Our observations during the audit of financial statements or conversations with statutory auditors and chief accountants also show that only a few entities have decided to change their accounting policy and make a one-off depreciation of fixed assets of up to PLN 10,000. The majority of entities have left the lower limit of recognition of fixed assets at the level of PLN 3,500, thus separating the tax law from the balance-sheet law with regard to depreciation of low value assets.

7. The possibility of simplified accounts of low-value assets other than fixed assets and intangible assets

It is worth considering whether, since an entity uses simplified accounts in relation to low-value fixed assets or intangible assets, it is also not reasonable to apply simplifications in relation to other reported items, for example, insignificant amounts of accrued expenses, which are painstakingly settled in monthly periods, and which do not significantly affect either the assets or the financial result of the entity.

The Accounting Act explicitly refers to the possibility of a simplified account of fixed assets and intangible assets (in Article 32(6)), as well as materials, goods, production in progress or finished products. However, Art. 8(1) of this Act indicates that when defining accounting (policy) principles, it is important to emphasise in accounting all events relevant to the assessment of the asset and financial situation as well as financial result of an entity. Thus, the legislator allows entities to refrain from emphasis of irrelevant events, pointing to the possibility of simplified accounts. Therefore, extending the concept of low-value to other assets is possible through the principle of materiality: materiality is a tool for introducing low-value of various balance-sheet items (for example, accrued expenses or receivables), and low-value can be treated as a form of materiality limit (the threshold of materiality).

7.1. Examples of the use of simplified asset accounts indicated explicitly by the Accounting Act

If the materials (including goods) are found to be of low value, the entity may valuate them at the selling price instead of at the acquisition price.[4] The legislator also indicates that if products are considered non-material in the course of production, then they can be measured as for balance-sheet purposes in the amount of direct production costs, or in the amount accounting only for the materials used to produce them, or even not to be valued at all.

Pursuant to the Accounting Act, it is possible not to apply the provisions regarding the method of settling revenues and costs arising from long-term contracts (and therefore register them in a simplified way) when the share of revenue from incomplete services on the balance-sheet date is non-material relative to the total operating revenue in the reporting period.[5] The Accounting Act also indicates – but only in relation to strictly defined entities in Art. 28(4a) – the possibility of not applying the considerations of the idle production capacity when calculating the cost of manufactured finished products.

In each of the above-mentioned cases, the fact and rules of applying simplifications should be clearly indicated by a given entity's manager in its accounting policy. Particularly in the case of inventory components, it is important to clearly indicate the applicable accounting principles and establish the inventory components for which subsidiary ledger accounts are kept, because in accordance with Art. 37 of the Accounting Act, the subsidiary ledgers are kept for "the assets material for the entity," and therefore it is possible to resign from keeping subsidiary ledgers for the assets recognised as of low value.

However, the above-mentioned list of simplifications possible to make in asset recognition is not a closed list, given the fact that one of the main principles many times indicated by the legislator is the principle of materiality. Therefore, it is in the competence of a given entity's manager (under appropriate provisions in its accounting policy) to decide what values will be presented in assets and liabilities, and which will be charged to the financial result as regards the recognition of the effects of events considered irrelevant. Importantly, materiality is focused on what is presented in the accounting disclosures, because the effects of economic events will be registered after all. However, depending on whether these effects significantly affect the financial statements or not, these accounts may be made on the basis of general principles or – in the authors' opinion – in a simplified manner, analogically to the one explicitly indicated in the Accounting Act: simplified accounts of fixed assets, intangible assets, and inventory components.

4 Art. 34(1) of the Accounting Act.

5 Materiality can be determined using the proposed partial materiality index where the numerator in the formula should include the amount of the income from incomplete service, while the denominator should include an amount which is the sum of all revenues of the entities.

7.2. Examples of the use of simplified asset accounts based on the principle of materiality

In accordance with the principle of materiality, some expenses which should constitute (on account of the period of time they refer to) prepayments may be considered as of low value.

If the amounts of these expenses are considered non-material, it is possible to resign from prepayments and to register one-off expense at the date of its payment. In accordance with the materiality principle, an entity may set a threshold below which it will not settle prepayment (in spite of the fact that in accordance with the meaning of economic transaction – e.g. purchase of five-year insurance – this should be done), but recognise a one-off expense when it was incurred. Such a situation may apply to the purchase of insurance, subscriptions and even the repair expense to fixed assets or rental fees. One may ask whether it is really economical to distribute the cost of an annual magazine subscription (to accounts) in the amount of PLN 600 and recognise the amount of PLN 50 as a cost monthly, instead of a one-off recognition as the cost of PLN 600 in the month of subscription purchase. If the given amount is considered as non-material, and thus does not distort the reporting information, then it is possible – based on the principle of materiality – to depart from booking the prepayments and instead record the one-off charge of the costs.[6] The condition for applying such a solution is to establish a materiality threshold for this type of expenditure (the establishment of the partial materiality also for prepayments is possible using the model of partial materiality calculation proposed by the authors) and a clear indication in the accounting policy what type of expenses and what amounts can be considered 'of low value,' and thus accounted for in a simplified way. The condition for applying such a solution, however, is to verify whether the total amount of simplifications applied to the accounts recognised as of low value is not a material amount (as it is in the case of the simplified recognition of low-value fixed assets).

An entity may also consider the costs of the current period for which expense will occur in later periods, including the accrued expenses related to warranty repairs or employee benefits, for example, holiday benefits. However, low value in the case of accrued expenses should be introduced in the entity with a high degree of caution: low-value expenses are those which are not cumulative and are not transferred over several reporting periods (e.g. holiday benefits, compensation payable in the next period, or the cost of possible warranty repairs that may take

6 Empirical research on a group of 148 companies listed on the Warsaw Stock Exchange showed that the average partial materiality index calculated for the sum of prepayments for those companies for the years 2007–2014 amounted to PLN 1,138,000. However, the average partial materiality index calculated for a group of 80 companies listed on the Warsaw Stock Exchange but not belonging to WIG30, mWIG40 or sWIG80, amounted to PLN 329,000.

place in the near future), and which, therefore, due to their low value, permit refraining from making accrued expenses to cover them. On the other hand, in the case of the expenses that may accumulate over several reporting periods, even if they are identified as of low value in a certain period, simplifications cannot be made, because these costs in total, incurred in several reporting periods, may become a material amount: for example, the costs for accrued expenses of retirement benefits or jubilee bonuses.

The concept of low value may also be referred to other assets: for example, if an entity considers finished products to be of low value, it may choose not to determine the spare production capacity when calculating their value; what is more, if the products are considered as of low value, the simplified valuation is based on the assumption that these products are of low value, but in the case of statutory exemption from the apportion of costs for spare production capacities, it is assumed that the amount of these costs is not material, and hence it is possible to apply their simplified accounts.

Similarly, if an entity makes simplified accounts of materials (including goods) with the consent of the entity's manager by charging to costs the value of materials and goods at the date of their purchase, as well as determining the state of the assets, their valuation and the adjustment of costs by the value of that state (i.e.: considering the value of these assets at the balance-sheet date as non-material), then the cost adjustment may be waived by the value of low-value materials (goods) as at the balance-sheet date.

The low-value criterion may be applied also to the receivables, in particular to those receivables for which the costs of their investigation exceed the value of the receivable itself. In this case, writing down their value is both economically reasonable and in line with the tax approach, which indicates that one of the forms of documenting non-recoverability of debts is preparing a protocol by a taxpayer stating that the envisaged legal and enforcement costs related to debt recovery would be equal to or higher than the amounts of receivables.[7]

Although the concept of low value is commonly associated with fixed assets and intangible assets, according to the theory of accounting, it is possible to extend this concept also to other components of the balance sheet, as shown above. The indicated solutions, although not explicitly mentioned in the Accounting Act, but in accordance with its spirit and the principle of materiality, may turn out to be a significant convenience, which, however, will not adversely affect the quality of information presented in the financial statements. Recognition of a certain asset (cost or liability) as low-value may affect not only the manner of its recognition in the accounts and financial statements, but also affect the applied inventory method.

7 Art. 16(2)(3) of the Act on Corporate Income Tax.

It should be remembered that the recognition of a single asset or transaction as low-priced is not a 100% guarantee for making simplification, because the low-value of a single transaction does not ensure that a group of several or a dozen low-value transactions during the financial year will have no significant effect. Therefore, it is crucial to verify, at the end of the reporting period, whether the simplifications introduced into low-value transactions altogether do not constitute a significant deformation of the reporting information.

8. Conclusions

A significant change in tax regulations, allowing for one-off depreciation of assets in the amount of no more PLN 10,000, was an incentive to take up the subject of recognising low-value assets in the balance-sheet law. The change of the lower limit of fixed assets (as well as intangible assets) from PLN 3,500 to PLN 10,000 has numerous effects on accounting: entities that have adopted for accounting purposes the tax limit for recognising fixed assets (and this is a vast majority) are facing – due to the changes in tax regulations – the necessity of verification as well as possible changes in the accounting (policy) principles, or differentiation of the tax and accounting way of recognising fixed assets, which complicates their accounting considerably.

The range of acceptable solutions (especially in the case of convergence of tax and balance law) in the area of recognition of fixed assets and intangible assets, along with considerations on the validity of adopting these solutions, is presented in Section 3, considering, among others, whether it is possible to change the lower limit of recognition of low-value assets without the necessity to retrospectively restate data due to a change in accounting principles (policy). It has been shown that there are many arguments in favour of renouncing the retrospective restatement of data for the preceding year, especially since it is time-consuming and requires a great deal of attention. Departure from the retrospective restatement of comparative data is possible based on the principle of materiality: if the effects of not making retrospective restatements are not material, one can refrain from making restatements (Hołda, Staszel, 2018).

In the further part of the article, the fact that the concept of low-value can be also referred to assets, transactions and events related not only to fixed assets or intangible assets is presented. Areas in which it is possible to apply simplifications to operations with non-material value are numerous, and each entity should individually specify – in its accounting policy – what principles to apply to individual assets/transactions/events considered to be of low value, as well as what amount constitutes the limit value for the recognition of certain reporting items as non-material. It must be remembered that it is the principle of materiality that is the tool for inclusion of low value.

The determination of the materiality threshold for all the above mentioned assets and events can be based on the basis of the partial materiality index, the calculation methodology of which is presented in Section 1. The presented model for determining overall materiality and partial materiality is a universal model and can be successfully used by various economic entities.

To conclude the considerations of low value and materiality, it is worth noting that the entities which really want to observe the principles of true and fair view, and thereby achieve the goal of accounting, i.e. show the true (fair) picture of a given economic entity in the accounting books, should themselves determine whether applying certain simplifications, those explicitly indicated in the Accounting Act and those resulting from the accounting principles, will not cause a distortion of the reported data, and thus will significantly affect not only the amount of the financial result, but the entire picture of the entity in the financial statements. It should be noted that now not only the profit category itself is important for investors when making decisions, but also other items of the financial statements (Barth, Ken, McClure, 2017).

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Pojęcie niskocenności w kontekście środków trwałych

Streszczenie: Celem artykułu jest ukazanie możliwości stosowania uproszczeń w rachunkowości, w szczególności w zakresie ujmowania środków trwałych oraz innych pozycji bilansowych, zgodnie z zasadą istotności i dochowując zasady wiernego odzwierciedlenia. Aby osiągnąć ten cel, wykorzystano dedukcyjno-indukcyjne metody badawcze w postaci przeglądu literatury, analizy treści sprawozdań finansowych oraz statystycznej weryfikacji ustaleń.

Stosowanie uproszczeń w rachunkowości jest możliwe pod warunkiem, że nie zniekształca to obrazu jednostki ukazanego w sprawozdaniu finansowym, a tym samym nie wprowadza w błąd użytkowników tego sprawozdania, czyli nie jest istotne. Określenie progów, od których daną informację należy uznać za istotną, jest zadaniem trudnym, a równocześnie kluczowym w sprawozdawczości, jak również rewizji finansowej. Autorzy w artykule prezentują model, który pozwala na wyznaczenie poziomów istotności (zarówno w stosunku do całości sprawozdania finansowego, jak i poszczególnych jego elementów) w każdej jednostce gospodarczej, niezależnie od jej wielkości czy branży, w której funkcjonuje. Zaprezentowany model wynika z danych sprawozdawczych polskich przedsiębiorstw, stanowiąc korektę podobnych modeli stosowanych w krajach Europy Zachodniej, i ułatwia określenie zobiektywizowanego poziomu istotności cząstkowej w zasadzie dla wszystkich pozycji sprawozdawczych.

Wykorzystując zaprezentowany model, autorzy przeprowadzili badania na grupie 148 spółek giełdowych, analizując sprawozdania finansowe tych jednostek sporządzone za lata 2007–2014 i dokonując tym samym przeglądu danych zwartych w 1184 sprawozdaniach finansowych, oraz na grupie 337 mniejszych polskich spółek, analizując ich sprawozdania finansowe za lata 2010–2017 i dokonując przeglądu danych zwartych w kolejnych 2696 sprawozdaniach finansowych. Łącznie przeanalizowano dane z 3880 sprawozdań finansowych. Z przeprowadzonych badań wyciągnięto wnioski dotyczące możliwości stosowania przez jednostki uproszczeń w zakresie ujmowania środków trwałych. Badania umożliwiły wskazanie progów istotności dla jednostek notowanych na WIG30, mWIG40, sWIG80 oraz spółek giełdowych nienotowanych na żadnym z wymienionych indeksów, w szczególności istotności cząstkowej liczonej dla amortyzacji. Analiza wyników badań, w tym zastosowanie testu chi kwadrat, pozwoliło podać w wątpliwość to, czy z punktu widzenia rachunkowości finansowej dokonywanie jednorazowych amortyzacji w kwotach zbliżonych 10 000 zł (co jednostki mogą chcieć praktykować w związku ze zmianą przepisów podatkowych) nie zniekształci obrazu jednostki prezentowanego w jej sprawozdaniu finansowym. Hipotezą badawczą artykułu jest konstatacja, że nie wszystkie jednostki prowadzące księgi rachunkowe mogą stosować przepisy podatkowe w zakresie ujmowania nieskocennych środków trwałych.

Słowa kluczowe: niskocenność, istotność, wiarygodność, środki trwałe, wartość bilansowa

JEL: M41

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Calendar Effects in the Stock Markets of Central European Countries

Abstract: The efficient market hypothesis suggests that there are no opportunities to gain above-normal profits using available information, because it is all reflected in the prices. However, calendar anomalies are found to contradict the efficient market hypothesis and enable investors to predict prices during specific days. Based on a review of papers on market efficiency and market anomalies, this paper examines and compares calendar effects known as 'the month-of-the year effect' and 'the day-of-the-week effect' between the stock markets of three Central European countries: Poland, Hungary and the Czech Republic. The study has revealed the presence of calendar anomalies in the indexes representing small-cap stocks listed on the Polish stock market and, to some extent, in the indexes used in the Hungarian and Czech stock markets.

Keywords: capital market, seasonal anomalies, calendar effects, market efficiency, January effect

JEL: G14, G41, C58

1. Introduction

Market efficiency is one of the founding concepts of modern financial theory. According to the efficient market hypothesis (EMH), stock returns in an efficient market reflect all information available to investors, so in the long run they cannot beat the market to earn above-average returns (Fama, 1970: 383–417). However, some studies, for example, Gultkein (1983), Reinganum, Shapiro (1987: 281–295), have shown irregularities in the behaviour of stock prices which the EMH fails to explain and which the economic literature calls "anomalies". The probability of such anomalies occurring and their relative unpredictability largely determine the efficiency of investors' strategies, so it seems important to find the answer to the following question about the nature of calendar anomalies: Are they temporary irregularities or, perhaps, a sign of market inefficiencies?

In this paper, calendar anomalies known as the month-of-the-year effect and the day-of-the week effect are analysed and compared among the stock markets of three Central European countries: Poland, Hungary and the Czech Republic. One of the purposes of statistical analysis is to establish whether introducing control variables, such as: S&P500 index quotes, prices of gold, yields on 10-year Treasury bonds (YTM) and USD/PLN, USD/CZK and USD/HUF exchange rates, into regression models will offset or amplify the effect of the identified anomalies.

There are several features of our research that distinguish it from other studies. Firstly, we compare calendar anomalies among different emerging market countries. Most studies on market efficiency focus on developed economies, some emerging markets have also been tested for calendar anomalies, however, very few papers compare calendar anomalies among different emerging market countries. Secondly, we investigate how the financial crisis in 2007 impacted the occurrence of calendar anomalies. Thirdly, we introduce control variables to the testing of calendar effects. Last but not least, we explore whether calendar anomalies are still present in the markets, because some literature suggests that in recent years calendar effects have become less prominent and may be disappearing.

The paper is organised as follows. Section one gives an overview of the selected calendar anomalies and explains the efficient market hypothesis. Section two describes the research sample. Section three presents the research methodology, and in section four (last) the research results and conclusions are discussed.

2. An efficient market and calendar anomalies – literature review

A definition of the efficient market has been presented by Fama (1970: 383) and Damodaran (2002: 115). An efficient market means that each new piece of information reaches all investors, spurs them to action and changes stock prices at the same time. A market is informationally efficient if prices always incorporate all available information. Accordingly, there are no opportunities for above-average gains and investors' efforts to find tips that might give them advantage over other market players are doomed to be futile.

The key assumption of the efficient market hypothesis, i.e. that above-average returns cannot be earned in the long run, is challenged by stock market anomalies. The word 'anomaly' is understood in the economic literature as a deviation from the expected result, an exception to the rule. Two representative definitions of stock market anomalies describe them as:

1) situations allowing investors to earn positive, above-average returns (Fama, French, 1996: 55; Peters, 1997: 36);
2) instances when investment strategies or techniques yield returns challenging the fundamentals of the efficient market theory (Jones, 1996: 282).

Among the best known stock market anomalies are seasonal (calendar) anomalies, defined as inconsistencies between actual stock returns and the EMH. Widely known are monthly anomalies in stock returns, which according to the efficient market hypothesis should not be regular, let alone predictable. Most studies investigating monthly anomalies focus on the January effect, i.e. a tendency for stock returns to be, on average, positive and higher in January than in the other months (Mahdian, Perry, 2002: 141).

The likely occurrence of the January effect was first reported by Wachtel (1942), who studied the impacts of seasonality on the US DJIA index in the period from 1927 to 1942.

Studies on the US stock market found a relationship between companies' capitalisation rates and the occurrence of the January effect, and associated most rises in capital markets in that month with changing prices of small-cap stocks. They also observed that most above-average returns on investments in small cap-companies were earned in January, as a consequence of which the phenomenon has become known as 'the small-company effect' (Hull, Mazachek, Ockree, 1998: 8–20).

However, Gu (2003) found the January effect to be present also in the stocks of high-cap companies and M. Gultkein (1983) demonstrated its presence in the stock markets of 15 different countries.

Different explanations of the January effect have been put forward. One of them attributes it to investors' efforts to reduce their annual gains at the year-end, and

thereby tax liabilities, by selling the underperforming stocks. Then, in January, investors readily seize opportunities to purchase low-priced stocks and so their prices go up (Szyszka, 2009: 166).

Research shows, however, that the January effect is also present in countries without income tax, such as Japan (Kato, Schallheim, 1985: 243–260), and in countries where the end of the tax year and the calendar year fall on different dates coincide, for instance, in the UK and Australia (Reinganum, Shapiro, 1987: 281–295). This casts serious doubts on whether the hypothesis contributing the January effect to investors selling off in December for tax reasons holds for the stock markets of these countries. Globalisation processes and strong linkages between capital markets seem to be a more probable explanation.

Another interesting explanation of the January effect refers to the fact that the portfolio managers' compensation depends on the performance of their portfolios measured against a suitably selected benchmark index. Because better performance means higher fees, managers shed the worst-performing stocks at the year-end to maximise them. Then, in January next year, they replenish their portfolios with the stocks of risky companies, offering higher expected rates of return.

The explanation of the January effect that Kinney and Rozeff came up with attributes it to the effect of new information disclosed by companies in late December on investors' buying and selling decisions in January, and consequently on the prices of stocks (Kinney, Rozeff, 1976: 379–402).

Another interesting calendar anomaly has to do with the observation that on some trading days stock returns are consistently and repetitively different than on other days. Early on it was called the day-of-the-week effect but then the term the weekend effect became more popular. Studies of the US stock market revealed that Monday stock returns were, on average, lower than on other days (Higgins, Howton, Perfect, 2000: 19). Accordingly, the regularity was called the Monday effect, but new studies showed that Monday was not unique in that respect.

French, who compared the daily stock returns for companies comprising the S&P500 index in the years 1953 through 1977 (French, 1980: 57), found them to be higher on Mondays and Fridays. The regularity was correspondingly called 'the effect of the weekend'. Having studied the S&P500 and DJIA companies, Smirlock and Starks (1986: 197) concluded that the reason for negative rates of return on Mondays was related to falls in stock prices between the afternoon trading session on Friday and the commencement of trading on a Monday morning, but they failed to reach consensus over what was the cause of the phenomenon. Abnormal stock returns have been observed not only on Mondays and Fridays, but also on other days of the week.

Calendar anomalies have been studied also in the Polish capital market. Keller (2015: 69–79) studied the effect-of-the-day in the Polish stock market. In the analysis, he verified negatively the occurrence of the effect of weekdays, although small

market-cap companies show certain tendencies in terms of the effect-of-the-week. His analysis showed large inconsistencies of the results, both in the case of the correlation analysis and the regression analysis. Grotowski (2008: 55–75) studied four calendar anomalies in the Polish stock market. He did not find evidence for the holiday effect and end-of-month effect, however, his analysis shows that there is the Thursday effect and Friday effect. He also found the January effect to be present in small- and medium-cap companies. The January rate of return was about 4% higher than the rates of return for the remaining months. Ślepaczuk (2006: 1–12) presented basic anomalies of the capital market, described both in the Polish and world literature. Fiszeder and Kożuchowska (2013: 217–229) used permutational tests and GARCH models. The results indicated the occurrence of the turn-of-the-month effect, no seasonal fluctuations and very weak weekly fluctuations. Although significantly positive rates of return were observed on Mondays, and significantly lower on Wednesdays, it was only for the WIG20 index, and only at the significance level of 0.1. However, none of these authors has convincingly answered the following question: "Are there calendar anomalies on the Warsaw Stock Exchange?".

Among authors who have investigated calendar anomalies in emerging stock markets are Tonchev and Kim (2006: 1035–1043). They studied the Czech Republic, Slovakia and Slovenia to investigate whether calendar effects are present in the newly developing financial markets. Out of the five calendar effects examined (the day of the week effect, the January effect, the half-month effect, the turn of the month effect, and the holiday effect), very weak evidence has been found for these calendar effects in the three countries, and the effects have different characteristics in different stock markets.

Calendar anomalies were tested after the 2007 crisis. Jayaraman, Muruganandan and Santhi (2017: 26–30) tested anomalies in Brazil, Russia, India and China in three sub-periods: the pre-financial crisis period (2000–2007), the financial crisis period (2008–2009) and the post-crisis period (2010–2016). Regression results show that after the crisis BRIC capital markets reached the efficient stage where day of the week trading rules lose the ground to earn the abnormal return. This could be attributed to changes in the capital markets regulations and vigilance of the stock market.

Gajdošová, Heryán and Tufan (2011) analysed the day of the week effect in the European emerging markets (Czech, Hungarian, Polish, Slovak and Turkish stock markets) in the period from 2005 to 2010. The results show that anomalies appeared only during the financial crisis. Moreover, Marquering, Nisser and Valla (2006) point to strong evidence that the weekend effect and the January effect disappeared after the information about the occurrence of those anomalies had been published.

Calendar effects have attracted a large number of scholars, but results have often been mixed. The EMH, particularly in its semi-strong and strong forms, is often

strongly criticised (Rossi, 2015). Despite the existence of great empirical and theoretical research papers, there is no clear picture whether calendar anomalies exist on a given stock exchange, if they are constant in time, and what circumstances influence them. The bulk of studies on market efficiency focus on the US market and markets in developed countries. Some of the emerging markets have also been tested for the presence of calendar anomalies. However, very few papers compare calendar anomalies among different emerging market countries. It is also worth investigating how the financial crisis in 2007 impacted the occurrence of calendar anomalies. The crisis had a different impact on emerging markets and developed countries. Even among emerging countries there were differences. For example, in the Czech Republic and Hungary there was a negative economic growth rate, whereas in Poland economic growth remained positive. Some literature, for example, Marquering, Nisser and Valla (2006), suggests that in recent years calendar effects have become less prominent and may be disappearing. The reason for this may be found in the crisis itself or perhaps in new regulations introduced to the economies after the crisis. The main research question in our paper is whether the best know anomalies (the month-of-the-year effect and the day-of-the week effect) still occur in markets after the crisis of 2007 or if they have become less prominent or have disappeared. In our research, we also have introduced control variables to the testing of calendar effects to check whether the detected anomalies disappear or gain significance if control variables are included.

3. Research sample

Indexes: WIG, mWIG40, sWIG80 (Warsaw), PX (Prague) and BUX (Budapest) were analysed for the presence of the day-of-the-week effect and the month-of-the-year effect. WIG and BUX are total return indexes, which means they take into consideration the price fluctuations of the components of the index as well as dividends that companies pay. PX, mWIG40 and sWIG80 are price indexes, which means they calculate only the changes in the price of the index components. We used daily returns (around 2600 observations) and monthly returns (126 observations) from a period spanning from 1 January 2008 to 30 June 2018. The historical WIG, mWIG40 and sWIG80 prices were sourced from http://www.biznesradar.pl and https://www.gpw.pl (accessed on 1 July 2018), and PX and BUX prices from https://stooq.pl (accessed on 1 July 2018). Descriptive statistics and the number of observations for each index are reported in Table 1. For control variables, we also used daily returns (around 2600 observations) and monthly returns (126 observations) from a period spanning from 1 January 2008 to 30 June 2018. The data were derived from https://stooq.pl (accessed on 1 July 2018).

4. Research method

In the study, we analysed the Polish, Czech and Hungarian capital markets and compared for the presence of two calendar anomalies: the month-of-the-year effect and the day-of-the-week effect. The focus of the analysis was on the following stock indexes:

1) the Warsaw Stock Exchange (WSE) – WIG – Total Return index, mWIG40 and sWIG80 – both Price Return indexes,
2) the main index of the Prague Stock Exchange – PX – a Price Return index,
3) the main index of the Budapest Stock Exchange – BUX – a Total Return index.

The statistical analysis of both anomalies was carried out using mainly linear regression models, and additionally non-parametric testing.

For the linear regression, we calculated logarithmic rates of return, then assessed the probability of calendar effects being present by estimating parameters of regression models. Our approach is similar to that of French (1980), Junkus (1986), Grotowski (2008), Gajdošová, Heryán and Tufan (2011). The index prices were converted into logarithmic rates of return using the following formula:

$$r_t = \ln\left(\frac{P_t}{P_{t-1}}\right),$$

where r_t – the logarithmic rate of return, P_t – the index price at the end of the trading day t, P_{t-1} – the index price at the end of the trading day t – 1. The testing for the day-of-the-week effect involved the use of the following model:

$$r_t = \gamma r_{t-1} + \sum_{i=1}^{5} \beta_i d_t^i + \varepsilon_t,$$

where r_{t-1} is the logarithmic rate of return on the previous day, d_t^i is a dummy variable, representing consecutive trading days (Monday through Friday) and taking the value of "1" when t is Monday and "0" for the other four days. Hence, d_t^1 stands for Monday, d_t^2 for Tuesday, etc. The model was estimated using the ordinary least squares method (OLS). The model employed to determine whether the month-of-the-year effect was present in the selected stock markets was as follows:

$$r_t = \gamma r_{t-1} + \sum_{i=1}^{12} \beta_i d_t^i + \varepsilon_t,$$

where d_t^i is a dummy variable representing consecutive months of the year (January through December) and taking the value of "1" when t is January and "0" for

each consecutive month. Hence, d_t^1 denotes January, d_t^2 February, etc. This model, too, was estimated by the OLS.

Testing for the presence of a calendar effect basically comes down to estimating the statistical significance of the β_i coefficient for a given dummy variable.

To be estimable by the OLS method, a model has to meet a number of restrictive assumptions about the distribution of random term ε_t, including the absence of autocorrelation. Because the autocorrelation of the time series of daily stock returns is a frequent problem in statistical analysis, an independent variable represented by a one period lagged-return was introduced as a precaution.

Both the day-of-the-week effect and the month-of-the-year effect were subjected to the Kruskal-Wallis test, a non-parametric alternative to one-way ANOVA enabling the comparison of three or more samples. The Kruskal-Wallis test is applied when ANOVA assumptions are not met or when the nature of variables prevents its use.

In modelling economic phenomena, the model's robustness is a critical piece of information, because models that are insufficiently robust may misrepresent the mechanisms underlying the phenomenon under consideration and lead to incorrect conclusions and decisions. The robustness of both models used in the study was checked against four control variables:

1) X_1 – the US stock index S&P500,
2) X_2 – the exchange rate between the domestic currency and the US dollar, the exchange rates are: USD/PLN, USD/CZK and USD/HUF,
3) X_3 – the yield on 10-year Treasury bonds in each country,
4) X_4 – gold futures price (New York Mercantile Exchange and Commodity Exchange – Comex).

5. Research results

The linear regression results for the day-of-the-week effect are shown in Tables 2–6 consisting of five panels each. Tables 7–11 show the linear regression results for the month-of-the-year effect. In these tables, Panel I contains the values of β_i coefficients for models without control variables and Panels II–V for models with X_1, X_2, X_3 and X_4 control variables, respectively. Table 12 presents the Kruskal-Wallis test statistics for both effects.

The values of β_i coefficients on particular days of the week calculated for the WIG and mWIG40 indexes are not statistically significant, but in the case of the sWIG80 they are significant for Monday and Friday (p-value = 0.012 and 0.027 respectively). Monday returns on this index are, on average, lower than on other trading days, and on Fridays they are higher. The significance of the β_i coefficients for the sWIG80 does not change after the inclusion of the control variables ($\alpha = 0.05$).

All three WSE indexes are statistically significantly influenced by the S&P500 index and the USD/PLN exchange rate. Their effect is positive (S&P500) and negative when the Polish currency is depreciating (USD/PLN). The analysis also shows that the WIG and mWIG40 indexes are sensitive to changes in T-bond yields.

The average return growth rate for the PX is lower on Tuesday compared to other days of the week. The β_i coefficients for daily returns are not statistically significant, but Tuesday returns become significantly different from zero ($\alpha = 0.05$) following the inclusion of the control variables. The S&P500 and the USD/CZK exchange rate have a significant effect on the PX, like in the case of the Polish indexes. The S&P500 increases returns on the PX and a depreciating Czech koruna decreases them.

The β_i coefficients for variables representing individual daily returns on the Hungarian stock exchange are not statistically significant either, but the inclusion of the control variables causes the β_i coefficient for 'Monday' to become statistically significant ($\alpha = 0.1$). The Monday returns on the BUX are, on average, higher than those noted on other trading days. Interestingly, of all indexes studied, only the BUX is statistically significantly influenced by all control variables ($\alpha = 0.001$).

Overall, the analysis does not provide grounds to conclude that the day of the week effect is present in the main indexes of the analysed stock markets, with the exception of the sWIG80, which generates statistically significantly lower returns on Mondays and higher on Fridays. Statistically different returns on the PX and the BUX (both made up of fewer companies than the Polish WIG) occur on Tuesday (PX) and Monday (BUX). The effect of the S&P500 and domestic currencies/USD exchange rates on the analysed indexes is considerable.

The linear regression results for the month-of-the-year effect are shown in Tables 7–11, which also consist of five panels each. The β_i coefficients in Panel I were calculated for each month's returns without the control variables. Their effect is accounted for in the statistics presented in Panels II–V. The monthly returns on the broadest-based Polish index, WIG, are generally not significantly different from zero, except for July when they are positive ($\alpha = 0.1$), but only until the control variables are included. The S&P500 and the USD/PLN exchange rate's effect on monthly returns is statistically significant.

Monthly returns on the mWIG40 are statistically significantly lower ($\alpha = 0.1$) in June than in other months, and this does not change after the inclusion of the control variables.

Monthly returns yielded by the sWIG80 (the small-cap companies) are significantly different from zero in January and June, and their β-coefficients remain statistically significant ($\alpha = 0.05$), even after the inclusion of the control variables. Higher returns in January are typical of the January effect. In June, stock returns are lower than in other months. The sWIG80 is statistically significantly influenced by the S&P500.

Stock returns on the Czech stock market are, on average, lower in June and September implying the presence of the month-of-the year effect. The β-coefficients for the monthly returns are significantly different from zero even after the control variables are included. The July's β_i is also statistically significant, but only until the inclusion of the control variables. As in the case of the Polish indexes, the S&P500 is the only control variable to have a statistically significant effect on the PX.

The β-coefficients on the monthly returns on the Hungarian BUX become statistically different from zero only under the influence of the control variables. January returns are, on average, higher than in other months ($\alpha = 0.05$), implying the presence of the January effect, but the conclusion may be premature because the effect is not discernible until the control variables are included. As far as the control variables are concerned, a significant effect on the BUX is exerted by the US S&P500 index and the USD/HUF exchange rate.

The foregoing analysis offers the following conclusions. The Polish sWIG80 index and, to some extent, the Hungarian BUX index exhibit the January effect. Returns generated by the Czech PX index and the Polish mWIG40 and sWIG80 indexes are, on average, lower in January than in other months. The Czech stock market is the only one to generate statistically significantly different returns in September. In all the three countries, the S&P500 index and exchange rates against the US dollar influence stock index returns (excluding the PX).

Table 12 contains the results of the Kruskal-Wallis test for the day-of-the-week and month-of-the-year effects. As it can be seen, statistically significant differences between returns were only obtained for the sWIG80 tested for the 'day-of-the-week-effect', namely between Monday and Friday, Tuesday and Friday, Wednesday and Friday. The validity of this result is indirectly supported by the regression analysis, which shows that the Monday and Friday rates of return for this index are significantly different from zero. For the other indexes, no statistically significant differences were found.

Of the three WSE indexes studied, positive returns on Fridays and negative on Mondays, pointing to the presence of the day-of-the week-effect, were only found for the sWIG80. The result was confirmed by both the linear regression analysis and non-parametric testing. A tendency for stock prices to drop between Friday and Monday was also reported by French (1980) for the US stock market. One of the explanations of this weekend effect is connected with the new information reaching investors during the weekend, however, it was not the subject of our study. The behaviour of the Polish stock market is also well explained by the results of earlier reports which attribute the presence of calendar effects to changes in small-cap returns such as Hull, Mazachek and Ockree (1998). However, the day-of-the-week-effect was not found to be present in the WIG and mWIG40, which confirms the research conducted by Patev (2003), who studied calendar anomalies for the main market indexes in the Central European stock markets. In his work,

he indicates that the Polish indexes do not show effects related to the days of the week, but the significance of individual days in other markets can be indicated.

The PX yielding lower returns on Tuesdays and the BUX positive returns on Mondays partially confirmed weak presence of the day-of-the-week effect on the Prague and Budapest stock markets.

As far as the month-of-the-year effect is concerned, the sWIG80 returns were positive in January and negative in June. The presence of January effect on small market companies is consistent with Grotowski (2008). The Czech PX generated statistically significantly lower returns in February, June and September. The January effect was found in the Hungarian stock market, which generated the biggest above-normal returns in January among the studied markets.

The occurrence of the January effect in the Polish and Hungarian stock markets was reported also by Asteriou and Kavetos (2006). Their results supported the existence of seasonal effects, particularly the January effect, in Poland and Hungary, but not in the Czech Republic, stronger evidence (in terms of statistical significance) was seen for the cases of Hungary and Poland. The January effect may have two probable explanations. One assumes that investors sell off underperforming stocks in December to reduce their tax bill and buy stocks again in January. The other explanation holds that the effect may be caused by portfolio managers who shed 'loser stocks' at the year-end to maximise their fees (which depend on the performance of their portfolios) and in January readily buy riskier stocks with higher expected rates of return. The likely cause of the June anomaly (negative returns) is investors selling part of their portfolios for the summer to have more time for themselves or simply to have the money for summer holidays. Whatever the reason, the increasing supply of stock drives stock prices upwards.

The analysis of the effect of the control variables on the selected indexes shows that all of them are sensitive to the US S&P500 index and exchange rates against the US dollar, and partially to yields on 10-year Treasury bonds.

The obtained results indicate that some anomalies are still present in the stock markets of the three emerging countries in the period after the financial crisis.

6. Conclusions

This paper tested for the existence of calendar effects in the stock markets of Central European countries: Poland, Hungary and the Czech Republic. The stock markets of all the three countries analysed in the study exhibit calendar anomalies such as the day-of-the-week effect and the month-of-the-year effect in the period after the financial crisis. The day-of-the-week (Friday and Monday) was found for the sWIG80 in Poland, and to some extent for the BUX (Monday) in Hungary and the PX (Tuesday) in the Czech Republic. However, statistical significance was weaker

for the Hungarian and Czech Republic stock markets. The month-of-the-year effect was found in all the three studied markets, mainly the January effect in the case of Poland and Hungary. Our conclusion requires several comments, though. Firstly, it only holds for the selected time period. Secondly, it would have been more convincing had the stocks of individual companies been used rather than stock market indexes. Lastly, the classical linear regression analysis requires a number of restrictive assumptions (e.g. concerning the presence of normal distributions, the absence of autocorrelation, etc.) to be fulfilled, therefore the authors in their upcoming paper plan to use the GARCH models.

Table 1. Descriptive statistics for daily and monthly returns in the sample period

	Daily rate of return				
	Mean	**St. Dev.**	**Min.**	**Max.**	**No. of obs.**
WIG	0.00%	1.22%	–8.29%	6.08%	2625
mWIG40	0.00%	1.09%	–9.10%	5.12%	2625
sWIG80	–0.01%	0.90%	–7.52%	4.78%	2625
BUX	0.01%	1.59%	–12.65%	13.18%	2621
PX	–0.02%	1.45%	–16.19%	12.36%	2633
	Monthly rate of return				
	Mean	**St. Dev.**	**Min.**	**Max.**	**No. of obs.**
WIG	0.12%	5.60%	–27.45%	18.84%	125
mWIG40	0.18%	5.92%	–0.3272%	19.84%	125
sWIG80	–0.10%	5.69%	–25.77%	20.98%	125
BUX	0.34%	6.73%	–33.40%	15.07%	125
PX	–0.27%	6.18%	–31.65%	17.11%	125

Source: own elaboration

Table 2. Poland, WIG index, the day-of-the-week effect

	I			II			III			IV			V		
	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value
γ	.100***	5.167	.000	.100***	5.709	.000	.070***	3.659	.000	.065***	3.361	.001	.065***	3.393	.001
B_1	.046	.866	.387	.058	1.207	.227	.057	1.190	.234	.054	1.138	.255	.052	1.091	.276
B_2	.017	.328	.743	–.027	–.576	.565	–.024	–.508	.612	–.025	–.537	.591	–.026	–.552	.581
B_3	.002	.033	.974	–.013	–.271	.787	–.012	–.252	.801	–.009	–.196	.845	–.008	–.172	.863
B_4	–.010	–.193	.847	–.008	–.169	.866	–.007	–.151	.880	–.011	–.228	.820	–.011	–.231	.817
B_5	–.054	–1.010	.313	–.053	–1.098	.273	–.052	–1.089	.276	–.052	–1.081	.280	–.051	–1.066	.286
S&P500				.415***	24.867	.000	.413***	24.818	.000	.413***	24.824	.000	.413***	24.840	.000
USD/PLN							–.091***	–3.836	.000	–.082***	–3.428	.001	–.076***	–3.070	.002
YTM										–.038**	–2.350	.019	–.037**	–2.289	.022
Gold													.020	1.082	.279

* Statistical significance $\alpha = 0.1$.
** Statistical significance $\alpha = 0.05$.
*** Statistical significance $\alpha = 0.01$.

Source: own elaboration

Table 3. Poland, mWIG40 index, the day-of-the-week effect

	I			II			III			IV			V		
	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value
γ	.187***	9.761	.000	.185***	10.370	.000	.184***	10.655	.000	.185***	10.743	.000	.184***	10.727	.000
B_1	–.011	–.236	.814	–.002	–.054	.957	.004	.087	.931	–.001	–.021	.983	–.001	–.019	.985
B_2	.036	.782	.434	.003	.074	.941	.009	.222	.824	.015	.361	.718	.015	.349	.727
B_3	.008	.180	.857	–.002	–.044	.965	.001	.025	.980	–.005	–.119	.906	–.008	–.185	.853
B_4	–.026	–.564	.573	–.025	–.569	.570	–.019	–.458	.647	–.019	–.459	.646	–.020	–.479	.632
B_5	.000	–.007	.994	.001	.012	.991	.001	.023	.982	–.003	–.064	.949	–.001	–.018	.985
S&P500				.307***	20.245	.000	.236***	15.132	.000	.232***	14.903	.000	.231***	14.814	.000
USD/PLN							–.271***	–13.329	.000	–.251***	–12.156	.000	–.255***	–11.937	.000
YTM										–.074***	–5.298	.000	–.075***	–5.359	.000
Gold													–.014	–.844	.399

* Statistical significance $\alpha = 0.1$.
** Statistical significance $\alpha = 0.05$.
*** Statistical significance $\alpha = 0.01$.

Source: own elaboration

Table 4. Poland, sWIG80 index, the day-of-the-week effect

	I			II			III			IV			V		
	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value
γ	.237***	12.502	.000	.232***	13.170	.000	.218***	11.738	.000	.218***	11.655	.000	.217***	11.600	.000
B_1	–.096**	–2.502	.012	–.088**	–2.482	.013	–.087**	–2.445	.015	–.087**	–2.447	.014	–.086**	–2.414	.016
B_2	–.037	–.977	.329	–.065*	–1.847	.065	–.066*	–1.853	.064	–.066*	–1.855	.064	–.065*	–1.847	.065
B_3	–.003	–.081	.935	–.012	–.346	.729	–.013	–.357	.721	–.012	–.353	.724	–.013	–.368	.713
B_4	.016	.428	.669	.018	.496	.620	.018	.498	.619	.018	.492	.623	.019	.535	.593
B_5	.085**	2.213	.027	.086**	2.409	.016	.087**	2.424	.015	.087**	2.424	.015	.086**	2.415	.016
S&P500				.258***	20.746	.000	.257***	20.708	.000	.257***	20.703	.000	.257***	20.676	.000
USD/PLN							–.039**	–2.248	.025	–.038**	–2.181	.029	–.041**	–2.283	.023
YTM										–.002	–.178	.858	–.002	–.200	.842
Gold													–.009	–.658	.511

* Statistical significance $\alpha = 0.1$.
** Statistical significance $\alpha = 0.05$.
*** Statistical significance $\alpha = 0.01$.

Source: own elaboration

Table 5. Czech Republic, PX index, the day-of-the-week effect

	I			II			III			IV			V		
	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value
γ	.056***	2.883	.004	.082***	4.560	.000	.085***	4.744	.000	.085***	4.741	.000	.085***	4.738	.000
B_1	–.001	–.012	.991	.016	.275	.783	.018	.302	.763	.018	.303	.762	.018	.303	.762
B_2	–.093	–1.478	.140	–.135**	–2.329	.020	–.124**	–2.150	.032	–.125**	–2.154	.031	–.125**	–2.153	.031
B_3	.061	.969	.333	.064	1.102	.271	.065	1.124	.261	.065	1.125	.261	.065	1.125	.261
B_4	.018	.291	.771	.003	.057	.955	–.004	–.068	.946	–.004	–.066	.948	–.004	–.066	.948
B_5	–.081	–1.274	.203	–.093	–1.587	.113	–.088	–1.523	.128	–.089	–1.527	.127	–.089	–1.524	.128
S&P500				.449***	21.716	.000	.412***	19.065	.000	.412***	19.060	.000	.412***	18.973	.000
USD/CZK							–.181***	–5.565	.000	–.181***	–5.563	.000	–.181***	–5.281	.000
YTM										–.001	–.180	.857	–.001	–.181	.857
Gold													.000	–.011	.991

* Statistical significance $\alpha = 0.1$.
** Statistical significance $\alpha = 0.05$.
*** Statistical significance $\alpha = 0.01$.

Source: own elaboration

Table 6. Hungary, BUX index, the day-of-the-week effect

	I			II			III			IV			V		
	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value
γ	.047**	2.415	.016	.064***	3.585	.000	.062***	3.592	.000	.039**	2.268	.023	.039**	2.253	.024
B_1	.095	1.347	.178	.108*	1.663	.096	.120*	1.948	.052	.114*	1.860	.063	.113*	1.854	.064
B_2	–.030	–.441	.659	–.079	–1.248	.212	–.077	–1.278	.201	–.083	–1.397	.163	–.085	–1.419	.156
B_3	.049	.710	.478	.033	.520	.603	.044	.737	.461	.040	.664	.507	.040	.670	.503
B_4	–.037	–.533	.594	–.042	–.672	.501	–.035	–.579	.562	–.043	–.724	.469	–.044	–.741	.459
B_5	–.013	–.181	.856	–.021	–.322	.748	–.003	–.047	.963	.010	.162	.871	.020	.325	.745
S&P500				.491***	22.007	.000	.373***	16.549	.000	.358***	15.965	.000	.353	15.733	.000
USD/HUF							–.457***	–15.975	.000	–.417***	–14.389	.000	–.441***	–14.775	.000
YTM										–.106***	–6.734	.000	–.105***	–6.660	.000
Gold													–.077***	–3.257	.001

* Statistical significance $\alpha = 0.1$.
** Statistical significance $\alpha = 0.05$.
*** Statistical significance $\alpha = 0.01$.

Source: own elaboration

Table 7. Poland, WIG index, the month-of-the-year effect

	I			II			III			IV			V		
	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value
γ	.002**	2.077	.040	.000	–.678	.499	–.001	–.815	.417	.000	–.658	.512	.000	–.532	.596
B_1	.002	.126	.900	.009	.718	.474	.012	1.023	.309	.012	1.036	.303	.008	.719	.474
B_2	–.006	–.380	.704	–.010	–.885	.378	–.011	–.969	.335	–.011	–.966	.336	–.012	–1.106	.271
B_3	.019	1.142	.256	–.002	–.198	.843	–.002	–.217	.829	–.003	–.246	.806	–.001	–.098	.922
B_4	.020	1.156	.250	.004	.368	.714	.005	.447	.656	.005	.420	.676	.005	.409	.683
B_5	–.017	–1.006	.316	–.011	–1.000	.320	–.001	–.116	.908	–.001	–.096	.924	–.002	–.176	.861
B_6	–.021	–1.214	.227	–.012	–1.021	.309	–.016	–1.438	.153	–.015	–1.384	.169	–.015	–1.335	.185
B_7	.031*	1.731	.086	.003	.275	.784	.000	–.027	.978	–.001	–.064	.949	.000	–.017	.987
B_8	.002	.095	.924	.018	1.496	.137	.021*	1.841	.068	.020*	1.720	.088	.018	1.505	.135
B_9	–.005	–.303	.763	–.002	–.131	.896	.001	.111	.912	.001	.107	.915	.001	.129	.898
B_{10}	–.005	–.305	.761	–.012	–1.040	.301	–.007	–.636	.526	–.008	–.669	.505	–.007	–.587	.558
B_{11}	–.011	–.643	.521	–.019	–1.596	.113	–.009	–.743	.459	–.009	–.752	.454	–.011	–.898	.371
B_{12}	.004	.227	.821	–.015	–1.204	.231	–.012	–1.071	.287	–.012	–1.066	.289	–.011	–.954	.342
S&P500				.010***	11.601	.000	.008***	7.370	.000	.008***	7.267	.000	.008***	7.391	.000
USD/PLN							–.003***	–3.335	.001	–.003***	–3.222	.002	–.003***	–2.721	.008
YTM										.000	–.550	.583	.000	–.322	.748
Gold													.001	1.346	.181

* Statistical significance $\alpha = 0.1$.
** Statistical significance $\alpha = 0.05$.
*** Statistical significance $\alpha = 0.01$.

Source: own elaboration

Table 8. Poland, mWIG40 index, the month-of-the-year effect

	I			II			III			IV			V		
	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value
γ	.320***	3.573	.001	.090	1.372	.173	.082	1.263	.209	.086	1.284	.202	.091	1.345	.182
B_1	.900	.495	.622	1.519	1.206	.230	1.715	1.374	.172	1.726	1.375	.172	1.543	1.196	.234
B_2	.248	.143	.887	.015	.013	.990	–.010	–.009	.993	–.013	–.011	.991	–.097	–.081	.936
B_3	1.698	.978	.330	–.219	–.180	.857	–.222	–.186	.853	–.244	–.202	.840	–.162	–.133	.894
B_4	.998	.573	.568	–.558	–.460	.646	–.512	–.427	.670	–.526	–.436	.664	–.533	–.441	.660
B_5	–.993	–.570	.570	–.610	–.507	.613	.023	.019	.985	.037	.030	.976	–.009	–.007	.994
B_6	–3.001*	–1.729	.086	–1.915	–1.591	.114	–2.171*	–1.813	.073	–2.149*	–1.783	.077	–2.121*	–1.754	.082
B_7	2.613	1.423	.158	–.284	–.219	.827	–.530	–.411	.682	–.550	–.424	.672	–.515	–.396	.693
B_8	.500	.274	.785	1.923	1.516	.132	2.133*	1.694	.093	2.082	1.628	.106	1.958	1.509	.134
B_9	.096	.053	.958	.558	.443	.659	.740	.592	.555	.736	.587	.559	.747	.593	.554
B_{10}	–1.543	–.848	.398	–2.058	–1.635	.105	–1.738	–1.384	.169	–1.763	–1.394	.166	–1.717	–1.352	.179
B_{11}	–.520	–.285	.776	–1.475	–1.168	.245	–.847	–.656	.513	–.852	–.656	.513	–.941	–.719	.474
B_{12}	.371	.204	.839	–1.427	–1.124	.263	–1.299	–1.034	.303	–1.300	–1.030	.305	–1.233	–.971	.334
S&P500				1.000***	11.106	.000	.866***	7.636	.000	.864***	7.554	.000	.871***	7.560	.000
USD/PLN							–.214*	–1.900	.060	–.210*	–1.838	.069	–.187	–1.571	.119
YTM										–.015	–.257	.797	–.009	–.149	.882
Gold													.048	.643	.521

* Statistical significance $\alpha = 0.1$.
** Statistical significance $\alpha = 0.05$.
*** Statistical significance $\alpha = 0.01$.

Source: own elaboration

Table 9. Poland, sWIG80 index, the month-of-the-year effect

	I			II			III			IV			V		
	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value
γ	.004***	4.312	.000	.002**	2.533	.013	.002**	2.386	.019	.002**	2.426	.017	.002**	2.382	.019
B_1	.028*	1.644	.103	.033**	2.578	.011	.035**	2.732	.007	.035**	2.736	.007	.036**	2.712	.008
B_2	.002	.152	.879	.004	.324	.747	.004	.325	.746	.004	.308	.758	.004	.334	.739
B_3	.012	.753	.453	–.003	–.212	.833	–.003	–.211	.834	–.003	–.248	.805	–.003	–.270	.788
B_4	.001	.053	.958	–.013	–1.021	.309	–.012	–.993	.323	–.012	–1.009	.315	–.012	–1.003	.318
B_5	–.010	–.621	.536	–.008	–.695	.488	–.003	–.217	.829	–.002	–.190	.850	–.002	–.176	.861
B_6	–.032**	–1.995	.048	–.024*	–1.930	.056	–.026**	–2.127	.036	–.025**	–2.078	.040	–.026**	–2.077	.040
B_7	.006	.372	.711	–.019	–1.429	.156	–.021	–1.616	.109	–.022	–1.634	.105	–.022	–1.636	.105
B_8	.007	.442	.659	.015	1.182	.240	.017	1.325	.188	.016	1.248	.215	.016	1.265	.209
B_9	–.004	–.239	.811	–.001	–.085	.933	.001	.045	.964	.001	.042	.967	.000	.038	.970
B_{10}	–.016	–.953	.343	–.022*	–1.700	.092	–.019	–1.476	.143	–.019	–1.501	.136	–.019	–1.507	.135
B_{11}	–.008	–.474	.636	–.017	–1.308	.194	–.011	–.847	.399	–.011	–.850	.397	–.011	–.815	.417
B_{12}	.005	.319	.750	–.011	–.837	.405	–.010	–.760	.449	–.010	–.756	.451	–.010	–.771	.443
S&P500				.008***	9.271	.000	.007***	6.304	.000	.007***	6.223	.000	.007***	6.138	.000
USD/PLN							–.002*	–1.700	.092	–.002	–1.606	.111	–.002	–1.603	.112
YTM										.000	–.484	.629	.000	–.516	.607
Gold													.000	–.247	.806

* Statistical significance $\alpha = 0.1$.
** Statistical significance $\alpha = 0.05$.
*** Statistical significance $\alpha = 0.01$.

Source: own elaboration

Table 10. Czech Republic, PX index, the month-of-the-year effect

	I			II			III			IV			V		
	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value
γ	.238**	2.590	.011	.032	.484	.629	.031	.453	.651	.024	.346	.730	.023	.336	.738
B_1	.123	.065	.948	.965	.729	.468	1.014	.760	.449	1.065	.796	.428	1.169	.852	.396
B_2	–1.570	–.832	.407	–2.323*	–1.758	.081	–2.284*	–1.718	.089	–2.356*	–1.765	.080	–2.297*	–1.701	.092
B_3	2.028	1.127	.262	–.230	–.180	.857	–.249	–.194	.846	–.296	–.230	.819	–.341	–.263	.793
B_4	2.006	1.111	.269	.363	.286	.776	.359	.281	.779	.392	.306	.760	.389	.302	.763
B_5	–2.478	–1.367	.174	–1.963	–1.547	.125	–1.855	–1.428	.156	–1.891	–1.452	.149	–1.880	–1.437	.154
B_6	–3.185*	–1.763	.081	–2.363*	–1.866	.065	–2.464*	–1.904	.060	–2.589**	–1.982	.050	–2.611**	–1.988	.049
B_7	4.125**	2.149	.034	1.037	.756	.451	1.016	.737	.463	1.181	.845	.400	1.167	.832	.407
B_8	–.308	–.161	.872	1.389	1.033	.304	1.402	1.039	.301	1.560	1.141	.256	1.617	1.171	.244
B_9	–3.436*	–1.821	.071	–3.121**	–2.364	.020	–3.118**	–2.353	.020	–3.079**	–2.318	.022	–3.104**	–2.324	.022
B_{10}	–.701	–.367	.714	–2.009	–1.497	.137	–1.939	–1.429	.156	–2.036	–1.491	.139	–2.054	–1.497	.137
B_{11}	–.938	–.496	.621	–1.885	–1.422	.158	–1.736	–1.260	.211	–1.749	–1.267	.208	–1.690	–1.210	.229
B_{12}	1.424	.753	.453	–.437	–.328	.743	–.414	–.309	.758	–.402	–.299	.765	–.442	–.327	.744
S&P500				1.013***	10.810	.000	.991***	9.112	.000	.997***	9.129	.000	.994***	9.052	.000
USD/CZK							–.051	–.413	.680	–.045	–.366	.715	–.060	–.460	.646
YTM										.018	.782	.436	.016	.681	.497
Gold													–.029	–.370	.712

* Statistical significance $\alpha = 0.1$.
** Statistical significance $\alpha = 0.05$.
*** Statistical significance $\alpha = 0.01$.

Source: own elaboration

Table 11. Hungary, BUX index, the month-of-the-year effect

	I			II			III			IV			V		
	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value	coeff.	t-statistic	p-value
γ	.249***	2.723	.008	.087	1.272	.206	.082	1.227	.222	.097	1.449	.150	.095	1.414	.160
B_1	2.521	1.205	.231	3.178**	2.096	.038	3.544**	2.390	.019	3.506**	2.376	.019	3.597**	2.372	.019
B_2	–2.397	–1.195	.234	–2.478*	–1.706	.091	–2.360*	–1.668	.098	–2.226	–1.578	.117	–2.174	–1.522	.131
B_3	2.273	1.136	.258	–.203	–.138	.890	–.082	–.058	.954	.005	.003	.997	–.029	–.020	.984
B_4	3.883*	1.941	.055	2.051	1.404	.163	1.905	1.338	.184	1.713	1.205	.231	1.708	1.196	.234
B_5	–1.325	–.652	.516	–.605	–.410	.683	.002	.001	.999	.017	.012	.990	.025	.017	.986
B_6	–1.001	–.502	.617	.241	.166	.868	–.180	–.127	.899	.000	.000	1.000	–.016	–.011	.991
B_7	2.618	1.249	.214	–.025	–.016	.987	.012	.008	.993	–.118	–.079	.937	–.111	–.074	.941
B_8	–1.189	–.566	.573	.279	.182	.856	.554	.371	.711	.294	.197	.845	.359	.236	.814
B_9	–1.431	–.684	.495	–1.297	–.856	.394	–1.168	–.791	.431	–1.499	–1.008	.315	–1.518	–1.016	.312
B_{10}	.038	.018	.986	–.879	–.578	.564	–.316	–.211	.833	–.496	–.332	.740	–.519	–.346	.730
B_{11}	–1.238	–.592	.555	–1.973	–1.301	.196	–1.210	–.804	.423	–1.184	–.791	.431	–1.144	–.757	.451
B_{12}	.396	.189	.851	–1.506	–.985	.327	–1.196	–.801	.425	–1.366	–.917	.361	–1.397	–.931	.354
S&P500				1.071***	10.125	.000	.886***	7.129	.000	.864***	6.936	.000	.861***	6.864	.000
USD/HUF							–.306***	–2.656	.009	–.236*	–1.899	.060	–.245*	–1.899	.060
YTM										–.087	–1.465	.146	–.088	–1.475	.143
Gold													–.024	–.281	.780

* Statistical significance $\alpha = 0.1$.
** Statistical significance $\alpha = 0.05$.
*** Statistical significance $\alpha = 0.01$.

Source: own elaboration

Table 12. Kruskal-Wallis test

Index	Effect	p-value	
WIG	day-of-the-week	0.374	
mWIG40	day-of-the-week	0.893	
sWIG80	day-of-the-week	0.018**	Tuesday–Friday. p-value = 0.001 Monday–Friday. p-value = 0.009 Wednesday–Friday. p-value = 0.021
PX	day-of-the-week	0.309	
BUX	day-of-the-week	0.723	
WIG	month-of-the-year	0.515	
mWIG40	month-of-the-year	0.672	
sWIG80	month-of-the-year	0.372	
PX	month-of-the-year	0.109	
BUX	month-of-the-year	0.249	

* Statistical significance $\alpha = 0.1$.
** Statistical significance $\alpha = 0.05$.
*** Statistical significance $\alpha = 0.01$.

Source: own elaboration

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Efekty kalendarzowe na giełdach papierów wartościowych państw Europy Środkowej

Streszczenie: Według hipotezy rynku efektywnego inwestorzy nie są w stanie uzyskiwać ponadprzeciętnych zysków, ponieważ w każdej chwili ceny walorów w pełni odzwierciedlają informacje dostępne na ich temat. Jednakże na rynku występuje wiele anomalii kalendarzowych, co stanowi wyjątek od hipotezy efektywnego rynku. Głównym celem tego artykułu jest analiza i porównanie anomalii kalendarzowych – efektu miesiąca w roku i efektu dnia w tygodniu – na giełdach papierów wartościowych krajów Europy Środkowej (Polska, Węgry i Czechy). W pracy przeprowadzono krytyczną analizę literatury z zakresu anomalii rynkowych. Wyniki badań nie są jednoznaczne. Na polskiej giełdzie zaobserwowano anomalie w przypadku małych firm. Anomalie sezonowe zostały również zaobserwowane do pewnego stopnia na giełdzie węgierskiej oraz czeskiej.

Słowa kluczowe: rynek kapitałowy, anomalie sezonowe, efekty kalendarzowe, efektywność rynku, efekt stycznia

JEL: G14, G41, C58

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On the Power of Some Nonparametric Isotropy Tests

Abstract: In this paper, properties of nonparametric significance tests verifying the random field isotropy hypothesis are discussed. In particular, the subject of the conducted analysis is the probability of rejecting the null hypothesis when it is true. A potential significant difference of empirical rejection probability from the assumed significance level could distort the results of statistical inference. The tests proposed by Guan, Sherman, Calvin (2004) and Lu, Zimmerman (2005) are considered. A simulation study has been carried out through generating samples from a given theoretical distribution and repeatedly testing the null hypothesis. Isotropic distributions are considered, among others, those based on a multidimensional normal distribution. The main aim of the paper is to compare both considered nonparametric significance tests verifying the random field isotropy hypothesis. For this purpose, the empirical rejection probabilities for both tests have been calculated and compared with the assumed significance level.

Keywords: isotropy, anisotropy, significance tests

JEL: C15

1. Introduction

In spatial statistics, observations of the study variables are treated as realisations of the spatial stochastic process, understood as a collection of random variables $X=(X_t)_{t\in T}$ indexed by a coordinate vector $T\subset\mathbb{R}^n$. In this paper, weakly stationary spatial processes are considered. These are processes for which the expected value is constant and the covariance function depends only on the shift vector, i.e.

$Cov(X_s,X_t)=C(s-t)=E\big((X_s-E(X_s))(X_t-E(X_t))\big)$. One of the basic tools used to study the variability structure of studied phenomena is the variogram. It is

a measure defined in locations shifted by the vector h as $2\gamma(h)=Var(X_s-X_t)$, where $h=s-t$. An important assumption used in the estimation of variograms is random field isotropy (Sherman, 2010).

The aim of the article is to investigate the properties of nonparametric significance tests verifying the random field isotropy hypothesis. The subject of the analysis will be the empirical probability of rejecting the null hypothesis estimated by percentage of null hypothesis rejections recorded in a simulation. A potential significant difference of empirical rejection probability from the assumed significance level could distort the results of statistical inference.

2. Isotropy

Isotropy is a property of the stochastic process that occurs when covariance depends only on the distance between locations. In other words, the covariance between realisations of the spatial stochastic process in locations shifted by the vector $(x_1,x_2,\dots,x_n)$ depends only on the length of the vector $(x_1,x_2,\dots,x_n)$, (in this work, understood as the Euclidean norm) i.e. $C(x_1,x_2,\dots,x_n)=C^*(\|(x_1,x_2,\dots,x_n)\|)$, where C^* is the covariance function of a one-dimensional random process. However, in reality, anisotropy is common. It is a situation in which the covariance between realisations of the stochastic process in any fixed location and realisations in at least two other locations away by the same distance is different. Anisotropy is a subject of research in many areas, such as computer graphics, chemistry, geology, or physics. In physics, anisotropy in cosmic blackbody radiation is a good example (Smoot, Gorenstein, Muller, 1977). Figures 1 and 2 respectively show examples of the isotropic and anisotropic function of covariance, where $C(x,y)$ represents the covariance between realisations in locations shifted by the vector (x,y).

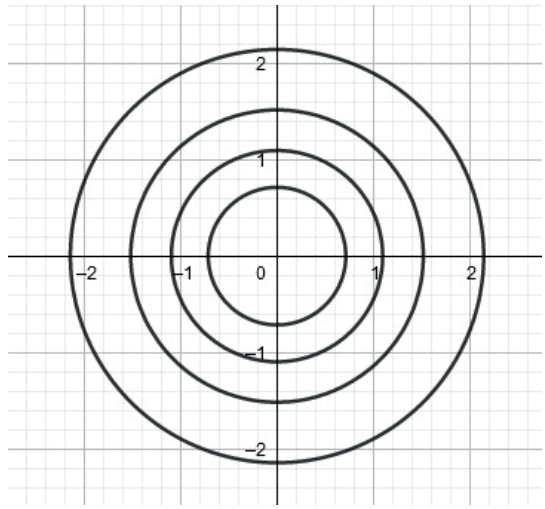

Figure 1. $\boldsymbol{C}(\boldsymbol{x},\boldsymbol{y}) = \mathbf{exp}\left(-\boldsymbol{x}^2 - \boldsymbol{y}^2\right)$

Source: own calculations

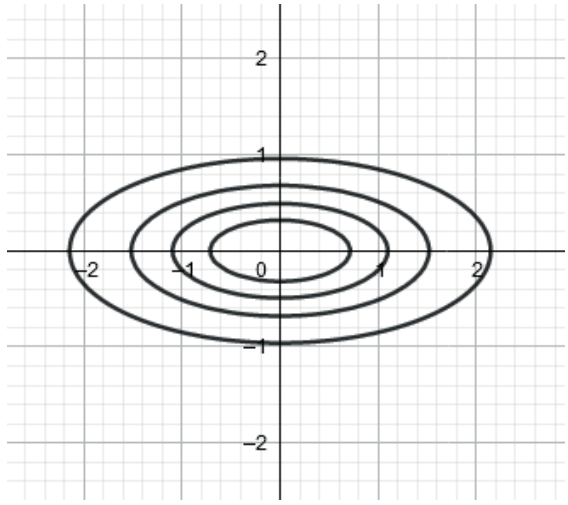

Figure 2. $\boldsymbol{C}(\boldsymbol{x},\boldsymbol{y}) = \mathbf{exp}\left(-\boldsymbol{x}^2 - 5\boldsymbol{y}^2\right)$

Source: own calculations

3. Simulation

The purpose of the simulation was to estimate the empirical rejection probability. The simulation was carried out in the following steps:

– generation of the realisation of a random field using a given isotropic theoretical distribution on a 16 × 16 square grid;
– verification of the null hypothesis about random field isotropy;
– repetition of the first two steps 10,000 times;
– calculation of the empirical rejection probability.

Three isotropic theoretical distributions were used to generate the realisations of the random field:

– 256 – dimensional normal distribution with mean 0 and covariance between locations shifted by the vector (x, y) given by the formula

$$C(x,y) = \exp\left(-\frac{1}{4}\sqrt{x^2+y^2}\right);$$

– 256 – dimensional normal distribution with mean 0 and a unit variance-covariance matrix;
– for each location, a realisation was independently generated from the uniform distribution over the range (–1, 1).

The *spTest* package (Weller, 2015) in the R environment was used to verify the hypothesis $H_0 : \exists C^* \ \forall(x,y)\ C(x,y) = C^*\left(\left\|(x,y)\right\|\right)$. The two tests used were proposed by: Guan, Sherman and Calvin (2004) and Lu and Zimmerman (2005). Four *p*-values were calculated. In the first test, those were *p*-values calculated on the basis of the asymptotic distribution of test statistics, taking into account and excluding the correction for the finite sample size. Let Γ be a set of lags which is used in the estimate of the variogram. Define $G = \{2\gamma(h) : h \in \Gamma\}$. Consider a sequence of increasing index sets T_n, with $\{X(s) : s \in T_n\}$. Let $2\hat{\gamma}(h)$ and let $\hat{G}_n = \{2\hat{\gamma}(h) : h \in \Gamma\}$ be the estimators of $2\hat{\gamma}(h)$ and G be obtained over T_n. Moreover, if H_0 is true, then there exists a full rank matrix A such that $AG = 0$ (Lu, Zimmerman, 2001), where 0 is the zero matrix. Then the test statistic is given by the formula: $TS_n = |T_n| x\left(A\hat{G}_n\right)'\left(A\hat{\Sigma}_n A'\right)^{-1}\left(A\hat{G}_n\right)$, where $\hat{\Sigma}_n$ is an estimator of the variance-covariance matrix and $|T_n|$ is the cardinality of the index set T_n.

According to multivariate Slutsky's theorem (Ferguson, 1996), the test statistic has an asymptotic chi-square distribution with d degrees of freedom, where d is the row rank of A. In the Lu and Zimmerman test, symmetry tests were used to study isotropy. The p-values were calculated by verifying the hypothesis about reflective symmetry and complete symmetry (Hoeting, Weller, 2016). They are defined as follows:

Definition 1
A weakly stationary spatial process on a grid is reflection symmetric if

$$\forall(x,y)C(x,y)=C(-x,y).$$

Definition 2
A weakly stationary spatial process on a grid is completely symmetric if

$$\forall(x,y)C(x,y)=C(-x,y)=C(y,x)=C(-y,x).$$

Both symmetries are field properties weaker than isotropy. Therefore, by rejecting the null hypothesis of symmetry, we have reasons to reject the hypothesis of isotropy. Lu and Zimmerman (2005) used the periodogram as an estimator of the spectral density. They took advantage of the fact that under certain conditions and at certain frequencies and when the null hypothesis of reflection or complete symmetry is true, ratios of periodogram values at different frequencies follow an $F(2,2)$ distribution, where $F(2,2)$ means Snedecor's F-distribution with parameters 2 and 2. To calculate the p-value, it is preferable to use a Cramér–von Mises goodness-of-fit test (Csörgo, Faraway, 1996) using the appropriate set of periodogram ratios.

4. Results of experiments

The first of the distributions used is a multidimensional normal distribution with exponential covariance.

4.1. Multidimensional normal distribution – exponential covariance

Figure 3 shows an example of realisation. This realisation was generated using the *mvtnorm* package.

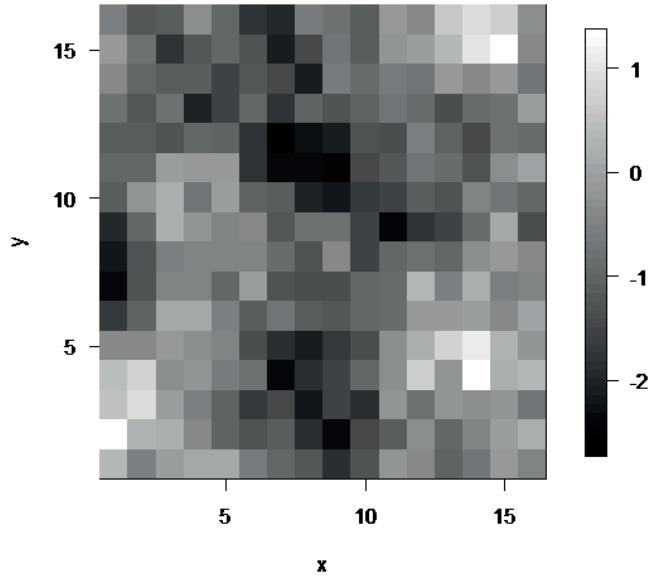

Figure 3. Multidimensional normal distribution – exponential covariance

Source: own calculations

Empirical rejection probabilities depending on the significance level for Guan, Sherman, Calvin and Lu, Zimmerman tests were calculated (10,000 realisations were used). The results are shown in Tables 1 and 2 respectively.

Table 1. Empirical rejection probabilities – Guan, Sherman and Calvin test

Significance level	1%	2%	5%	10%
Empirical rejection probability (correction)	0.0037	0.0126	0.0556	0.1404
Empirical rejection probability	0.0344	0.0541	0.1056	0.1794

Source: own calculations

Table 2. Empirical rejection probabilities – Lu and Zimmerman test

Significance level	1%	2%	5%	10%
Empirical rejection probability (reflective symmetry)	0.0075	0.0178	0.0464	0.0978
Empirical rejection probability (complete symmetry)	0.0264	0.0444	0.0901	0.1558

Source: own calculations

Empirical rejection probabilities significantly differ from the assumed significance level. Empirical rejection probability values greater than the significance level mean that the test rejects the null hypothesis more often than the user is willing to accept.

4.2. Multidimensional normal distribution – lack of correlation

Figure 4 shows an example of a multidimensional normal distribution with mean 0 and a unit variance-covariance matrix.

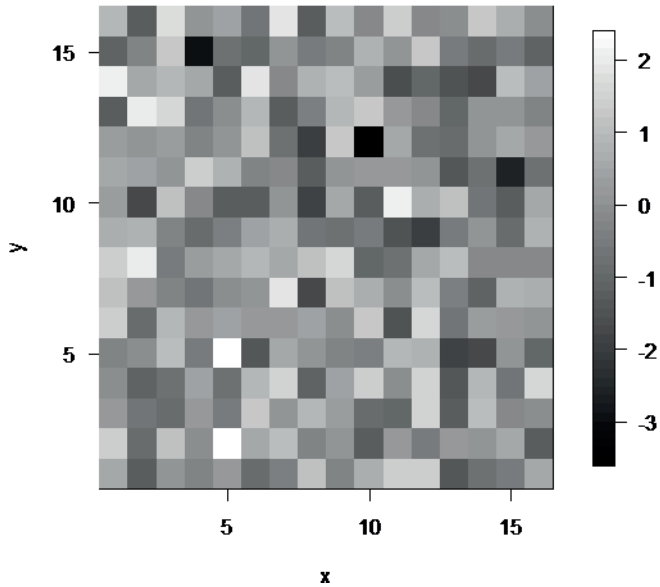

Figure 4. Multidimensional normal distribution – lack of correlation

Source: own calculations

Empirical rejection probabilities depending on the significance level for Guan, Sherman, Calvin and Lu, Zimmerman tests were calculated. The results are shown in Tables 3 and 4 respectively.

Table 3. Empirical rejection probabilities – Guan, Sherman and Calvin test

Significance level	1%	2%	5%	10%
Empirical rejection probability (correction)	0.0003	0.0017	0.0181	0.0629
Empirical rejection probability	0.0081	0.0151	0.0396	0.0837

Source: own calculations

Table 4. Empirical rejection probabilities – Lu and Zimmerman test

Significance level	1%	2%	5%	10%
Empirical rejection probability (reflective symmetry)	0.0109	0.0204	0.0474	0.0995
Empirical rejection probability (complete symmetry)	0.0079	0.0166	0.0463	0.0918

Source: own calculations

It is worth noting that in the case of the Guan, Sherman and Calvin test, the empirical rejection probabilities are lower than the significance level in each simulated case. This may suggest that it is possible to shift the critical value increasing the test power.

4.3. Uniform distribution

Figure 5 shows an example of a realisation created by independently generating (for each location from a 16 × 16 grid) realisations from a uniform distribution over the interval (–1.1).

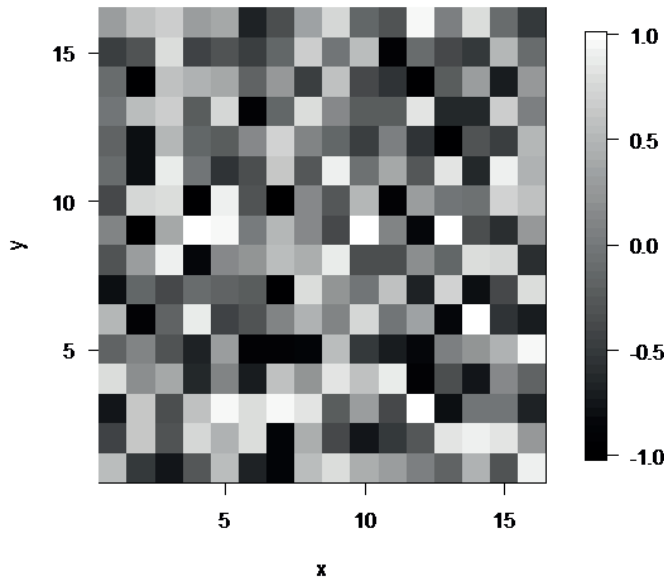

Figure 5. Uniform distribution

Source: own calculations

Empirical rejection probabilities depending on the significance level for the Guan, Sherman, Calvin and Lu, Zimmerman tests were calculated. The results are shown in Tables 5 and 6 respectively.

Table 5. Empirical rejection probabilities – Guan, Sherman and Calvin test

Significance level	1%	2%	5%	10%
Empirical rejection probability (correction)	0.0060	0.0123	0.0411	0.0982
Empirical rejection probability	0.0153	0.0295	0.0620	0.1164

Source: own calculations

Table 6. Empirical rejection probabilities – Lu and Zimmerman test

Significance level	1%	2%	5%	10%
Empirical rejection probability (reflective symmetry)	0.0095	0.0186	0.0499	0.0967
Empirical rejection probability (complete symmetry)	0.0110	0.0215	0.0534	0.1033

Source: own calculations

The difference between empirical rejection probabilities and significance levels is smaller than in the normal distributions case.

5. Conclusions

In the case of the Guan, Sherman and Calvin test, including correction for the finite sample and the Lu and Zimmerman test (complete symmetry), relative percentage errors were calculated as

$$\frac{\text{empirical rejection probability} - \text{significance level}}{\text{significance level}} 100\%.$$

The results are shown in Tables 7 and 8 respectively.

Table 7. Empirical rejection probabilities – Guan, Sherman and Calvin test – correction

Significance level	1%	2%	5%	10%
Multidimensional normal distribution – exponential covariance	–63%	–37%	11%	40%
Multidimensional normal distribution – lack of correlation	–97%	–92%	–64%	37%
Uniform distribution	–40%	–39%	–18%	–2%

Source: own calculations

Table 8. Empirical rejection probabilities – Lu and Zimmerman test – complete symmetry

Significance level	1%	2%	5%	10%
Multidimensional normal distribution – exponential covariance	164%	122%	80%	56%
Multidimensional normal distribution – lack of correlation	–21%	–17%	–7%	–8%
Uniform distribution	10%	7%	7%	3%

Source: own calculations

Empirical rejection probabilities significantly differ from the assumed significance level. For the Lu and Zimmerman test and the multivariate normal distribution

with exponential covariance, the percentage relative error is up to 164%. A downward trend is visible – the higher the level of significance, the smaller the percentage relative error is. It is advisable to be extremely cautious when using the tests presented in this work.

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Moc wybranych nieparametrycznych testów izotropii

Streszczenie: W artykule zbadano własności wybranych nieparametrycznych testów istotności, weryfikujących prawdziwość hipotezy o izotropii pola losowego. Przedmiotem analiz było w szczególności prawdopodobieństwo odrzucenia hipotezy zerowej w przypadku, gdy jest ona prawdziwa. Ewentualna znaczna różnica empirycznego prawdopodobieństwa odrzucenia od zakładanego poziomu istotności testu mogłaby świadczyć o zniekształceniu wyników wnioskowania statystycznego.

Testy, które rozważono w badaniu, to testy zaproponowane przez Guana, Shermana i Calvina (2004) oraz Lu i Zimmermana (2005). W artykule przeprowadzono symulację polegającą na wygenerowaniu ciągów realizacji pola losowego o zadanym rozkładzie teoretycznym, dla których testowano hipotezę zerową stanowiącą o izotropii. Rozważano procesy izotropowe – między innymi oparte na wielowymiarowym rozkładzie normalnym. Głównym celem artykułu było porównanie obu rozważanych nieparametrycznych testów istotności, weryfikujących hipotezę izotropii pola losowego. W tym celu wyznaczono empiryczne prawdopodobieństwa odrzuceń dla obu testów i porównano je z zakładanym z góry poziomem istotności.

Słowa kluczowe: izotropia, anizotropia, testy istotności

JEL: C15

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A Content Management System as an Information Management System in Interdisciplinary Research

Abstract: Teams of scientific specialists have replaced independent researchers, simultaneously the research team size has increased by 50% over the 19-year period. Better collaborations between project team members might improve research outcomes or R&D project products. Knowledge needs to be communicated among a research team effectively and shared among all research team members as it is created collaboratively. Collaboration can be successfully supported by providing a knowledge sharing environment and communication facilities. The purpose of this paper is to evaluate the feasibility and discuss novel communication among scientists using a content management system (CMS) which operates based on the Software-as-a-Service (SaaS) cloud-computing model. This study presents the use of CMS for the collaboration of a research team carrying out a research project funded by the Polish National Science Centre.

Keywords: team science, content management system, software-as-a-service, case study

JEL: O31, O32, O33

1. Introduction

Team science is research conducted by more than one individual in an interdependent fashion, including research conducted by small teams and larger groups (National Research Council, 2015). Team science can be conducted within a single, focused discipline, or can span different disciplines (Hall et al., 2008). Science is performed in teams, however, at a fundamental level, knowledge still resides within and is created by individuals (Nonaka et al., 1994). One of the most important factors related to team science is integration and information management (provided by a team member or collected in the future). Integration of knowledge derived from a group of people in one central application is one of key features of content management systems. Higher Education Institutions need to implement effective tools of information management web systems (Melchor-Ferrer, Buendía-Carrillo, 2016).

The use of CMS at universities is noticed and described in publications. Pinho, Franco and Mendes (2018) presented a detailed analysis of 126 published works related to the CMS usage at universities and identified the following topics: software used in web portals (e-learning platform), acceptance of technology, information management and storage, as well as internal and external benefits of using CMS (collaborative development). However, a significant amount of the existing literature refers to various benefits of e-learning platforms and library management systems. There are well-documented examples of CMS implementation used for knowledge generating, sharing and managing among team members in healthcare (Nakata et al., 2005; Sittig et al., 2010; Fox et al., 2015). Systems supporting knowledge management can enhance the effectiveness of teams that analyse complex, non-recurring problems (e.g. a research team) by improving team knowledge diversity and specific knowledge of individuals (Gray, 2000). Knowledge of how a system supporting knowledge management works can be enhanced significantly through contact with the "real-world". Case study research is a primary means of exploring field conditions (McCutcheon, Meredith, 1993). The objective of this paper is to justify the usefulness of CMS in interdisciplinary research projects. The main method the authors base their argument on is the single case study method.

The rest of the paper is organised as follows: First, we briefly review the literature on Content Management Systems and Cloud Computing. Then, the authors present the research methodology and describe: the project, the project team and the Confluence. Next the authors present several insights from the case study. Finally, the summary and discussion are also provided.

2. Content Management Systems

Nowadays users during online communication share different types of content (i.e. pictures, videos, documents, databases, etc.). The amount and diversity of content, metadata, and users makes it a non-trivial task to manage, retrieve and share the content. As a solution to problems related to sharing the content, the IT industry proposes dedicated systems – Content Management Systems (CMSs). Content Management Systems (CMSs) are software applications for creating, publishing, editing, and managing content (Lamming et al., 2000). They are widely used by news and media organisations, e-commerce websites, libraries, the broadcasting and film industry, and educational institutions to handle the content efficiently (Laleci et al., 2010). The development of the Internet, and in particular the World Wide Web (WWW), one of the most popular services available on the Internet, has redefined the way organisations communicate with employees, customers, and suppliers, etc. An active use of WWW has become one of key elements of the communication and information management strategy of many organisations. As a response to management difficulties of websites which contain many pages and a large amount of content (information), CMS software emerged in the mid–1990s for easy management of the content (Boiko, 2001). A CMS made creating, sharing, and editing of multimedia resources and information a common and easy task. A CMS has evolved to address business needs, as it integrates independent content management technologies, such as document management, enterprise collaboration, knowledge management, email management, archiving solution, records management, etc. all in a unified platform (Svärd, 2017). A CMS has become a macro-label used to classify a broad and extensive set of technological products existing on the market, ranging from document management systems in the traditional sense to new solutions for the creation and diffusion of knowledge (Pérez-Montoro, 2011). The content used by a CMS is stored mostly in a content repository which is a hierarchical content store with support for structured and unstructured data.

3. Cloud Computing

The Cloud Computing (CC) technology delivers subscription-based, on demand and Internet-based access to a shared pool of resources such as networks, storage space, computing algorithms, servers, and applications. One of the strengths of cloud services based on Cloud Computing is a fact that CC frees the organisation from the burden of developing and maintaining large-scale IT systems; therefore, the organisation can focus on its core processes and implement the supporting applications with less effort (Feuerlicht et al., 2010). There are other positive aspects

of CC. One of them is increasing IT efficiency, whereby the power of modern computers is utilised more efficiently through highly scalable hardware and software resources and business agility. IT can be used as a competitive tool through rapid deployment, parallel batch processing, the use of compute-intensive business analytics and mobile interactive applications that respond in real time to user requirements (Kim, 2009). CC can be categorised by different business models:

1) Software as a Service (SaaS),
2) Platform as a Service (PaaS),
3) Infrastructure as a Service (IaaS).

SaaS is designed to provide application software to tenants while PaaS provides a platform that enables tenants to perform their operations. Physical or virtual devices are provided to tenants in the form of IaaS (Hawedi, Talhi, Boucheneb, 2018). Software-as-a-service (SaaS) emerges as an innovative approach to deliver software applications based on cloud-computing technology (Chou, Chou, 2007). Therefore, the SaaS model has been used for the purpose of this study. It will be described in more detail. SaaS emerged as an improved form of the application service provider (ASP) model (Kim et al., 2012). In view of the fact that single-tenant ASP architecture has some limitations, the development of the software market has led to the proposition of new multi-tenant architecture implemented through SaaS. Multi-tenant architecture is a type of architecture in which a single instance of a software application serves multiple customers. This type of architecture allows users to access several software products on demand (Benlian, Hess, 2011).

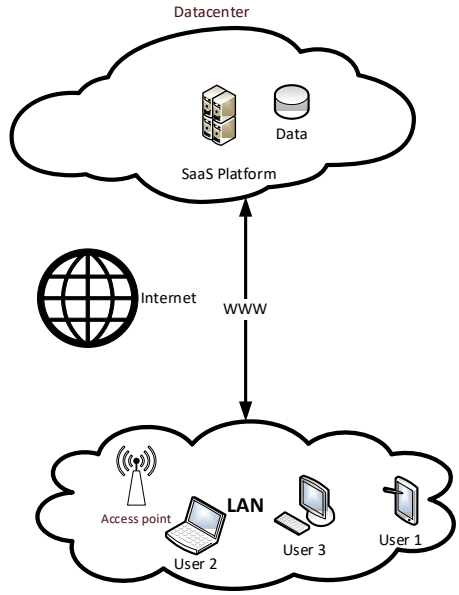

Figure 1. Using software in the SaaS model
Source: own elaboration

Figure 1 presents a scheme of using software in the SaaS model. In this model, the application is not shared by the user (only the web browser is launched on the user's computer). The users' interaction with the software takes place via the WWW browser interface. The software and data are hosted in a data centre accessible through the Internet. As a consequence, the users do not need to install the software on their own computers or mobile devices. SaaS widespread perception associates it with business software, thus it is possible to provide access to any type of software (applications available remotely, dedicated to private users are most commonly called a "Web 2.0" group of services). Business value and popularity of CC and SaaS seem to be reflected by their market value. The cloud software market reached $48.8 billion in revenue in 2014, representing a 24.4% year-to-year growth rate. The cloud software market is expected to grow to $112.8 billion by 2019 (IDC 2015) and the spending on "as a service" offerings is forecast to grow to $258 billion in 2020 (Goode et al., 2015).

4. Research methodology

As the research method, the single case study method (Dyer, Wilkins, 1991) was used. The main reason for using the single case study was the willingness of the authors of the paper to present a solution and practices used for solving a particular

management problem (improving collaboration between research project team members and other research teams). The acceptance of empirical studies in software engineering and their contributions to increasing knowledge is continuously growing. The case study method is particularly appropriate for investigating complex real life issues involving humans and their interactions with technology (Runeson, Host, 2008). This research, in the opinion of the authors, is an example of human interactions with technology. The data collection method for the purpose of this research was a direct one. Direct methods (also called the first-degree level methods) of data collection mean that the researcher is in a direct contact with the subjects and collects data in real time (Lethbridge, Sim, Singer, 2005). In the area of using a software application for the purpose of the collaborative knowledge-sharing in a project team, case studies had already been used as a research method (Dave, Koskela, 2009).

4.1. Project description

A CMS operating in the SaaS model was introduced in the research project entitled: "Identification of Success and Failure Factors of Research Projects" and used by research teams in the field of management sciences at a science and technology university in Poland. The main goal of the project was the identification of success and failure factors of research projects, with a special emphasis on projects implemented at universities and higher education schools in countries belonging to the European Union being at various development stages, using the example of Poland and France. The funding agency was the National Science Centre (NCN), Poland. The project started on 2015-03-17 and finished on 2017-03-16. Confluence as a CMS in the SaaS model was implemented on the first day of the project and remained in use by the project team until the end of the project.

4.2. Research project team

The research team consisted of nine researchers. The members of the research team used the CMS to support project management activities in a research project for the first time. The research team was of a distributed nature, as individual team members worked on a daily basis in different locations. However, at least once a month, the research team organised project meetings that had a face-to-face character. The aim of the face-to-face meetings was: synchronising work in terms of the people and the project management process, progress reporting, scheduling and rescheduling further work, project risk management, and discussing the challenges of ongoing research. None of the project team members had used the CMS

before to support knowledge and information exchange in a research project. One member of the research team had used CMS (SaaS model) in an implementation of commercial software development projects.

4.3. Confluence

In the presented study, the research team used the Confluence application as a CMS. Confluence is a CMS application which is a part of application development lifecycle management environment designed and developed by Atlassian Company. Mann et al. (2018) acknowledge the complexity of the application development lifecycle management market. In this analysis, the Atlassian environment is considered as a market leader, and its particular strengths are collaboration features provided, among others, due to the Confluence application. The Atlassian environment is used widely by software development teams, which is not unnoticed in scientific publications (Portillo-Rodríguez et al., 2014; Claps, Berntsson Svensson, Aurum, 2015; Chard et al., 2016; Yli-Huumo, Maglyas, Smolander 2016; Drury-Grogan, Conboy, Acton, 2017; Laukkarinen, Kuusinen, Mikkonen, 2018) and others. Confluence, the application used broadly in industry, seems to be flexible enough to bring benefits to teams operating in the university or industry environment and at the intersection of these two areas. Universities such as Stanford, Cambridge, and MIT, or the University of Toronto have integrated Confluence solutions for project management and customer service functionality, in addition to document collaboration in research and student groups (Fergusson, 2016; Stanford University, 2017). Polish universities (Uniwersytet Jagielloński, 2018; Uniwersytet Warszawski, 2018) use Confluence as well.

5. Insights from the case study

After the analysis of the obtained material (during research project execution), the authors derived three insights from the case study. They are based on the subjective assessment of the authors of the paper. In the presented case study, the authors of the paper were responsible for the implementation of the proposed solution (CMS) and were involved in the implementation of the researchers' work as well as the project management process (Project manager).The authors describe and present insights in analphabetic order (not defining their relevance, difficulty, significance, or any other characteristic).

5.1. The Confluence access solution for the research team

Access to the Confluence application was obtained by the research team through the PL-Grid project. The PL-Grid project was established to provide the Polish scientific community with a platform based on clusters of computers and e-science servants in various fields. PL Grid Polish Infrastructure enables scientists to conduct research on the basis of simulations and calculations using large-scale computer clusters, and provides convenient access to distributed computing resources. One of resources available as SaaS, provided by the PL Grid, is Confluence. The PL Grid platform is a part of project co-financed by the European Regional Development Fund under the Operational Program Innovative Economy. Individual scientists and research teams (Polish researchers and foreign researchers associated with universities or research institutes in Poland) can use its resources free of charge. In order to gain access to the Confluence application, participants from the project team had to set up an account in the PL GRID portal and apply for access to the CMS through the portal. It turned out that the applying process caused some problems, especially for those researchers who did not have any "IT background". To improve this process, a dedicated manual, describing all stages of the process was created. This manual solved problems with the process of getting access to the CMS. The authors would like to highlight that through the PL Grid portal it is possible to obtain free access to other tools to support team work. The available tools are:

1) Atlassian Confluence – CMS,
2) Atlassian Stash – code repository management,
3) Atlassian Jira – software for team planning, tracking, and releasing software,
4) Adobe connect – a teleconference tool.

The authors strongly believe that these sets of tools can satisfy most requirements of a research team (also distributed teams) in terms of collaboration and communication tools for better project management. Support in the form of a free available toolkit can be helpful especially in the context of research projects. For effective project management in the university environment, the following are of utmost importance (Baran, Strojny, 2013): the project environment, resource planning (time, range of activities, budgeting and cost estimate), as well as design teams with a precise division of roles and responsibilities. A rational arrangement of the project budget structure is a difficult task, requiring financial management skills from the management team members, as well as risk assessment and adjustment of budget expenditures to changing market realities (price volatility of goods and services) (Wilkin, 2013). The solution presented in this case study seems to support the optimal use of financial resources allocated in the budgets for collaboration and communication tools.

5.2. File repository

A large flow of new information published every minute requires the functionality which would support the creation of a catalogue of various pieces of data, especially those relevant from the point of view of a research team (Charte et al., 2018). Knowledge diffusion happens when knowledge is absorbed from another agent, while knowledge upgrade happens when new knowledge is created based on existing knowledge (Chandra, Dong, 2018). Both those activities (diffusion and upgrading) need as input a certain knowledge database from which knowledge can be obtained. Knowledge databases might be a solution to promote the creation of value in scientific activities (Figueiredo, Pereira, 2017). In the research project, the research team decided to create their own knowledge database. Individual members of the project team analysed the available literature. When a particular paper was recognised as valuable, it was shared among all team members, so that they could absorb knowledge and then create new knowledge based on it. Confluence was chosen as the repository for research papers, review papers, conference proceedings, reports, etc. used by the project team.

Figure 2 shows an example of the use of Confluence as a file repository for the needs of the research team. Different types of files were archived in the dedicated space. Each member of the research team had access to the repository. The repository turned out to be particularly useful during the literature research conducted by the research team.

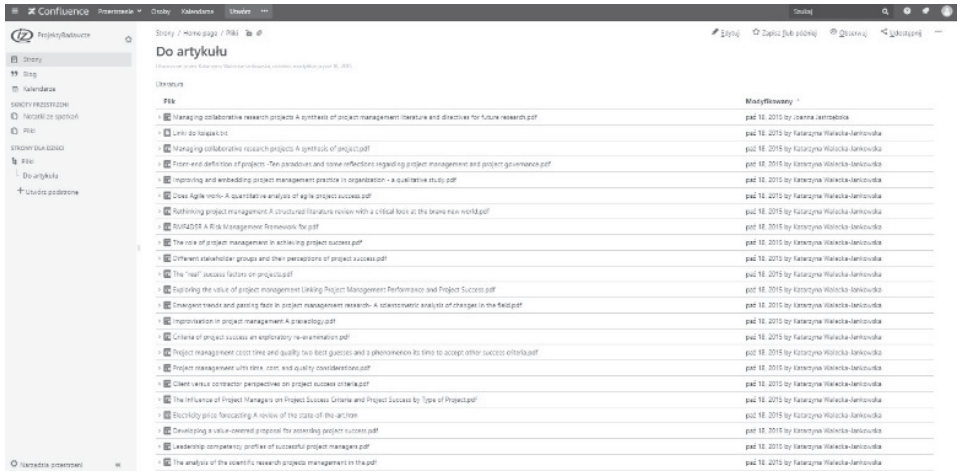

Figure 2. Research team file repository implemented in Confluence

Source: Rola, 2018

5.3. Supporting project communication

In terms of communication regarding research project teams, two main directions of communication can be distinguished (Matejun, Szczepańczyk, 2009):

1) internal communication – information exchange inside the team (between team members),
2) external communication – between the team members and people outside the research team, i.e. project stakeholders and project beneficiaries.

The CMS implemented by the research team operating in the SaaS model supported both directions of communication. Due to the limitations of this paper, the authors will present below one selected example of the support of communication for each of the directions.

Internal communication

An example of improving communication within the team is an internal dashboard in the Confluence space. On the dashboard, the team publish basic information about their work (the publication was partly automatically generated through the functionality implemented in Confluence) which can be seen by each member of the research team immediately after logging in Confluence. The information published on the dashboard included: the project team calendar, contact details to individual members, a list of recently updated webpages in the Confluence Space, a search box, etc. The information set was defined by the team and used as a tool helping particular members to stay up to date with project progress. Figure 3 presents the dashboard set up by the team.

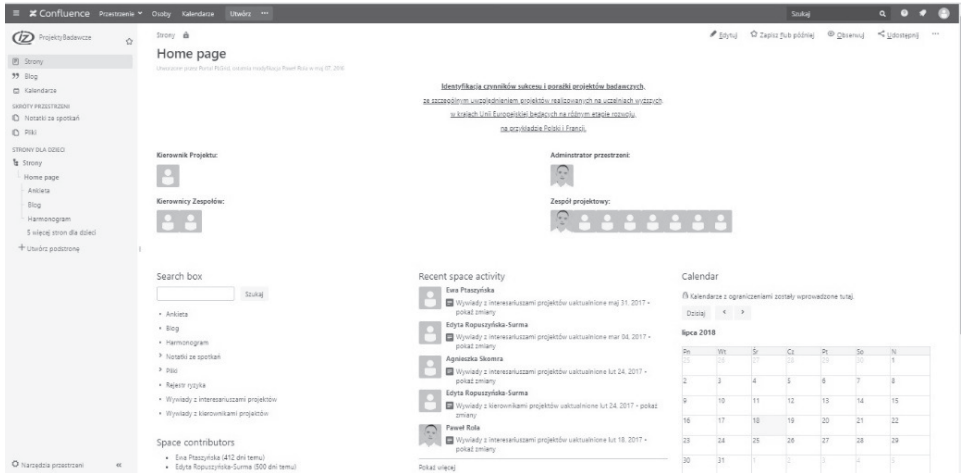

Figure 3. Dashboard of the research team

Source: Rola, 2018

A specific set of information (the scope of information depends on the team) should be communicated to the entire team in a continuous manner. Presentation of information should not interfere with the direct day-to-day communication taking place within the team (Rola, Kuchta, Kopczyk, 2016). The dashboard can be treated as an information radiator. The concept of the information radiator is introduced by (Cockburn, 2006). Its origins lie in the notion of "visual control" in the Toyota Production System set up in the 1980s. An information radiator can be defined as a large display of critical team information that is continuously updated and located in a spot where the team can see it constantly, immediately after the log in.

External communication

Creating and editing content using Confluence is rather simple. Editing and creating pages as well as subpages is carried out through a text editing mode and is similar to editors from the common office software packages (i.e. Ms Office, Open Office). All editing operations are carried out in a web browser, and additionally, built-in import/export functions from external sources (i.e. txt/doc/xlsx) facilitate content management and enable its use on various software and hardware platforms. By means of Confluence, the project team created and published a web page containing information about the research project despite the fact that the research project team had rather low competences in developing web pages.

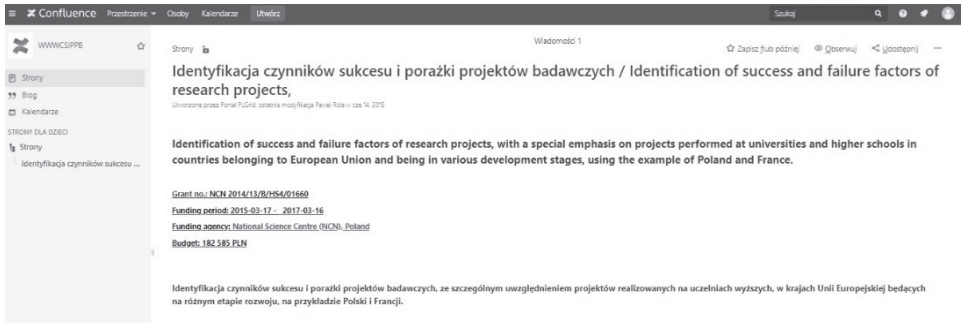

Figure 4. Project webpage

Source: Rola, 2018

Figure 4 presents the webpage created for the needs of the research team, published, developed and maintained through Confluence. The published webpage was a subpage of the Confluence space used by the team (with a different access policy set up), and each member of the team could easily update its content as needed.

Therefore, the website did not require support of the web service administrator, and content publication due to sharing one Confluence Space (both for internal and external communication) was simple to implement.

6. Conclusions

Creating infrastructure for sharing resources openly in an unfettered information environment across team members is a way in which cyber-infrastructures can support successful scientific collaboration (Hesse, 2008). 'Collaborative culture', 'mass creativity' and 'co-creation' appear to be contagious buzzwords that are rapidly influencing economic, cultural and research discourse on CMS (Van Dijck, Nieborg, 2009). This paper shows in a practical way how Content Management Systems in the SaaS model can support the work of research teams. The know-how presented in this work can be easily used by other research teams. The additional value that this study presents for research teams based in Poland is that it refers to solutions directly dedicated to the Polish researcher.

The reader should bear in mind that the study is based on a single case study. Therefore, it has severe limitations, as a single case naturally reflects a single set of circumstances. The conclusions and know-how drawn on the basis of a single case study can be generalised to other cases, however, conclusions and presented solutions may be inappropriate in different circumstances.

University–industry knowledge transfer is a broad concept identifying a wide set of interactions between companies and universities. In particular, university–industry research collaboration is a specific channel of inter-organisational knowledge flows and potential spill overs from (and to) academic research aimed at carrying out specific R&D projects (Scandura, 2016). The case study presented in this paper, consisting in an implementation of CMS, confirms that there exist tools supporting two-way transfer of knowledge and practices. Transfer of knowledge between university and industry is popular and well defined in the literature (Bekkers, Bodas Freitas, 2008; Ryńca, Kuchta, 2011; Anatan, 2015; Zavale, Macamo, 2016; Chau, Gilman, Serbanica, 2017; Huang, Chen, 2017) and others. In this paper, we present the reverse direction: that of transferring knowledge from industry to university. According to the authors, two-way knowledge transfer brings mutual benefits, both to university and industry entities. The authors hope that this statement has been confirmed by the above-cited publications and the insights derived from the presented case study.

Recently, a new body of literature has emerged, labelled as team science. It is a kind of science which brings in insights from how small groups of scientists handle their work (Falk-Krzesinski et al., 2010). This field has emerged rapidly in recent years, largely in response to growing concerns about the cost effective-

ness of public- and private-sector investments in team-based science and training initiatives (Stokols et al., 2008). The case study presented in this paper is a presentation of the know-how of a specific research team, filed using a CMS in the SaaS model, to support management and coordination of the work of the teams. The presented paper is, in the authors' intention, an invitation to a broader scientific discussion on the implementation of solutions and tools supporting "production" of science by team science.

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System zarządzania treścią jako system zarządzania informacją w badaniach interdyscyplinarnych

Streszczenie: Zespoły badawcze coraz częściej zastępują niezależnych badaczy. W ciągu 19 lat wielkość zespołu badawczego wzrosła o 50%. Lepsza współpraca między członkami zespołu badawczego może poprawić wyniki badań lub produkt projektu badawczo-rozwojowego. W zespole badawczym wiedza – jeżeli jest tworzona wspólnie – musi być skutecznie przekazywana i rozpowszechniona między wszystkich jego członków. Współpraca badaczy może być z powodzeniem wspierana przez zapewnienie odpowiedniego środowiska wymiany wiedzy i udogodnień komunikacyjnych. Celem tego artykułu jest przedstawienie sposobu dzielenia się informacją w zespole badawczym przy wykorzystaniu systemu zarządzania treścią (CMS), działającego

na podstawie rozwiązania chmurowego w modelu oprogramowania jako usługi (SaaS). Przedstawiono w nim także wykorzystanie CMS do wsparcia współpracy zespołu badawczego realizującego projekt badawczy finansowany przez Narodowe Centrum Nauki.

Słowa kluczowe: nauka zespołowa, system zarządzania treścią, oprogramowanie jako usługa, studium przypadku

JEL: O31, O32, O33

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Zabezpieczenie społeczne osób niepełnosprawnych w Polsce na tle państw Unii Europejskiej

Streszczenie: Celem artykułu jest klasyfikacja systemów zabezpieczenia społecznego osób niepełnosprawnych w państwach Unii Europejskiej z uwzględnieniem polskiego systemu zabezpieczenia społecznego na tle krajów Wspólnoty. Do oceny wykorzystano wybrane wskaźniki ekonomiczne, takie jak: udział wydatków na osoby z niepełnosprawnością w ogóle wydatków socjalnych i PKB państwa oraz wydatki na osoby niepełnosprawne *per capita*. Analizy wybranych państw dokonano głównie na podstawie dokumentów opublikowanych przez Komisję Europejską. Zakres czasowy badań to lata 2009–2016. Na podstawie przeprowadzonej klasyfikacji stwierdzono, że polski system zabezpieczenia społecznego zalicza się do średnio zaawansowanych. Do państw z wysoko rozwiniętym systemem zabezpieczenia społecznego osób niepełnosprawnych zaliczono między innymi kraje skandynawskie (Dania, Szwecja, Finlandia). Do państw z nisko zaawansowanym systemem zabezpieczenia społecznego osób niepełnosprawnych zaliczono między innymi Maltę i Cypr.

Słowa kluczowe: osoby niepełnosprawne, system zabezpieczenia społecznego, świadczenia dla niepełnosprawnych

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1. Wprowadzenie

Główną funkcją systemu zabezpieczenia społecznego jest gwarantowanie bezpieczeństwa socjalnego (w zakresie ustalonego poziomu i warunków życia) poprzez działania nakierowane między innymi na zmniejszenie i kompensowanie następstw zdarzeń, które powodują utratę dochodów lub ich zmniejszenie. Zabezpieczenie społeczne zgodnie z międzynarodowymi standardami i zaleceniami traktowane jest jako jedno z socjalnych praw każdego człowieka. Prawo do zabezpieczenia społecznego sformułowano w Powszechnej Deklaracji Praw Człowieka.

W zakresie zabezpieczenia społecznego Unia Europejska nie ma ustanowionych jednolitych rozwiązań materialno-prawnych. Jest to spowodowane różnicami w ustawodawstwach członków Wspólnoty. Różnice te są zauważalne podczas analizy systemów zabezpieczenia społecznego osób z niepełnosprawnością w państwach członkowskich Unii Europejskiej.

Celem artykułu jest klasyfikacja i ocena systemów zabezpieczenia społecznego osób z niepełnosprawnością w krajach Unii Europejskiej oraz wskazanie, jak prezentuje się system zabezpieczenia społecznego osób niepełnosprawnych w Polsce na tle państw Wspólnoty.

Klasyfikacji państw dokonano poprzez analizę każdego z następujących wskaźników:

– udział wydatków socjalnych na osoby niepełnosprawne w wydatkach socjalnych ogółem,
– wydatki na osoby z niepełnosprawnością *per capita*,
– udział wydatków socjalnych na osoby niepełnosprawne w stosunku do PKB krajów.

Ustalono trzy rankingi szeregujące państwa według wartości danego wskaźnika od najwyższej do najniższej. Następnie przyznawano każdemu państwu punkty od 1 do 28. Najwyższą liczbę punktów otrzymywało państwo, które w danym rankingu znajdowało się na najwyższej pozycji. Analogicznie państwo sklasyfikowane na końcu rankingu otrzymywało najniższą liczbę punktów. Rankingu dokonano na podstawie danych z 2016 roku, a w przypadku wydatków na osoby niepełnosprawne w stosunku do PKB z 2015 roku.

Po podsumowaniu liczby punktów przyznanych za sklasyfikowaną pozycję w odniesieniu do opisanych wyżej trzech wskaźników przygotowano ranking, dzięki któremu dokonano podziału na:

– państwa z nisko zaawansowanym systemem zabezpieczenia społecznego osób niepełnosprawnych (od 3 do 25 punktów),
– państwa ze średnio zaawansowanym systemem zabezpieczenia społecznego osób niepełnosprawnych (od 26 do 59 punktów),
– państwa z wysoko zaawansowanym systemem zabezpieczenia społecznego osób niepełnosprawnych (od 60 do 84 punktów).

Autorzy artykułu stawiają hipotezę, że polski system zabezpieczenia społecznego osób niepełnosprawnych można sklasyfikować jako średnio zaawansowany.

Do analizy wskaźników wykorzystano dane z publikacji Eurostatu zatytułowanej *Social protection statistics – social benefits* z 2017 roku oraz z innych danych statystycznych Eurostatu. Do opisów systemów zabezpieczeń społecznych osób niepełnosprawnych w wybranych państwach wykorzystano dokumenty opublikowane przez Komisję Europejską w 2019 roku. Zestawienie wartości wybranych wskaźników wpływających na poziom zabezpieczenia społecznego wraz z przypisaną punktacją w rankingach przedstawiono w Tabeli 1. Analizie poddano dane z lat 2009 i 2016, a w przypadku wydatków na osoby niepełnosprawne w stosunku do PKB kraju za lata 2009 i 2015. Kolejność państw w tabeli została uporządkowana alfabetycznie. Tabela przedstawia wartości wskaźników w okresie badawczym, zmiany w wysokości wskaźników na przestrzeni lat oraz liczbę punktów przyznanych zgodnie z wyżej opisanymi zasadami.

Ważnym czynnikiem wpływającym na klasyfikację systemu zabezpieczenia społecznego niepełnosprawnych w państwach Unii Europejskiej było wystąpienie podstawowego świadczenia dla osób niepełnosprawnych, jakim jest renta inwalidzka. Polskim odpowiednikiem renty inwalidzkiej jest renta z tytułu niezdolności do pracy. Świadczenie może otrzymać każda osoba niepełnosprawna prawnie, czyli mająca orzeczenie o niepełnosprawności. Renta inwalidzka stanowi podstawowe źródło dochodu osób niepełnosprawnych, dlatego też ustalona minimalna kwota renty inwalidzkiej w dużym stopniu wpływa na sytuację ekonomiczną osób dotkniętych niepełnosprawnością.

Tabela 1. Mierniki poziomu zabezpieczenia społecznego w krajach Unii Europejskiej w latach 2009–2016

Kraj	Udział wydatków na niepełnosprawnych w wydatkach socjalnych ogółem (w proc.)		Zmiana w stosunku do poprzedniego badanego okresu	Pkt	Wydatki na niepełnosprawnych w stosunku do PKB kraju (w proc.)		Zmiana w stosunku do poprzedniego badanego okresu	Pkt	Wydatki na niepełnosprawnych *per capita* (euro/mieszkańca)		Zmiana w stosunku do poprzedniego badanego okresu	Pkt
	2009	2016			2009	2015			2009	2016		
UE 28	7,40*	7,38*	–0,20	–	2,3**	2,00	–0,30	–	498,59*	585,09*	86,5	–
Austria	7,40	6,39	–1,01	8	2,30	2,80	0,50	25	668,21	688,73	20,52	21
Belgia	6,77	8,61	1,84	18	2,10	2,40	0,30	22	548,32	819,75	271,43	22
Bułgaria	8,36	7,35	–1,01	16	1,40	1,30	–0,10	7	139,01	195,3	56,29	4
Chorwacja	13,57	10,86	–2,71	25	–	2,50	–	23	414,65	402,36	–12,29	15
Cypr	3,62	4,20	0,58	2	0,80	0,70	–0,10	2	170,47	192,63	22,16	3
Czechy	7,46	6,44	–1,02	10	1,50	1,20	–0,30	5	320,97	322,56	1,59	11
Dania	13,34	13,08	–0,26	28	4,90	4,10	–0,80	28	1245,26	1366,63	121,37	27
Estonia	9,94	11,42	1,48	27	1,90	1,90	–	18	289,55	432,1	142,55	16
Finlandia	12,24	9,93	–2,31	23	3,60	3,20	–0,40	26	966,56	1004,78	38,22	25
Francja	6,17	6,41	0,24	9	1,90	2,00	0,10	19	516,27	644,67	128,4	20
Grecja	6,18*	5,89*	–0,29	6	1,30	1,70	0,40	16	343,93*	303,38*	–40,55	9
Hiszpania	6,94	7,13*	0,19	14	1,70	1,70	–	16	396,77	445,00*	48,23	17
Holandia	8,77	9,38	0,61	22	2,50	2,70	0,20	24	822,02	968,82	146,8	24
Irlandia	5,17	5,36	0,19	4	1,40	0,90	–0,50	3	346,42	371,84	25,42	13
Litwa	10,04	9,34*	–0,70	21	2,10	1,40	–0,70	10	288,96	315,56*	26,6	10
Luksemburg	11,36	10,76	–0,60	24	2,60	2,40	–0,20	22	1491,34	1530,82	39,48	28
Łotwa	7,72	9,07*	1,35	20	1,30	1,40	0,10	10	164,87	259,14*	94,27	6
Malta	4,52	3,59	–0,93	1	0,90	0,60	–0,30	1	172,05	162,29	–9,76	1
Niemcy	7,55	8,05*	0,50	17	2,40	2,30	–0,10	20	635,06	844,80*	209,74	23
Polska	8,14*	6,71	–1,43	12	1,40	1,50	0,10	11	252,64*	295,55	42,91	8
Portugalia	8,36	7,23	–1,13	15	2,20	1,80	–0,40	17	399,14	384,49	–14,65	14

Rumunia	9,54	6,92	–2,62	13	1,60	1,10	–0,50	4	191,9	178,5	–13,4	2
Słowacja	8,47	8,82*	0,35	19	1,70	1,60	–0,10	12	271,35	367,98*	96,63	12
Słowenia	7,44	5,35*	–2,09	3	1,70	1,30	–0,40	7	359,25	288,65	–70,6	7
Szwecja	14,11	10,88*	–3,23	26	4,60	3,40	–1,20	27	1275,97	1094,16*	–181,81	26
Węgry	9,13	6,32*	–2,81	7	2,10	1,40	–0,70	10	329,16	249,18*	–79,98	5
Wlk. Brytania	7,07	6,62*	–0,45	11	3,00	1,70	–1,30	16	504,16	515,14*	10,98	19
Włochy	5,80	5,84*	0,04	5	1,70	1,70	–	16	410,03	457,49*	47,46	18

* Dane szacunkowe.
** Dane dla UE–27.

Źródło: opracowanie własne na podstawie danych Eurostatu (2019a; 2019b)

2. Sytuacja osób niepełnosprawnych w państwach Unii Europejskiej

Prawna definicja niepełnosprawności w polskim systemie zabezpieczenia społecznego jest regulowana w Ustawie z dnia 27 sierpnia 1997 r. o rehabilitacji zawodowej i społecznej oraz zatrudnianiu osób niepełnosprawnych. Według niej osoby niepełnosprawne to osoby, których stan fizyczny, psychiczny lub umysłowy trwale lub okresowo utrudnia, ogranicza bądź uniemożliwia wypełnianie ról społecznych, a w szczególności ogranicza zdolności do wykonywania pracy zawodowej.

Z kolei Światowa Organizacja Zdrowia (World Health Organization) wyróżnia trzy grupy utraty sprawności (WHO, 1980):

niesprawność (*impairment*), czyli jakakolwiek utrata sprawności lub nieprawidłowość w budowie organizmu lub jego funkcjonowaniu pod względem anatomicznym, psychofizycznym lub psychologicznym;

niepełnosprawność (*disability*), czyli ograniczenie lub brak możliwości prowadzenia aktywnego życia w typowym zakresie, które jest wynikiem niesprawności;

ograniczenie w pełnieniu ról społecznych (*handicap*), czyli ułomność osoby z powodu niesprawności lub niepełnosprawności, uniemożliwiającej lub ograniczającej jej pełnienie ról społecznych odpowiadających wiekowi i płci oraz zgodnej z uwarunkowaniami kulturowymi i społecznymi.

Obecnie pojęcie niepełnosprawności w potocznym znaczeniu często jest zawężane i upraszczane. W modelu medycznym niepełnosprawność to niedobór lub anormalność, czyli odstępstwo od powszechnie uznanej normy. W celu usunięcia problemów związanych z niepełnosprawnością należy daną osobę przystosować do normy i poddać leczeniu. Taki model prowadzi do wyłączenia osób niepełnosprawnych z życia społecznego i zaznacza konieczność działań opiekuńczych i charytatywnych. Model interaktywny natomiast traktuje niepełnosprawność jako neutralną cechę. W tym modelu niepełnosprawność wynika ze wzajemnego oddziaływania osoby i społeczeństwa. Usuwanie problemów powinno polegać na zmianach wzajemnych oddziaływań między społeczeństwem a jednostką (Kirenko, 2007).

Z niepełnosprawnością często kojarzona jest obniżona sprawność, rozpatrywana pod względem (Hołówka, Niklas, 1999):

– ekonomicznym, czyli wynikająca z nieproduktywności,
– medycznym, czyli długotrwałe kalectwo, ograniczenie funkcji życiowych,
– prawnym, czyli uprawnienie do świadczeń określonych w aktach prawnych,
– zawodowym, czyli ograniczenie możliwości zatrudnienia,
– socjologicznym, czyli ograniczenie w pełnieniu ról społecznych.

Najczęściej występującymi rodzajami niepełnosprawności, które według specjalistów wymagają istotnego wsparcia, są: niepełnosprawność intelektualna, niepełnosprawność ruchowa oraz choroby neurologiczne.

Niepełnosprawność intelektualna to stan, w którym osoba przejawia znacznie niższy ogólny poziom rozwoju intelektualnego w porównaniu do powszechnie uznanego poziomu przeciętnego (Kirejczyk, 1981).

Niepełnosprawność ruchowa to dysfunkcja układu nerwowego, naczyniowego, kostnego, stawowego i mięśniowego. Można wyróżnić wady wrodzone oraz nabyte narządu ruchu (Wolski, 2013).

Choroby neurologiczne to schorzenia związane z nieprawidłowym funkcjonowaniem ośrodkowego i obwodowego układu nerwowego. Do chorób neurologicznych należą między innymi: zapalenie opon mózgowych, zespół Downa, choroba Alzheimera czy stwardnienie rozsiane (Rowland, 2008).

Według danych statystycznych Academic Network of European Disability (ANED) w 2016 roku osoby niepełnosprawne stanowiły 24,1% populacji Unii Europejskiej. Najwyższy odsetek osób niepełnosprawnych odnotowano na Łotwie (37,4%), w Austrii (34,2%) i Portugalii (33%), najniższy natomiast w Szwecji (12,6%), na Malcie (12,9%) i Cyprze (16%). W Polsce osoby niepełnosprawne stanowią 22,8% populacji (Grammenos, 2018).

Badanie ankietowe przeprowadzone przez ANED polegało na rozpoznaniu samooceny sytuacji respondentów będących w wieku 16 lat i więcej. Za osobę niepełnosprawną uznawano tę, która wskutek problemów zdrowotnych spostrzegła u siebie ograniczenie w wykonywaniu codziennych czynności przez co najmniej 6 miesięcy.

W jedenastu państwach Unii Europejskiej odnotowano wzrost udziału wydatków na osoby z niepełnosprawnością w wydatkach ogółem na zabezpieczenie społeczne. Średnia wartość wskaźnika w 28 krajach Wspólnoty w 2016 roku wynosiła 7,38%. Jest to o 0,2 punktu procentowego mniej niż w 2009 roku. Również udział wydatków na osoby z niepełnosprawnością w PKB państw Unii Europejskiej spadł o 0,3 punktu procentowego w stosunku do 2009 roku i wynosił 2% w 2015 roku. Spadek wskaźnika odnotowano w siedmiu państwach, a w trzech nie nastąpiła zmiana. Spadek obu wskaźników nie wpłynął negatywnie na poziom wydatków na osoby niepełnosprawne *per capita*. W 2009 roku wskaźnik ten wynosił 498,59 euro na mieszkańca UE, natomiast w 2016 roku odnotowano jego wzrost o 86,50 euro na mieszkańca UE. Spadek tego wskaźnika odnotowano tylko w ośmiu państwach Unii Europejskiej. Należy jednak pamiętać, że są to dane szacunkowe. Powodem tego jest opublikowanie wstępnych statystyk z instytucji gromadzących dane statystyczne w państwach Wspólnoty lub brak danych w roku badawczym.

Najwyższy udział wydatków socjalnych na osoby niepełnosprawne w wydatkach socjalnych ogółem odnotowano w Danii (13,08%). Kolejne miejsca w rankingu zajęły Estonia (11,42%), Szwecja (10,88%) oraz Chorwacja (10,86%). Najniżej

w rankingu znalazły się: Malta (3,59%), Cypr (4,2%), Słowenia (5,35%) oraz Irlandia (5,38%). Polska zajęła siedemnaste miejsce z wynikiem 6,71%.

Jeśli chodzi o poziom wydatków socjalnych na osoby niepełnosprawne w stosunku do PKB kraju, to najwyższy odnotowano w Danii (4,1%), Szwecji (3,4%) oraz Finlandii (3,2%). Najniższe pozycje w rankingu zajęły: Malta (0,6%), Cypr (0,7%) i Irlandia (0,9%). Polska z wynikiem 1,5% uplasowała się na osiemnastym miejscu w rankingu.

W przypadku wydatków na niepełnosprawnych *per capita* najwyższą pozycję w rankingu zajął Luksemburg (1530,82 euro/mieszkańca). Kolejne miejsca należały do Danii (1366,63 euro/mieszkańca), Szwecji (1094,18 euro/mieszkańca) oraz Finlandii (1004,78 euro/mieszkańca). Najniższe wydatki na osoby niepełnosprawne *per capita* odnotowano w takich państwach jak: Malta (162,29 euro/mieszkańca), Rumunia (178,50 euro/mieszkańca) i Cypr (192,63 euro/mieszkańca). W Polsce wydatki na osoby niepełnosprawne *per capita* wynosiły 295,55 euro na mieszkańca, co uplasowało Polskę na 21. pozycji w rankingu.

Wszystkie państwa Unii Europejskiej (z wyjątkiem Szwecji) w swoim katalogu świadczeń dla osób niepełnosprawnych uwzględniają rentę inwalidzką. Jest to podstawowe świadczenie dla niepełnosprawnych, które stanowi główne źródło ich dochodu. W Polsce renta inwalidzka nazywana jest rentą z tytułu niezdolności do pracy.

3. Klasyfikacja państwach z nisko zaawansowanym systemem zabezpieczenia społecznego osób niepełnosprawnych

Z analizy wynika, że najsłabiej rozwinięty system zabezpieczenia społecznego wobec osób z niepełnosprawnością mają Malta oraz Cypr. Do tej grupy zaliczono również systemy Słowenii, Rumunii, Irlandii oraz Węgier (Tabela 2).

Według przeprowadzonych badań Malta ma najsłabiej rozwinięty system zabezpieczenia społecznego skierowany do osób niepełnosprawnych (3 punkty). Jest to państwo, w którym wydatki na osoby niepełnosprawne w 2016 roku stanowiły 3,9% wszystkich wydatków socjalnych i spadły o 0,93 punktu procentowego w stosunku do 2009 roku. Udział wydatków na niepełnosprawnych w stosunku do PKB kraju w 2015 roku wynosił 9,6% i spadł o 0,3 punktu procentowego w stosunku do 2009 roku. Spadły też wydatki na osoby z niepełnosprawnością przypadające na mieszkańca. W 2009 roku wynosiły 172,05 euro, a w 2016 roku już tylko 162,29 euro (Tabela 2).

Na Malcie prawo do renty inwalidzkiej przysługuje każdemu ubezpieczonemu pracownikowi lub osobie prowadzącej działalność gospodarczą, która nie jest w stanie wykonywać pracy w pełnym wymiarze czasu pracy (lub regularnie

pracuje w niepełnym wymiarze czasu pracy) w wyniku niepełnosprawności przez co najmniej rok. Wymagane jest opłacanie składek przez co najmniej 250 tygodni. Średnia roczna liczba opłaconych składek musi wynosić przynajmniej 50 tygodni. Zmniejszona renta jest wypłacana osobom, u których roczna średnia składek waha się między 20 a 49 tygodniami.

Tabela 2. Zestawienie państw z nisko zaawansowanym systemem zabezpieczenia społecznego

Państwo	Udział wydatków na niepełnosprawnych w wydatkach socjalnych ogółem w 2016 roku (w proc.)	Wydatki na niepełnosprawnych w stosunku do PKB kraju w 2015 roku (w proc.)	Wydatki na niepełnosprawnych *per capita* w 2016 roku (euro/mieszkańca)	Suma punktów[a]
Malta	3,59	0,6	162,29	3
Cypr	4,20	0,7	192,63	7
Słowenia	5,35	1,3	288,65	17
Rumunia	6,92	1,1	178,50	19
Irlandia	5,36	0,9	371,84	20
Węgry	6,32	1,4	249,18	22

[a] Suma punktów odnosi się do podsumowania punktów przyznanych według ustalonych zasad zawartych w Tabeli 1.

Źródło: opracowanie własne na podstawie danych Eurostatu (2019a; 2019b)

Przed złożeniem wniosku o przyznanie renty inwalidzkiej na Malcie osoba starająca się o uzyskanie świadczenia musi być zatrudniona przez co najmniej 12 miesięcy od daty złożenia dokumentu (Majbańska, 2019).

Kwota renty inwalidzkiej w przypadku mężczyzn uzależniona jest od długości okresu składkowego oraz ich stanu cywilnego. Wiąże się to z potrzebą utrzymania rodziny, choć wysokość renty nie jest uzależniona od liczby dzieci. Maksymalna wysokość renty dla osoby w związku małżeńskim wynosi 147,72 euro tygodniowo.

Renta dla osób samotnych jest niższa i wynosi maksymalnie 127,92 euro tygodniowo. Renta inwalidzka może zostać zmniejszona w przypadku, gdy beneficjent pobiera świadczenie z tytułu stażu pracy, a jego średnia składka wynosi 50 tygodni. Poszczególne przypadki są kontrolowane przez radę lekarską.

W przypadku gdy beneficjent pobiera świadczenie z tytułu stażu pracy od byłego pracodawcy, jego renta inwalidzka jest pomniejszana. Maksymalna wysokość renty wynosi wtedy 103,38 euro tygodniowo dla osób w związku małżeńskim i 90,23 euro tygodniowo dla osób samotnych.

Dodatkowo osoby z niepełnosprawnością, u których stwierdzono trudności w samodzielnym wykonywaniu codziennych czynności, mogą skorzystać z usług pielęgniarki środowiskowej, a także z usług cateringowych, usług naprawczych, w tym prac elektrycznych i hydraulicznych, oraz usług pomocy domowej po obniżonej cenie (Komisja Europejska, 2019b).

4. Klasyfikacja państw ze średnio zaawansowanym systemem zabezpieczenia społecznego osób niepełnosprawnych

Do krajów, w których system zabezpieczenia społecznego niepełnosprawnych jest rozwinięty na średnim poziomie, zaliczono Austrię, Francję, Hiszpanię, Portugalię, Wielką Brytanię, Słowację, Litwę, Włochy, Łotwę, Grecję, Polskę, Bułgarię i Czechy (Tabela 3). W niniejszej części artykułu przedstawiona zostanie sytuacja osób niepełnosprawnych w Wielkiej Brytanii (46 punktów). Wyboru dokonano na podstawie najwyższej liczby świadczeń skierowanych do osób niepełnosprawnych.

Tabela 3. Zestawienie państw ze średnio zaawansowanym systemem zabezpieczenia społecznego osób niepełnosprawnych

Państwo	Udział wydatków na niepełnosprawnych w wydatkach socjalnych ogółem w 2016 roku (w proc.)	Wydatki na niepełnosprawnych w stosunku do PKB kraju w 2015 roku (w proc.)	Wydatki na niepełnosprawnych *per capita* w 2016 roku (euro/mieszkańca)	Suma punktów[a]
Austria	6,39	2,80	688,73	54
Francja	6,41	2,00	644,67	48
Hiszpania	7,13	1,70	445,00	47
Portugalia	7,23	1,80	384,49	46
Wielka Brytania	6,62	1,70	515,14	46
Słowacja	8,82	1,60	367,98	43
Litwa	9,34	1,40	315,56	41
Włochy	5,84	1,70	457,49	39
Łotwa	9,07	1,40	259,14	36
Grecja	5,89	1,70	303,38	31
Polska	6,71	1,50	295,55	31
Bułgaria	7,35	1,30	195,30	27
Czechy	6,44	1,20	322,56	26

[a] Suma punktów odnosi się do podsumowania punktów przyznanych według ustalonych zasad zawartych w Tabeli 1.

Źródło: opracowanie własne na podstawie danych Eurostatu (2019a; 2019b)

Z początkiem lutego 2020 roku Wielka Brytania przestała być członkiem Unii Europejskiej, jednak od lat uznawana jest za przykład dobrego systemu zabezpieczenia społecznego. W 2016 roku wydatki na osoby z niepełnosprawnością *per capita* wynosiły 515,14 euro, czyli niewiele więcej niż w 2009 roku (504,16 euro). Natomiast udział wydatków na niepełnosprawność w PKB spadł z 3% do 1,7%, a udział w wydatkach socjalnych ogółem z 7,07% do 6,62% (Tabela 3).

Zasiłek dla osób z niepełnosprawnością przysługuje dzieciom lub osobom w wieku od 16. do 64. roku życia, u których stwierdzono trudności w wykonywaniu codziennych czynności wskutek niepełnosprawności lub długotrwałej choroby. Przyznawany jest mieszkańcom Wielkiej Brytanii lub osobom przebywającym na terenie państwa przez co najmniej dwa z trzech ostatnich lat, które nie podlegają kontroli imigracyjnej. Kontrola imigracyjna oznacza, że o prawie pobytu obywateli innych państw na terytorium Wielkiej Brytanii decyduje opinia urzędnika imigracyjnego (Butrymowicz, 2016).

Wysokość zasiłku nie jest zależna od stopnia niepełnosprawności, ale od tego, w jaki sposób niepełnosprawność wpływa na wykonywanie czynności życiowych, takich jak przygotowanie posiłku, utrzymanie higieny osobistej, robienie zakupów, komunikowanie się czy przemieszczanie (Witczak-Dądela, 2019). Potrzeby beneficjentów są regularnie sprawdzane poprzez wypełnienie specjalnej ankiety.

Zasiłek dla osób z niepełnosprawnością wypłacany jest w dwóch etapach. Pierwszy etap trwa trzynaście tygodni. W tym czasie odpowiednie organy oceniają możliwości wykonywania pracy zawodowej wnioskodawcy. Proces ten może zostać przyspieszony, gdy stan zdrowia wnioskodawcy jest krytyczny. Drugi etap, zwany etapem głównym, następuje od czternastego tygodnia w przypadku, gdy u wnioskodawcy zostanie stwierdzona niezdolność do pracy. Zasiłek dla osób z niepełnosprawnością nie jest opodatkowany.

Osoba niepełnosprawna może zostać przypisana do jednej z grup. Pierwszą z nich jest grupa działania związana z pracą. Odbywają się w niej przygotowania do podjęcia pracy zarobkowej, prowadzone przez doradców. Rolą doradców jest zdobycie informacji na temat celów związanych z pracą i umiejętności członków grupy, aby następnie podjąć odpowiednie kroki ku aktywizacji zawodowej. Członkowie grupy, oprócz podstawowego zasiłku, otrzymują dodatek z tytułu działania związanego z pracą. Jeżeli jednak osoba z niepełnosprawnością odmówi udziału w grupie, może zostać pozbawiona prawa do otrzymywania zasiłku z tytułu niepełnosprawności. Drugą grupą jest grupa wsparcia, której członkami stają się osoby całkowicie niezdolne do pracy. Członkostwo w niej jest dobrowolne (Komisja Europejska, 2019c).

Standardowy zasiłek wynosi 58,70 (ok. 68 euro) funtów tygodniowo i w zależności od potrzeb może być powiększony do 87,65 (ok. 101 euro) funtów tygodniowo. Dodatek z tytułu działania związanego z pracą wynosi od 23,20 (ok. 27 euro) do 61,20 funtów tygodniowo (ok. 71 euro). Dodatkowo osoby z niepełnosprawnością mają prawo do skorzystania z dodatku pielęgnacyjnego, kredytu na specjalnych warunkach, dodatkowego ubezpieczenia, dodatkowego zasiłku w przypadku pracujących osób z niepełnosprawnością, zwolnienia z podatku samochodowego, wynajmu samochodu, dotacji na dostosowanie mieszkania, zwolnienia z podatku VAT w przypadku niektórych towarów i usług (Komisja Europejska, 2019c).

5. Klasyfikacja państw z wysoko zaawansowanym systemem zabezpieczenia społecznego osób niepełnosprawnych

Analiza wszystkich krajów członkowskich Unii Europejskiej pozwala stwierdzić, że najlepiej rozwinięty system zabezpieczenia społecznego osób z niepełnosprawnością mają Dania i Szwecja. Do tej grupy zaliczono również systemy Finlandii, Luksemburga, Holandii, Chorwacji, Belgii, Estonii oraz Niemiec.

Tabela 4. Zestawienie państw z wysoko zaawansowanym systemem zabezpieczenia społecznego osób niepełnosprawnych

Państwo	Udział wydatków na niepełnosprawnych w wydatkach socjalnych ogółem w 2016 roku (w proc.)	Wydatki na niepełnosprawnych w stosunku do PKB kraju w 2015 roku (w proc.)	Wydatki na niepełnosprawnych *per capita* w 2016 roku (euro/mieszkańca)	Suma punktów[a]
Dania	13,08	4,1	1366,63	83
Szwecja	10,88	3,4	1094,16	79
Finlandia	9,93	3,2	1004,78	74
Luksemburg	10,76	2,4	1530,82	74
Holandia	8,05	2,3	844,80	70
Chorwacja	9,38	2,7	968,82	63
Belgia	10,86	2,5	402,36	62
Estonia	11,42	1,9	432,10	61
Niemcy	8,05	2,3	844,80	60

[a] Suma punktów odnosi się do podsumowania punktów przyznanych według ustalonych zasad zawartych w Tabeli 1.

Źródło: opracowanie własne na podstawie danych Eurostatu (2019a; 2019b)

Najwyższy udział wydatków na osoby niepełnosprawne w wydatkach socjalnych ogółem oraz w PKB odnotowano w Danii. Pierwszy z wymienionych wskaźników w 2016 roku wynosił 13,8% i spadł o 0,26 punktu procentowego w stosunku do 2009 roku. Udział wydatków na niepełnosprawnych w PKB kraju wynosił 4,1% w 2015 roku i spadł o 0,8 punktu procentowego w stosunku do 2009 roku. Wydatki na niepełnosprawność *per capita* wzrosły z 1245,26 euro w 2009 roku do 1366,63 euro w 2016 roku (Tabela 4).

O rentę inwalidzką w Danii mogą starać się osoby ze stanem zdrowia niepozwalającym na wykonywanie pracy zarobkowej, która zapewni minimalne zaspokojenie potrzeb. Uznaje się, że jest to stan, w którym stopień inwalidztwa wynosi minimum 50% (Lewko, 2018). Praca socjalna (subwencjonowana przez państwo) nie jest uwzględniana przy ustalaniu dochodu. Osoba uprawniona

do otrzymywania renty musi być obywatelem Danii lub przebywać na jej terytorium co najmniej dziesięć lat oraz być objęta zakresem rozporządzenia w sprawie koordynacji systemów zabezpieczenia społecznego (Komisja Europejska, 2019a).

Wysokość renty inwalidzkiej jest uzależniona od dochodów beneficjenta i współmałżonka i nie jest zależna od wcześniejszej kwoty wynagrodzenia. Aby uzyskać prawo do renty, beneficjent musi przez 80% okresu od ukończenia 15. roku życia do daty przyznania renty (co najmniej trzy lata) być zameldowany na terytorium Danii. W przypadku krótszego okresu obliczany jest stosunek okresu zamieszkania do 80% okresu między 15. rokiem życia a datą przyznania renty. Po osiągnięciu wieku emerytalnego renta inwalidzka przekształca się w emeryturę, jednak jej kwota nie ulega zmianie. Renta jest przyznawania nie wcześniej niż pierwszego dnia miesiąca po wydaniu decyzji. Wnioski są rozpatrywane najdłużej do trzech pełnych miesięcy. Wysokość renty inwalidzkiej wynosi 18 875 koron duńskich (DKK) miesięcznie dla osób samotnych, czyli około 2527 euro. Dla osób w związku małżeńskim jest to 16 044 DKK (ok. 2148 euro).

Beneficjenci mogą liczyć na dodatki socjalne mające na celu rekompensatę dodatkowych wydatków związanych z niepełnosprawnością (pomoc osoby trzeciej, koszty leczenia, specjalistyczny sprzęt). Świadczenie jest ustalane indywidualnie.

Wniosek o przyznanie renty inwalidzkiej należy złożyć do właściwych dla miejsca zamieszkania władz lokalnych wraz z zaświadczeniem lekarskim. Koszty wystawienia zaświadczenia pokrywają władze lokalne, które również rozpatrują inne możliwości pomocy społecznej dla wnioskodawcy. Renta inwalidzka zostanie przyznana w przypadku, gdy nie ma możliwości polepszenia stanu zdrowia wnioskodawcy przy wykorzystaniu środków rehabilitacyjnych, terapeutycznych i aktywizacyjnych.

W przypadku gdy wnioskodawca nie zgadza się z decyzją władz lokalnych, może złożyć odwołanie do regionalnej rady apelacyjnej do spraw zatrudnienia w terminie do czterech tygodni od daty otrzymania decyzji (Komisja Europejska, 2019a).

6. Polski system zabezpieczenia społecznego niepełnosprawnych

Polska (31 punktów) zaliczana jest do państw, w których system zabezpieczenia społecznego osób niepełnosprawnych jest rozwinięty na średnim poziomie. Udział wydatków na osoby niepełnosprawne stanowiły w 2016 roku 6,71% całkowitych wydatków socjalnych, czyli o 1,43 punktu procentowego mniej niż w 2009 roku. Zarówno wydatki na osoby niepełnosprawne *per capita*, jak i udział wydatków na osoby z niepełnosprawnością w PKB zwiększyły się w badanym okresie.

Wydatki na osoby z niepełnosprawnością *per capita* w 2015 roku wynosiły 295,55 euro na mieszkańca. To o 42,91 euro więcej niż w 2009 roku. Przyjętym okresem badawczym w przypadku udziału wydatków na osoby z niepełnosprawnością w PKB są lata 2009 i 2014. Wskaźnik w tym okresie wzrósł o 0,1 punktu procentowego i wynosił 1,5% (Tabela 2).

W Polsce osoba niezdolna do pracy ma prawo otrzymać rentę z tytułu niezdolności do pracy, rentę szkoleniową oraz rentę rodzinną, czyli świadczenie dla członków rodziny ubezpieczonego w razie jego śmierci (ZUS, 2018b). Prawo do renty z tytułu niezdolności do pracy może otrzymać osoba, u której stwierdzono całkowitą niezdolność do wykonywania pracy, lub częściowo niezdolna do pracy, tj. taka, która utraciła w znacznym stopniu zdolność do wykonywania pracy zgodnej z kwalifikacjami. Niezdolność do pracy orzekana jest na okres nie dłuższy niż pięć lat. W przypadku gdy lekarz orzecznik stwierdzi brak możliwości poprawy stanu zdrowia, okres ten może zostać wydłużony (ZUS, 2019).

Renta z tytułu niezdolności do pracy przysługuje osobom mającym orzeczenie lekarskie o niezdolności do wykonywania pracy zarobkowej oraz wykazującym wymagany okres składkowy i nieskładkowy. Niezdolność do pracy musi wystąpić w okresie ubezpieczenia, zatrudnienia, pobierania świadczenia dla bezrobotnych lub innych świadczeń z ubezpieczenia społecznego.

Wymagany okres składkowy i nieskładkowy jest uzależniony od wieku wnioskodawcy, w którym wystąpiła niepełnosprawność. Jest to:

– rok w przypadku osób poniżej 20. roku życia,
– 2 lata w przypadku osób między 20. a 22. rokiem życia,
– 3 lata w przypadku osób między 22. a 25. rokiem życia,
– 4 lata w przypadku osób między 25. a 30. rokiem życia,
– 5 lat w przypadku osób powyżej 30. roku życia.

Dla osób powyżej 30. roku życia okres pięciu lat składkowych musi przypadać w ostatnich dziesięciu latach od daty złożenia wniosku.

Renta z tytułu całkowitej niezdolności do pracy obejmuje 24% kwoty bazowej, 1,3% podstawy wymiaru za każdy rok okresów składkowych, 0,7% podstawy wymiaru za każdy rok okresów nieskładkowych, 0,7% podstawy wymiaru za każdy rok okresu brakującego do pełnych 25 lat stażu, rozpoczynając od dnia złożenia wniosku o rentę do dnia ukończenia przez wnioskodawcę sześćdziesięciu lat. Renta z tytułu częściowej niezdolności do pracy wynosi 75% renty z tytułu całkowitej niezdolności do pracy (Ustawa z dnia 17 grudnia 1998 r. o emeryturach i rentach z Funduszu Ubezpieczeń Społecznych).

Minimalna renta z tytułu całkowitej niezdolności do pracy wynosi od 1 marca 2019 roku 1100 zł (ok. 257 euro) miesięcznie, a minimalna renta z tytułu częściowej niezdolności do pracy 825 zł (ok. 193 euro) miesięcznie. W przypadku gdy niepełnosprawność wynika z wypadku przy pracy lub choroby zawodowej, wysokość minimalnej całkowitej renty z tytułu niezdolności do pracy wynosi

1320 zł (ok. 309 euro), a wysokość minimalnej częściowej renty z tytułu niezdolności do pracy 990 zł (ok. 231,5 euro) (ZUS, b.r.).

Do otrzymywania renty szkoleniowej mają prawo osoby spełniające kryteria do otrzymywania renty z tytułu niezdolności do pracy, u których stwierdzono możliwość przekwalifikowania. Po otrzymaniu świadczenia beneficjent kierowany jest na szkolenie przygotowujące do podjęcia nowej pracy. Renta szkoleniowa przyznawana jest na okres sześciu miesięcy, który może zostać skrócony w przypadku, gdy organ rentowy stwierdzi, że nie ma możliwości przekwalifikowania beneficjenta lub beneficjent nie wyrazi chęci udziału w szkoleniu. Okres ten może być również wydłużony – nawet do 36 miesięcy – w celu pełnego przekwalifikowania beneficjenta. Renta szkoleniowa wynosi 75% podstawy wymiaru renty z tytułu niezdolności do pracy. Świadczenie nie może być mniejsze niż najniższa wysokość renty z tytułu częściowej niezdolności do pracy (Ministerstwo Rodziny i Polityki Społecznej, 2018).

Osoby z niepełnosprawnością mogą ubiegać się dodatkowo o rentę socjalną. Jest ona przyznawana osobom pełnoletnim, u których niepełnosprawność wystąpiła w okresie edukacji, a ich dochody w danym miesiącu nie przekroczyły 70% przeciętnego miesięcznego wynagrodzenia za kwartał. Renta socjalna odpowiada 100% minimalnej renty z tytułu całkowitej niezdolności do pracy (Ustawa z dnia 27 czerwca 2003 r. o rencie socjalnej).

Innymi dodatkowymi świadczeniami do renty inwalidzkiej są zasiłek pielęgnacyjny oraz dodatek pielęgnacyjny. Mają one na celu częściowe sfinansowanie kosztów wynikających z braku samodzielności. Zasiłek pielęgnacyjny jest przyznawany:

– dzieciom z niepełnosprawnością do 16. roku życia,
– osobom powyżej 16. roku życia ze znacznym lub umiarkowanym stopniem niepełnosprawności, gdy niepełnosprawność powstała przed ukończeniem 21. roku życia,
– osobom powyżej 75. roku życia.

Jego minimalna wysokość od listopada 2019 roku wynosi 215,84 zł (ok. 50,5 euro) miesięcznie (Borysiuk, 2019). Dodatek pielęgnacyjny przysługuje osobom niepełnosprawnym, u których stwierdzono niezdolność do samodzielnego życia. Od marca 2019 roku wynosi on 222,01 zł (ok. 52 euro) miesięcznie. Dodatek pielęgnacyjny nie może zostać wypłacony, gdy osoba niepełnosprawna jest beneficjentem zasiłku pielęgnacyjnego. Świadczenia nie są uzależnione od dochodów rodziny i nie podlegają opodatkowaniu (ZUS, 2018a).

O niezdolności do pracy decyduje lekarz orzecznik Zakładu Ubezpieczeń Społecznych. Wnioskodawca może odwołać się od decyzji lekarza orzecznika w terminie do czternastu dni od doręczenia orzeczenia.

7. Podsumowanie

Polski system zabezpieczenia społecznego osób z niepełnosprawnością zalicza się do średnio zaawansowanych systemów europejskich. Na podstawie danych Eurostatu można prognozować poprawę sytuacji osób z niepełnosprawnością w wyniku wzrostu wydatków socjalnych. Najbardziej rozwinięte systemy zabezpieczenia społecznego osób z niepełnosprawnością zaobserwowano w krajach skandynawskich, Luksemburgu, Niemczech, Holandii i Chorwacji. Najwyższe wskaźniki odnotowano w Danii i Szwecji, których kompleksowe systemy zabezpieczenia społecznego uznawane są za jedne z najlepszych i wciąż się rozwijają. Najniższe natomiast odnotowano na Cyprze i Malcie. Powodem mogą być restrykcyjne zasady orzekania o stopniu niepełnosprawności lub niski odsetek osób zaliczających się do tej grupy społecznej. Do krajów ze słabo rozwiniętym systemem zabezpieczenia społecznego niepełnosprawnych można zaliczyć również Słowenię, Rumunię, Irlandię oraz Węgry.

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Social Security of Disabled People in Poland Against the Background of European Union Countries

Abstract: The aim of this article is to classify the security systems for disabled people within the European Union in relation to the Polish social security system in light of other European Union countries. The results were based on economic indicators such as: the role of expenses for disabled people within the overall national social expenses and GDP as well as the expenses for people with disability per capita. The analysis of the chosen countries took place mostly based on documents published by the European commission. The time period included the years 2009–2016. Based on the classification which has been carried out it has been concluded that the Polish social security system can be considered mid-advanced. The countries which were considered to have a highly developed social security system for people with disability included mostly Scandinavian countries (Switzerland, Finland, Denmark). Countries with the lowest advancement rate for their social security system for people with disability included, among others, Cyprus and Malta.

Keywords: people with disabilities, social security system, benefits for disabled people

JEL: J14

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Inter-Municipal Cooperation in Education as a Possible Remedy for Current Difficulties of Local Government in Poland

Abstract: The purpose of this article is to fill the existing gap and contribute to the literature in two ways: firstly, by investigating problems that caused the emergence of cooperation between two municipalities despite the administrative border at the county level, and secondly, by analysing the effects of joint provision of public education based on a case study from Poland. The case study is preceded by the use of the literature review method. The problem of possible enhancement of inter-municipal cooperation (IMC) in Poland is proposed as a potential remedy for current difficulties that Polish local governments face after the reform of the education system and the COVID–19 pandemic, as well as due to demographic decline and budgetary challenges. Studies suggest that net benefits of cooperating are higher if IMC partners are smaller and more homogenous with respect to the quality and level of public services. The theory of exploiting economies of scale and scope was studied based on the case study of a Polish inter-municipal union created only to provide education in two municipalities. The cooperation resulted in little positive financial effects reflected in the lower spending per pupil only in the case of primary school. However, the union caused nonfinancial benefits not only for pupils but also for parents and teachers, who are voters as well. The article concludes that inter-municipal unions could be used especially by small and rural municipalities that struggle with the previously mentioned problems.

Keywords: inter-municipal cooperation, education system, reform, Poland, COVID–19

JEL: H70, H75, H77, H79

1. Introduction

After the economic transformation, which took place in the 1990s, there are three basic layers of local government in Poland entitled to provide public goods and services: municipalities, counties and voivodeships. At the same time, the decentralisation of public tasks from the central level to local governments occurred. Many of those tasks were assigned to municipalities that constitute a basic tier of local government according to the Constitution of the Republic of Poland (Konstytucja Rzeczypospolitej Polskiej z dnia 2 kwietnia 1997, art. 164). These tasks concern, among others, public education, healthcare, waste management, water and sewage management, road infrastructure, local transportation, culture and environmental protection (Ustawa z dnia 8 marca 1990 r. o samorządzie gminnym, art. 7).

Transferring public tasks to municipalities and setting most of them as mandatory ones required providing these units with public funds from the central budget in the form of conditional and unconditional grants. However, these funds are insufficient and municipalities use their power of partial economic self-reliance to obtain money from their own resources such as local taxes and charges as well as shares in revenues from the personal and corporate income tax (Ustawa z dnia 13 listopada 2003 r. o dochodach jednostek samorządu terytorialnego, art. 3–4).

The lack of sufficient funds for educational tasks has been observed for many years. It is a problem concerning especially small and rural municipalities that struggle with demographic decline to a greater extent than urban municipalities. In Poland, it has been enhanced recently by the reform of the education system and the COVID–19 pandemic. Moreover, both international (e.g. Blaeschke, 2014) and national (e.g. Swianiewicz et al., 2016) studies on fiscal federalism point out that administrative borders between municipalities are not necessarily in accordance with efficient provision of public services. One of the possible solutions is to deliver public services jointly which can help to keep raising costs down, hence increase efficiency of public spending and also the quality of public services. However, it is uncommon for municipalities to cooperate with local governments from other counties – cooperation is limited to one county, which suggests that administrative borders affect it (Fuhrmann et al., 2005). Besides, inter-municipal cooperation is not a popular way to provide public education by local governments in Europe. In most cases, it serves as a platform to deal with waste, water or sewage management (e.g. Bel, Warner, 2015), which can be described as capital-intensive tasks, whereas labour-intensive tasks are less often undertaken jointly, and thus are less analysed in the literature (Bischoff, Wolfschütz, 2017). The purpose of this article is to fill the existing gap and contribute to the literature in two ways: firstly, by investigating problems that caused the emergence of cooperation between two municipalities despite the administrative border at the county level, and secondly, by analysing the effects of joint provision of public education based on a case study

from Poland – the Gostkowo-Niepart Educational Inter-Municipal Union. Hence, the paper answers the following questions: what kind of challenges in general do local government face nowadays? What are the possible ways to approach them? What are the positive and negative sides of delivering educational tasks jointly? Which factors triggered the cooperation in public education in the analysed municipalities? What kind of effects did this cooperation bring to local governments and also to local inhabitants comprising parents and teachers, who are also voters? In order to answer the above-indicated questions and achieve the aim of the paper, it is organised as follows. First a brief literature review on IMC as a remedy for the enumerated problems of local government is conducted. Then, the legal framework for inter-municipal cooperation (IMC) in Poland is developed. The next section discusses the changes of the education system after the new reform in 2017. Inter-municipal cooperation in the field of education in Poland is explained in Section 5. One of the most important parts of the paper (Section 6) is the first analysis – to the best of author's knowledge – of the only one inter-municipal union that was established in Poland to jointly provide education. Section 6 contains the results and discussion, and Section 7 concludes the presented considerations.

2. Methods and data

The methods used in this article are based on the national and international literature review, the legal analysis of inter-municipal cooperation in Poland which is followed by the study of changes in local governments due to the reforms of the education system in Poland, and the analysis of inter-municipal cooperation in the field of education in Poland. All these analyses create a foundation for the case study of the Gostkowo-Niepart Educational Inter-Municipal Union. The reason for selecting this particular union stems from two facts: firstly, as it will be discussed further in detail, it is the only inter-municipal union that was created solely for the purpose of providing educational services, and secondly, two municipalities being partners of the union are members of two different counties. This extraordinary case allows us to analyse and understand what kind of factors could drive them to cooperate, despite their regional differences. The case study was conducted on the basis of legal acts (national ones and very detailed local acts) as well as financial, social and educational data of two municipalities and the union itself. The analysis based on those data was compared to the analogous average results of particular types of municipalities in Poland. The data were extracted from the Central Statistical Office Local Data Bank, detailed local governments' and inter-municipal unions' budgetary statements and from the official register of IMC-unions run by the Ministry of the Interior and Administration presented on the basis of their official statutes.

3. The Literature Review on IMC

Empirical studies on fiscal federalism point out that administrative borders between municipalities are not necessarily in accordance with efficient provision of public services (e.g. Blaeschke, 2014). The pressure of efficient public spending as well as the emphasis placed on the quality of public goods and services have increased in the last decades in many European countries. On the one hand, local government faces budget challenges, must adhere to the EU fiscal discipline and fulfil public finance requirements of the central government that should increase its efficiency[1] (Bel, Warner, 2015). On the other hand, societies are more conscious and care about the quality and amount of public goods and services they pay for through taxes and fees. It is especially a challenge for small and rural municipalities that are obliged to perform certain tasks experiencing at the same time the pressure to reduce their expenditures (Ferraresi, Migali, Rizzo, 2017: 2). The problem is even more enhanced by the consequences of a decline in population (Bergholz, Bischoff, 2015: 1).

One way to solve the enumerated issues and deal with the problem of the optimum scale of production is to achieve economies of scale and scope with low transaction costs through inter-municipal cooperation (Adelaja, Gibson, Racevskis, 2010; Bel, Fageda, Mur, 2011: 6; Allers, de Greef, 2017). Inter-municipal cooperation is a form of horizontal voluntary cooperation between local governments. They join their forces to perform obligatory and facultative tasks in order to provide local communities with public services and goods. This kind of cooperation can help to reduce inefficiencies without limiting political autonomy of municipalities (Blaeschke, 2014: 3–4).

The cooperation is restricted to certain activities and there are no boundaries for municipalities to cooperate within many different IMC depending on their aim. It also means that provision of a specific service or good does not affect tasks performed individually by IMC municipalities that are not subject to cooperation (Bergholz, Bischoff, 2015: 4).

Municipal authorities that face fiscal[2], demographic and qualitative challenges of providing citizens with public goods and services should calculate costs and benefits of the cooperation via IMC. Studies indicate that the more homogenous populations in cooperating municipalities are, the higher the net benefits derived from cooperation. The size of the municipality also matters – the smaller it is, the more benefits of the economies of scale and scope can be achieved from IMC. However, joint provision of public goods and services means a partial loss of the

1 Municipal demand for IMC was studied by e.g. Bischoff, Wolfschütz (2017).

2 The increase in IMCs in Europe can be observed especially after the introduction of austerity fiscal policies (stricter rules of borrowing and deficits). It particularly applies to Iceland, Italy, the Netherlands, Portugal, and the UK (Swianiewicz, Teles, 2018: 31–32).

ability to adjust them to the needs of citizens in a particular municipality (Bergholz, Bischoff, 2015: 4–5).

The literature provides studies on the effects of IMC on different kinds of tasks performed by municipalities.[3] Most researchers focus on capital-intensive fields, whereas cooperation in public education has received little attention. IMC is not a popular form of providing public education by local government in Europe, despite its advantages. In Norway only up to 5% of local governments have decided to use IMC to provide citizens with kindergartens and primary schools. In Spain, up to 8% of inter-municipal associations provide education. In Finland and Iceland, IMC is used only in vocational education (Swianiewicz, Teles, 2018: 120–121). In Croatia, some efforts have been made in order to jointly run kindergartens. 8.6% (32) of IMC has been aimed at providing care for children (Podolnjak et al., 2010: 41, 54).

However, there are examples of positive effects of IMC implementation for education and upbringing. One of them comes from the Czech Republic, which also faced the problem of demographic decline. In 2005, the central government allowed local governments to form cooperation in order to run micro-regional schools, but only three unions were established. Most local governments decided to use less integrated approaches. However, choosing IMC in the case of three municipalities proved to be an effective solution. Running jointly three grammar schools, three kindergartens and two kitchens brought advantages to all three municipalities. First of all, municipalities of that IMC are not competitors and do not tailor their services just in order to attract more pupils. They cooperate to create more specific classes to meet students' actual needs. As a result of cooperation, municipalities exploited the economies of scale and lowered their expenditures (operational costs especially). Moreover, IMC allowed them to increase local governments' capacity to obtain lower energy prices on the market than individual municipalities did before. The IMC also owns a common bus that is used not only for the purposes of students' transportation but also for local communities (Swianiewicz, Teles, 2018: 320–321).

The reason why local government do not often choose IMC to provide public education was explained by some authors on the basis of their research. Swianiewicz and Teles (2018: 121, 124) indicate that education is a core service for local governments and it is hard to organise welfare services and goods via IMC. It is presented more clearly by other authors who argue that large school districts (or joint provision of education by IMC) can reach the economies of scale owing to common services (schools' administration, libraries, sport facilities, etc.). It is true as long as communities in IMC's municipalities are homogenous and expect the same quality and level of educational policy. Otherwise, extending the area

3 The literature review on IMC effects is presented, by e.g. Blaeschke and Haug (2018).

of IMC affects heterogeneity (Alesina, Baqir, Hoxby, 2004: 349). Hence, it might not meet with the approval of local communities. Nevertheless, positive aspects of IMC can be obtained in practice.

4. Legal framework for inter-municipal unions in Poland

Polish municipalities are allowed to cooperate in order to provide public goods and services they are obliged to supply. This right is guaranteed by the Constitution of the Republic of Poland (Konstytucja Rzeczypospolitej Polskiej z dnia 2 kwietnia 1997, art. 172) and can be applied in different forms (Ustawa z dnia 8 marca 1990 r. o samorządzie gminnym):

- of greater importance:
  - inter-municipal unions,
  - inter-municipal contracts,
  - inter-municipal associations,
- of lesser importance:
  - inter-municipal companies,
  - consortia,
  - local action groups,
  - local tourist groups.

Inter-municipal unions create the main institutional form of cooperation between municipalities in Poland. They constitute separate entities with legal personality, the right to pursue independent financial management and economic activity. They also possess the right of ownership and have the right to incur liabilities. Inter-municipal unions are managed by two bodies: the assembly (control and resolution-passing authority) and the management board (executive authority). Due to the legal personality of the unions, their assemblies are entitled to make administrative decisions such as determining fee rates e.g. for water supply, sewage disposal, or garbage removal (Ustawa z dnia 8 marca 1990 r. o samorządzie gminnym, art. 64–74).

Table 1 contains data about Polish inter-municipal unions. Since 1990 there were 314 inter-municipal unions created in Poland out of which 205 have been active until 2020.

As for 2020, active unions have been created by 1673 municipalities of which almost two thirds are rural ones. Analysing the number of municipalities in each union, we can distinguish small, medium-sized and large unions. Small unions consist of 2–3 municipalities and constitute around 11% of operating unions. Medium-sized unions (4–9 municipalities) constitute approx. 54% of operating unions.

Large unions consist of 10–20 or even 30 municipalities (35% of operating unions) (MSWiA, 2020).

Table 1. The number of inter-municipal unions in Poland (total since 1990 and active in 2020)

	Total	Active	Active as % of total
Number of unions	313	205	66.45
Number of urban municipalities in unions	450	278	61.78
Number of rural municipalities in unions	1742	1114	63.95
Number of urban-rural municipalities in unions	434	281	64.75

Source: own calculations based on MSWiA, 2020

The reason why rural municipalities are those that cooperate more often can be related to their population size (e.g. Blaeschke, 2014). Differences in the average number of people in Polish municipalities are considerable (Figure 1).

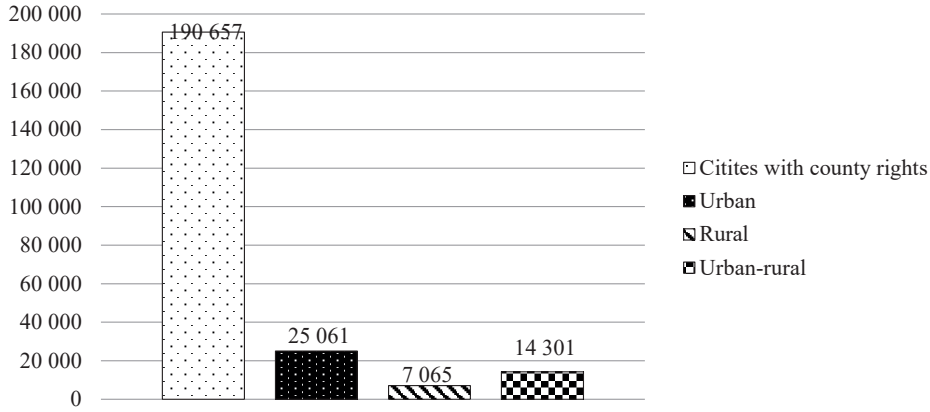


Figure 1. The average population in each type of municipality in 2018

Source: own calculations based on Local Data Bank

The largest disparities can be observed while comparing rural municipalities with other types of municipalities. The population size in rural municipalities is approximately 3.5 times smaller than in urban municipalities and two times smaller than in urban-rural municipalities, on average. As stated before, the size of local government matters regarding the economies of scale and scope. This is simple empirical evidence why Polish inter-municipal unions are mostly created by the smallest municipalities.

With respect to tasks performed by inter-municipal unions, most of them operate to provide public goods and services that concern environmental protection, waste management, water and sewage management, tourism and wastewater treatment (MSWiA, 2020). Some of the unions have been established since

Polish accession to the European Union in order to obtain EU funds (e.g. the Union of the Upper Raba Communities and Kraków). Funds needed to deal with water and sewage management system were too large for these individual municipalities to deal with those issues individually. Hence, establishing the union helped to increase their financial capacity to provide services to citizens (Osterrieder et al., 2006: 16–17).

The decision to cooperate is also determined by financial aspects. Along with delegating public tasks to unions, municipalities must provide appropriate funds. Unions are mostly financed by fees for public services, municipalities' contributions (current and investment) and grants (national and EU). However, the structure of unions' revenues differs depending on the year, e.g. in the period of 2010–2012, the share of EU grants was significantly bigger than before or after (Ministerstwo Finansów, 2016).

The analysis of current expenditures incurred by each type of municipalities, including cities with county rights, and inter-municipal unions provides some evidence (Table 2).

Table 2. Total and average current expenditures in each type of municipality and inter-municipal unions in Poland in 2018 in PLN

	Total	**Number of units**	**Average expenditures per unit**	**Average per inhabitant**
Urban (without cities with county rights)	14 273 841 136	236	60 482 378	2 413
Rural	25 980 048 004	1 547	16 793 825	2 377
Urban-rural	21 429 787 504	628	34 123 865	2 386
Cities with county rights	50 726 243 184	66	768 579 442	4 031
IMC unions	1 687 834 531	205	8 114 589	37

Source: own calculations based on Local Data Bank, local governments' budgetary statements and MSWiA, 2020

Total current expenditures of inter-municipal unions accounted for 1.50% of total current expenditures made by all other units indicated in Table 2. Similarly, they made up 2.73% of municipalities' current expenditures (without cities with county rights). Nonetheless, the share in public current expenditures borne by inter-municipal unions in Poland was low, which is supported by average current expenditures per inhabitant. It also means that there is room for stronger cooperation, especially in the case of rural municipalities.

5. Changes in local governments due to the reforms of the education system in Poland

After economic transformation in the 1990s in Poland, which endowed local governments with a great deal of independence, the Polish education system went through a major reform in 1999. Secondary schools were divided into lower secondary schools and upper secondary schools (general, technical and vocational) (Figure 2).

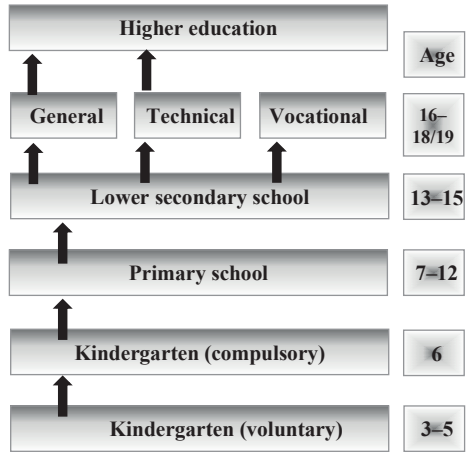


Figure 2. The system of education in Poland in 1999–2017
Source: own elaboration based on Ustawa z dnia 7 września 1991 r. o systemie oświaty

These regulations were applicable until September 2017 when the new reform was carried out. The reform restored the system of education in Poland to a system that consisted of kindergartens and two levels of schools providing compulsory education – primary and lower secondary schools (Figure 3).

Lower secondary schools were ultimately liquidated in 2019. This caused financial problems for municipalities that still have to maintain school buildings but with fewer pupils attending. After the new reform, municipalities are obliged to provide compulsory education not for 9 grades, as it was before, but for 8 grades, which means the loss of the part of the educational unconditional grant that is given to municipalities on the basis of the number of pupils, among others. At the same time, costs of maintaining school buildings have not been reduced.

The financial problem associated with providing public education faced by municipalities is enhanced also due to the demographic decline which affects the number of pupils. The problem has been observed almost continuously since 1999 both in primary (Figure 4) and lower secondary schools (Figure 5).

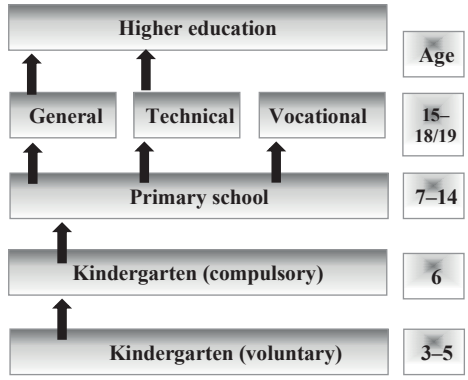


Figure 3. The system of education in Poland since 2017

Source: own elaboration based on Ustawa z dnia 14 grudnia 2016 r. – Prawo oświatowe

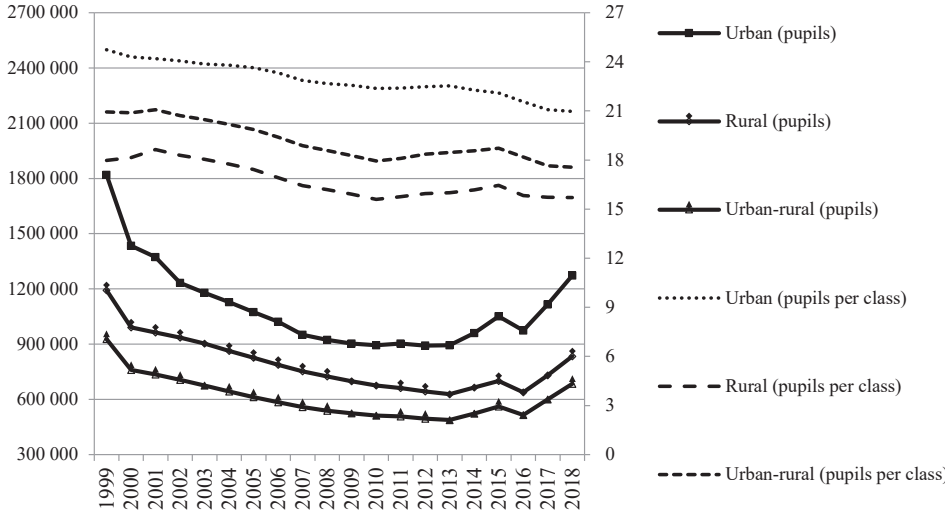


Figure 4. The number of pupils (left axis) and pupils in one class (right axis) in Polish primary schools run by municipalities in 1999–2018

Source: own calculations based on Local Data Bank

The fall in the number of primary school pupils in Poland in 1999–2000 was caused by the reform of the education system. Since then primary schools have run 6 not 8 grades. The demographic decline was reflected in the following years. It should be noted that the increase in 2014–2015 was mainly caused by the change in the age of children starting their compulsory education in primary school – from 7 to 6. The obligation was then restored in 2016 to the age of 7 (Ustawa z dnia 7 września 1991 r. o systemie oświaty). After the new reform, since 2017 the total number of pupils has increased due to the extension of the period of education

in primary school from 6 to 8 years and liquidating lower secondary schools that were run by municipalities until that time.

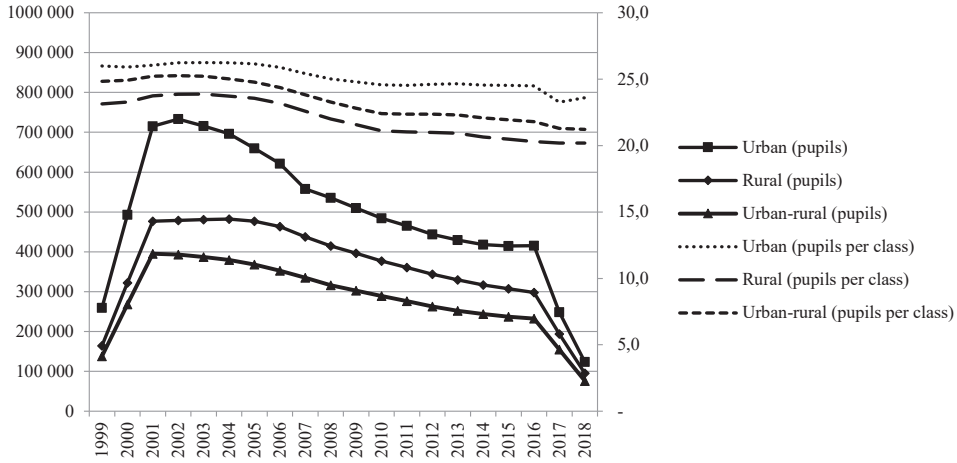


Figure 5. The number of pupils (left axis) and pupils in one class (right axis) in Polish primary schools run by municipalities in 1999–2018

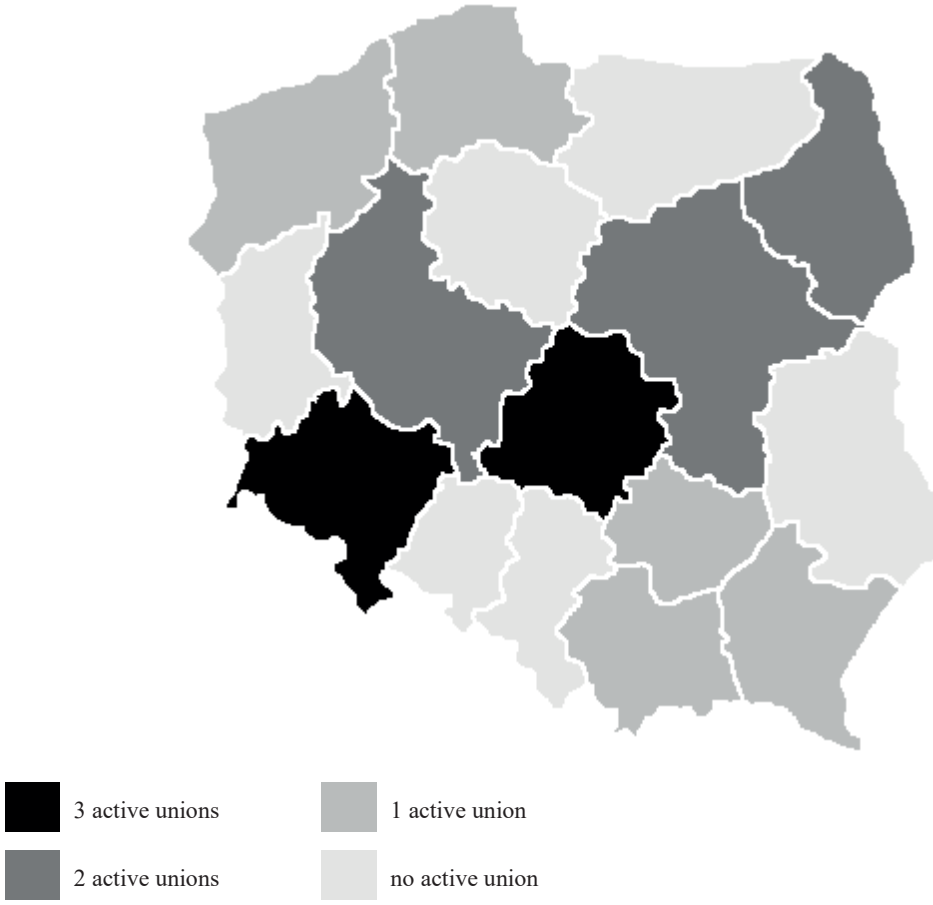
Source: own calculations based on Local Data Bank

Regarding the number of lower secondary students, the change in 1999–2001 was also determined by the reform of the education system. In addition, in the following years, until 2017, the number of pupils was also affected by the demographic decline.

The average number of pupils in one class in primary and lower secondary schools was generally descending in the analysed period. The size of the class can be increased easily by local governments through reducing the number of classes (and hence usually limiting the number of hired teachers). However, such a solution may not necessarily be effective because of the operating costs associated with building maintenance or running libraries, as well as the provision of financial and administrative departments and services. Moreover, public education is perceived as a congestible public good so a lower cost per pupil can be achieved only to a certain point. This point is set by the number of students that are studying together in one class. After reaching this point, the educational policy is inefficient and annoys families (voters). Therefore, seeking other solutions seems to be justified and needed, especially in the case of Polish rural municipalities. Nonetheless, since the 1990s only a few inter-municipal unions have been established to somehow deal with that concern.

6. Inter-municipal cooperation in the field of education in Poland

Out of 205 active unions only 17 (8.29%) have performed some educational tasks. In 10 out of 16 voivodeships municipal authorities have decided to cooperate in the field of education (Map 1). The next map (Map 2) presents municipalities cooperating and not cooperating in education via unions. Cooperating ones are relatively evenly distributed over the territory of Poland.



Map 1. The number of active unions performing tasks in education in each voivodeship in 2020
Source: own calculations based on MSWiA, 2020

Map 2. Polish municipalities cooperating and not cooperating in education

Source: own calculations based on MSWiA, 2020

Though 17 unions claim to perform, among others, educational tasks together, there is only one inter-municipal union in Poland that was established by two municipalities only for educational purposes (MSWiA, 2020). The Gostkowo-Niepart Educational Inter-Municipal Union (Edukacyjny Związek Międzygminny Gostkowo-Niepart) was established by two municipalities that struggled with running schools – Krobia and Miejska Górka. Both municipalities are urban-rural, which means they consist of one town and several villages that create a rural area. Their population remained stable in the analysed period (Figure 6). However, when we compare it with the average number of inhabitants in urban-rural municipalities (Figure 1), both Krobia and Miejska Górka are below this average (14,301 inhabitants in 2018 compared to 12,993 in Krobia and 9,356 in Miejska Górka).

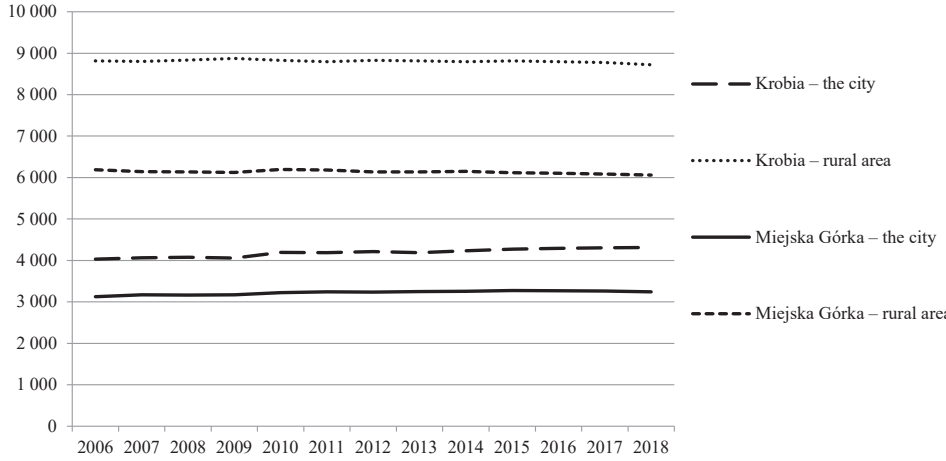


Figure 6. The population of Krobia and Miejska Górka – divided into the city and rural area

Source: own calculations based on Local Data Bank

Regarding the towns, it should be noted that Krobia is approximately 30% bigger than Miejska Górka. However, the difference in the number of citizens is bigger (43%) when considering only rural areas. This implies that joint provision of public services like education could generate economies of scale in the case of the Miejska Górka municipality.

According to the literature, cooperation is usually limited to one county, which may suggest that administrative borders affect it (Fuhrmann et al., 2005). However, although Krobia and Miejska Górka belong to two different counties (Rawicki and Gostyński), they share a border, and, what is most important, similar problems. This case suggests that political or administrative reasons are not always the most important, and decisions to cooperate may be a result of social bottom-up initiatives.

An incentive to create the union emerged after many years of protests of parents and teachers from two urban-rural villages: Niepart (from the Krobia municipality) and Gostkowo (from the Miejska Górka municipality). As many other villages in Poland, they both struggled with consequences of a decrease in the birth rate. This resulted in an insufficient number of pupils in each class. Running classes with a small number of pupils is inefficient in terms of economic issues and – what emerges from studies – children attainment results.[4] Therefore, the primary school in Niepart was about to be shut down on 31 August 2005. Eventually it stopped running grades IV–VI forcing children of this age to commute to the Krobia city (Protokół Nr XXVII/2005 and Nr XXVIII/2005 z sesji Rady Miejskiej w Krobi, Ad. 10; Uchwała Nr XXVIII/199/2005 Rady Miejskiej w Krobi).

4 The impact of the number of pupils in one class on efficiency (inputs: expenditures per one pupil, outputs: tests results) was examined by e.g. Kaczyńska (2017).

However, the old as well the new law enables parents to decide whether their children attend an appropriate school from the point of view of the administrative district or not (Ustawa z dnia 7 września 1991 r. o systemie oświaty, art. 20e ust. 3; Ustawa z dnia 14 grudnia 2016 r. – Prawo oświatowe, art. 133 ust. 2). This regulation was used by parents of 43 pupils who instead of commuting to to school in the Krobia municipality continued their education at the school located in the neighbouring municipality's (Miejska Górka) village – Gostkowo (Protokół Nr XXXII/2005 and Nr XXXIV/2005 z sesji Rady Miejskiej w Krobi). Data concerning the number of pupils and classes in primary schools in rural areas[5] of Krobia and Miejska Górka are presented in Figure 7.

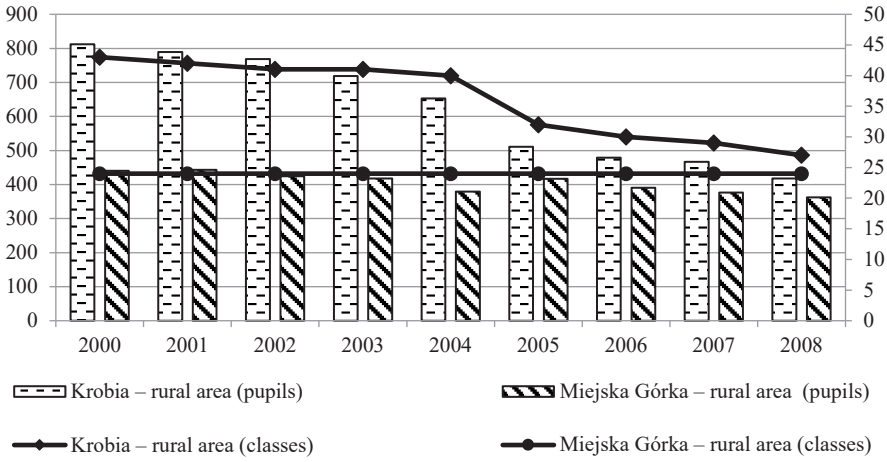


Figure 7. The number of pupils (left axis) and classes (right axis) in primary schools in rural areas of Krobia and Miejska Górka municipalities in 2000–2008

Source: own calculations based on Local Data Bank

The decline in the number of pupils in Krobia was recorded especially in 2005 and was caused not only by the decrease in the number of school children. It was also a consequence of changing the school district in another municipality – Miejska Górka. As a result, Krobia got less funds from the central government for running its schools. In accordance with the law, the educational part of the grant given to a municipality for running its school is calculated[6] mainly on the basis

5 The rural area of Krobia consists of 26 villages (including Niepart) and in the rural area of Miejska Górka there are 42 villages apart from Gostkowo.

6 The amount of the educational grant redistributed from the central government to each local government is calculated using the algorithm of division of the educational grant that includes many coefficients such as: the number of pupils, the number of disabled pupils, the type of educational institution run by the municipality, the school, the location (rural, urban), the level of professional advancement of teachers, etc. (Rozporządzenie Ministra Edukacji Narodowej

of the number of pupils that attend schools and kindergarten in this municipality (Rozporządzenie Ministra Edukacji Narodowej i Sportu z dnia 28 grudnia 2004 r. w sprawie sposobu podziału części oświatowej subwencji ogólnej dla jednostek samorządu terytorialnego w roku 2005; Rozporządzenie Ministra Edukacji Narodowej z dnia 12 grudnia 2019 r. w sprawie sposobu podziału części oświatowej subwencji ogólnej dla jednostek samorządu terytorialnego w roku 2020).

Taking all this into consideration, the local authorities of Krobia and Miejska Górka decided to join their forces to create the Educational Inter-Municipal Union Gostkowo-Niepart based in Niepart (a village of the Krobia municipality) (Uchwała Nr XXIV/179/2008 z sesji Rady Miejskiej w Krobi). The union was established in September 2009 to run the following educational institutions (Statut Zespołu Szkół w Gostkowie):

– primary school (with kindergarten) located in Niepart (Krobia municipality),
– lower secondary school located in Gostkowo (Miejska Górka municipality).

The district of the union covers two villages from Krobia (Niepart and Gogolewo) and four villages from Miejska Górka (Gostkowo, Zmysłowo, Rozstępniewo, Roszkówko). Since 2017, due to lower secondary schools' closure, the union has been running only one primary school in Niepart (Krobia).

Before analysing financial consequences of the creation of the union, the number of pupils and classes run by each municipality and union should be shortly discussed. Figure 8 depicts the average number of pupils in one class and the total number of pupils in primary schools in 2006–2018.

The total number of pupils that attended primary schools located in Krobia and Miejska Górka was stable in the period of 2008–2013 that covered the year of setting up the union. The fact that the demographic decline was not a determinant in this case is crucial from the viewpoint of the further analysis. Before 2010 the number of pupils in one class both in schools of Krobia and Miejska Górka was relatively low and similar, which suggests unexploited scale economies. The situation changed after 2009 – the size of classes in both municipalities increased and was affected in 2014–2016 by the change of the birth rate, and, primarily, by the change in the age of children starting their compulsory education in primary school – from 7 to 6. At the same time, the number of pupils in one class of the union's school fell relatively rapidly and was not in accordance with the rise in the total number of pupils in both municipalities. The rise in the number of pupils in 2017 and 2018 was mainly caused by the new reform of the education system.

z dnia 12 grudnia 2019 r. w sprawie sposobu podziału części oświatowej subwencji ogólnej dla jednostek samorządu terytorialnego w roku 2020).

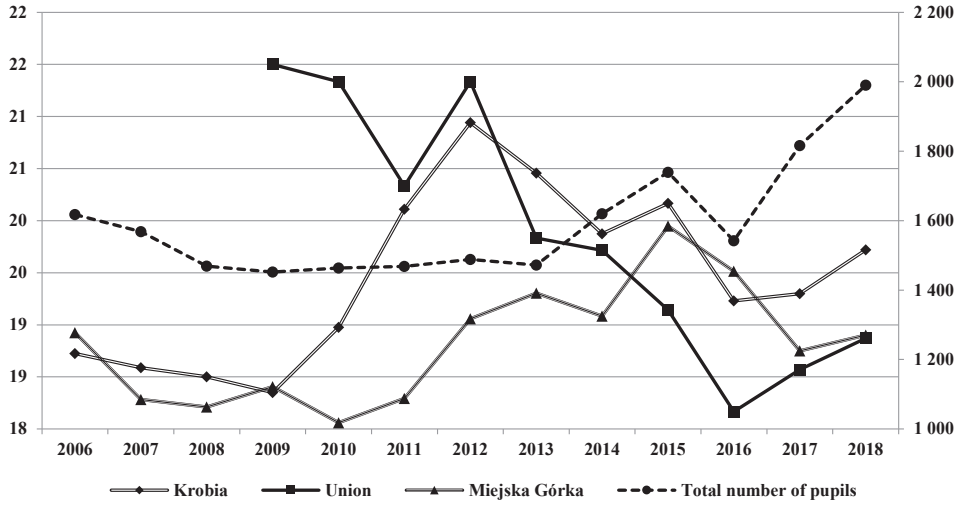


Figure 8. The average number of pupils in one class in primary schools (left axis) and the total number of pupils (right axis) in Krobia, Miejska Górka and the union in 2006–2018

Source: own calculations based on Local Data Bank

The total number of pupils in lower secondary schools (Figure 9) decreased in both municipalities in 2006–2011 to reach a relatively stable level in 2012–2014 and 2015–2016. This alteration was accompanied by the changes in the number of primary school pupils – the fall in 2006–2008 in lower secondary schools corresponds with the fall in primary schools and similarly – the steadiness in the subsequent years. As a consequence of the new reform of the education system, the number of pupils has begun declining since 2017.

Until 2011, the decrease in the size of lower secondary school classes in Krobia and Miejska Górka could be explained by the demographic change. Nonetheless, the rise in 2011 is not in accordance with the total number of pupils and could be related to the creation of the union. However, it seems that after the union was created both municipalities managed to boost the size of their lower secondary school classes (presumably decreasing current expenditures per pupil). The union itself adjusted its policy of supplying public goods and created an additional (third) class in 2011 due to the rise in the number of pupils from 46 in 2010 to 67 in 2011. The number of classes run by the union remained unchanged until the new reform of the education system (Figure 10).

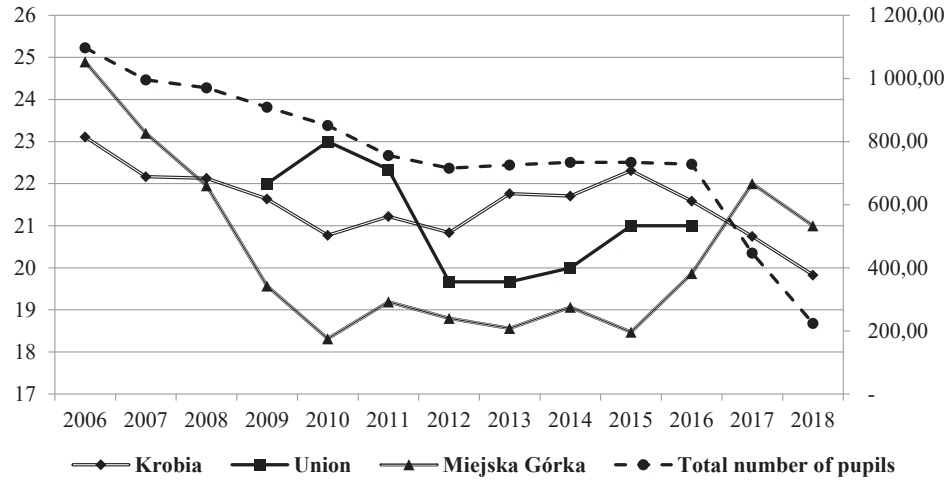


Figure 9. The average number of pupils in one class (left axis) in lower secondary schools and the total number of pupils (right axis) in Krobia, Miejska Górka and the union in 2006–2018

Source: own calculations based on Local Data Bank

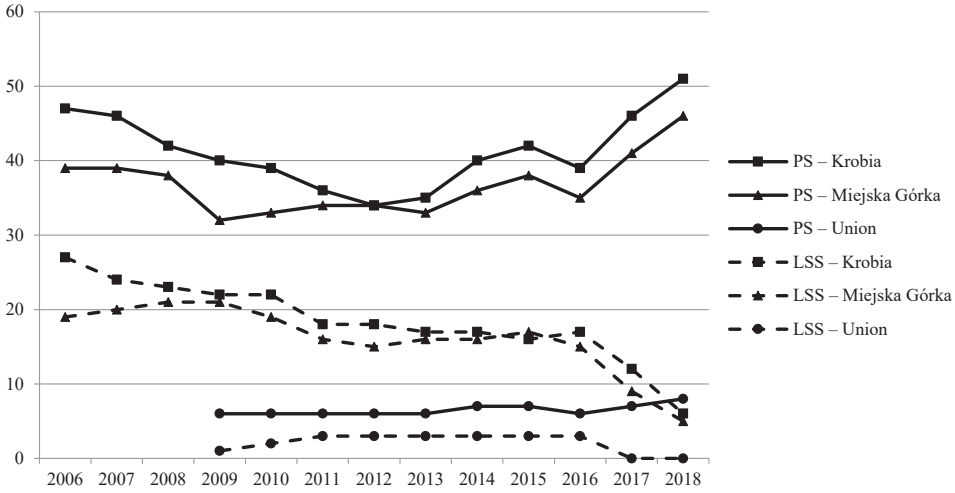


Figure 10. The number of classes run by Krobia, Miejska Górka and the union in primary (PS) and lower secondary schools (LSS) in 2006–2018

Source: own calculations based on Local Data Bank

The establishment of the union by the Krobia and Miejska Górka municipalities aimed mostly at meeting local inhabitants' needs. But did it help the union founders to generate economies of scale and scope, and hence lower spending per pupil? In order to assess this, the analysis of spending per pupil and the number of pupils in each municipality and the union was performed.[7] However, spending per pupil reflects both scale effects and varying levels of provided public service (public education in this case) that can be identified with the number of pupils in one class.

7. Results and discussion based on the chosen case study

First, the analysis is focused on primary schools. Regarding the Krobia municipality, in 2006–2010 the mean of current expenditures per pupil (Figure 11) was increasing despite limiting the number of classes (Figure 10) because of the diminishing number of pupils. The situation changed in 2010 and 2011, when despite a small increase in the number of pupils, costs fell much more, which can suggest generation of scale effects after the union was created. In 2012, spending per pupil increased slightly compared to 2011, to start falling until 2016. This change was accompanied by the increased number of classes with fewer pupils, which could have resulted from economies of scale as well as from the new temporary educational policy change (6-year old children started their compulsory education in primary schools until 2016). The rise in current expenditures per pupil since 2016 can be explained by a decline in the number of pupils because of the new reform. Therefore, it is hard to assess the impact of cooperation on spending per pupil in 2017–2018. In Miejska Górka, the situation was practically analogical to Krobia when comparing spending per pupil to the number of pupils, the number of classes and pupils per class. In the case of primary school run by the union, costs per pupil were fluctuating within a relatively small range in 2010–2015 to rise afterwards (Figure 11). This coincided with a stable number of classes and a declining number of pupils in one class. Later the number of pupils decreased causing a rise in expenditures that continued in 2017–2018 due to the reform of the education system.

7 The costs used for the purpose of the analysis cover only current expenditures, fixed prices: base year – 2018. However, current expenditures accounted for approximately 91% of total expenditures in Krobia, Miejska Górka and the union in 2006–2018 on average.

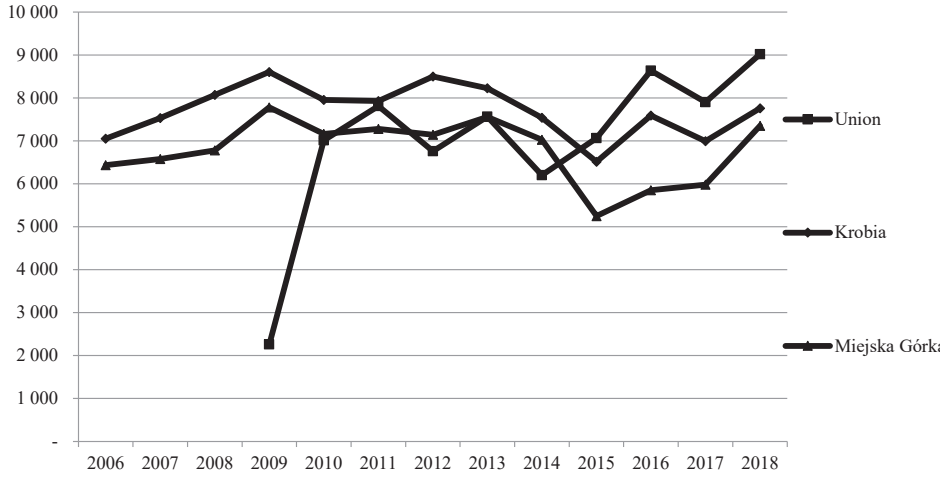


Figure 11. Spending per pupil in primary schools of Krobia, Miejska Górka and the union in 2006–2018

Source: own calculations based on Local Data Bank and local governments' budgetary statements

Regarding lower secondary schools, both in Krobia and Miejska Górka, the trend of spending per pupil (Figure 12) compared to the number of pupils, the number of classes (Figure 10) and pupils per class (Figure 9) was quite similar. Costs stopped rising in 2012 when the mean number of pupils per one class increased while the number of classes remained relatively stable. It could be that the establishment of the union helped to keep the rising costs down and ultimately led to their decrease since 2014. The situation continued until 2016, after which spending per pupil was affected by the previously indicated changes in the education system. However, it must be noted that positive effects in spending per pupils were larger in Miejska Górka, which can point to exploiting economies of scale. In the school run by the union in 2009–2017, at first current expenditures per pupil were rising until 2012 because of an increasing number of classes and a decreasing number of pupils per one class at the end of this period. Since 2013 costs have become relatively stable.

The creation of the union by two municipalities and transferring part of educational tasks to it lowered slightly costs per student in primary schools in both municipalities in the beginning. In the subsequent years expenditures per pupil incurred by municipalities and the union were comparable. In the case of lower secondary schools, it seems that there is no evidence for a reduction of costs per pupil. Therefore, joining forces in order to provide inhabitants with a different organisation of educational services has contributed only to a higher level (or quality) of these services rather than to generating the economies of scale.

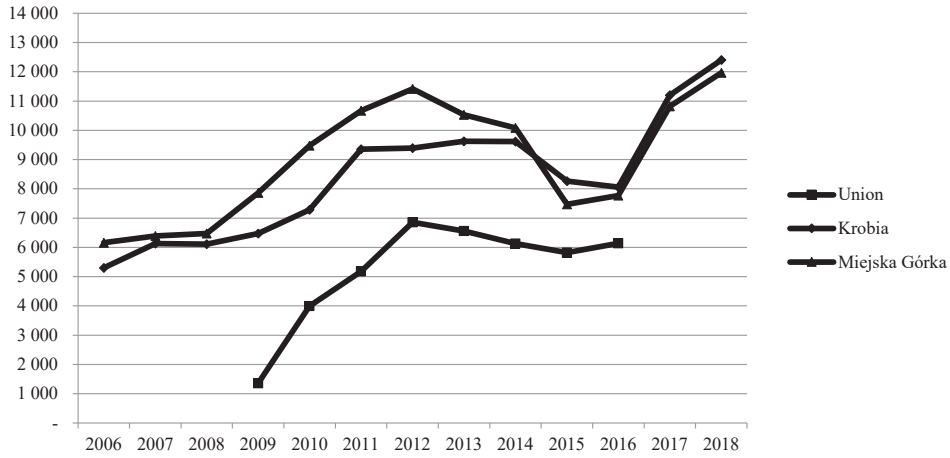


Figure 12. Spending per pupil in lower secondary schools of Krobia, Miejska Górka and the union in 2006–2018

Source: own calculations based on Local Data Bank and local governments' budgetary statements

There is a possible explanation of limited positive financial effects of joint public education provision in the case of the Gostkowo-Niepart Educational Inter-Municipal Union. Both municipalities that decided to cooperate are urban-rural. One could argue that the population in two medium-sized municipalities is not homogenous enough – some pupils study in schools run by Krobia, some in Miejska Górka, and some of them in schools run by the union. The provision of public education is then incompletely transferred from local governments to the union. It could be inefficient to organise common welfare service in such a big area, although it would have to be investigated.

8. Conclusions

The aim of this article was to present and analyse IMC in the context of public good such as education supported by the case study of the only one purely educational inter-municipal union in Poland. Nowadays problems with performing educational duties by Polish municipalities are not only due to the demographic decline but also to the reform of the education system that started in 2017. Moreover, fiscal austerities and the society's growing awareness increase the pressure on local governments to find efficient and effective solutions. One of such solutions is to deliver public services jointly, which can help to keep the raising costs down, and hence increase efficiency of public spending as well as the quality of public services. Studies show that net benefits of cooperating are higher if IMC partners are smaller and more homogenous and if they expect similar quality and level of public services.

The need to find efficient solutions rises also due to COVID–19, e.g. in joint purchase of remote learning software or developing forms of such learning.

So far, there is only one inter-municipal union in Poland that is solely providing educational services. The decision to create the union by Krobia and Miejska Górka to jointly fulfil some part of their educational duties seems to be reasonable from the perspective of pupils and their parents as well as teachers, who are also voters. Moreover, some success in generating economies of scale was achieved in the case of primary schools in the first two years after the union was created. However, according to the results, the theory of exploiting the benefits of scale economies owing to inter-municipal cooperation focused on education could be true for smaller or rural municipalities in the case of Poland. Therefore, common provision of compulsory public education could be used especially by smaller and rural municipalities that struggle with demographic decline and the pressure to efficiently use public funds since they were forced to reorganise their school networks due to the reform of the education system in Poland or to purchase remote learning software gaining in importance due to the pandemic. It would be very interesting though to conduct a detailed study to assess the exact determinants and effects of such cooperation implemented by Polish municipalities. It could also be useful to know to what extent cooperation is mainly caused by the voters' will or budgetary challenges, and to what extent by political factors.

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Współpraca międzygminna w edukacji jako możliwe remedium na obecne trudności samorządu terytorialnego w Polsce

Streszczenie: Celem artykułu jest wypełnienie istniejącej luki badawczej i wniesienie wkładu do literatury na dwa sposoby: po pierwsze – poprzez zbadanie problemów, które zapoczątkowały współpracę między dwiema gminami pomimo granicy administracyjnej na poziomie powiatu, a po drugie – poprzez analizę skutków wspólnie realizowanych zadań edukacyjnych na podstawie studium przypadku z Polski. Studium przypadku jest poprzedzone analizą literatury. Wzmocnienie współpracy międzygminnej (IMC) w Polsce jest proponowane jako potencjalne remedium na obecne trudności, z jakimi borykają się polskie samorządy po reformie systemu edukacji i pandemii Covid–19, a także z powodu niżu demograficznego i presji budżetowej. Badania sugerują, że korzyści netto ze współpracy są wyższe, jeśli partnerzy związku są mniejsi i bardziej jednorodni pod względem jakości i poziomu usług publicznych. Teoria wykorzystania korzyści skali i zakresu została zbadana na podstawie studium przypadku polskiego związku międzygminnego utworzonego wyłącznie w celu świadczenia usług edukacyjnych w dwóch gminach. Współpraca przyniosła niewielkie pozytywne efekty finansowe, które znalazły odzwierciedlenie w niższych wydatkach w przeliczeniu na jednego ucznia jedynie w przypadku szkoły podstawowej. Kooperacja spowodowała jednak pojawienie się korzyści pozafinansowych nie tylko u uczniów, ale także u rodziców i nauczycieli będących jednocześnie wyborcami. W artykule stwierdzono, że ze związków międzygminnych najbardziej mogą skorzystać gminy małe i wiejskie, borykające się z wcześniej wspomnianymi problemami.

Słowa kluczowe: współpraca międzygminna, system edukacji, reforma, Polska, Covid–19

JEL: H70, H75, H77, H79

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